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Jan Gyllenbok

Encyclopaedia of Historical Metrology, Weights, and Measures

Volume 1

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Jan Gyllenbok
Lomma, Sweden

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Weights and measures may be ranked among the necessaries of life to every individual of human society. They enter into the economical arrangements and daily concerns of every family. They are necessary to every occupation of human industry; to the distribution and security of every species of property; to every transaction of trade and commerce; to the labours of the husbandman; to the ingenuity of the artificer; to the studies of the philosopher; to the researches of the antiquarian; to the navigation of the mariner; and the marches of the soldier; to all the exchanges of peace, and all the operations of war. The knowledge of them, as in established use, is among the first elements of education, and is often learned by those who learn nothing else, not even to read and write. This knowledge is riveted in the memory by the habitual application of it to the employments of men throughout life.

John Quincy Adams, Report to the Congress, 1821.

This book is dedicated in loving memory to my parents, Elsa and Eric, who always supported me.

Preface

The use of weights and measures for length, volume, and area has often been said to be as old as civilization. Furthermore, the more complex the society and the greater its extent, the more formal its systems of weights and measures usually are. The result of this is that a study of weights and measures in any civilization constitutes one of the important parameters for understanding its growth and the very evolution of its economic history. In addition, the widening of a society's trade relations with other cultures becomes intimately associated with the development of its system of weights, measures, and coins. Linear measures were required in the building of houses and temples, weighing methods were developed when precious metals became important mediums of exchange, and systems for capacity measures were needed when wine, olive oil, and cereals became important items of commerce.

The science that covers the knowledge of weights, measures, and scales is generally called *metrology*. It can be further subcategorized as *legal metrology*—dealing with the accuracy of measurements in the economic and fiscal domains, as well as legislation dealing with the use of different measurement systems; *industrial metrology*—dealing with the functioning of measurement instruments and the accurate testing processes for a specific quantity; *scientific metrology*—dealing with definitions of units, fundamental constants, measurement standards, and methods currently in use; *historical metrology*—dealing with the fundamental units of measurement, systems of units formerly or currently in use in various countries, and the development of monetary units throughout their history; and *social metrology* or *metrosophy*—dealing with the political, religious, and spiritual significance of weights and measures and their patterns in a specific society.

The original intention in writing this book was just to provide a cohesive and hospitable package for the results of my prolonged interest and studies in historical metrology, obtained over a period of several years, in an A–Z dictionary. Under the persuasive influence of colleagues, I later broadened the scope of the book to also include a country-ordered section listing ancient as well as modern premetric units of weights and measures. In essence, this book is now basically a handbook of various systems of measurement and their development over time. Unfortunately, compilation works are almost never completely unobjectionable. Sometimes, scholars have come to inconsistent conclusions but each with seemingly substantiated conclusions. Here, I have often chosen to go more in depth, by setting the investigations against each other and sometimes briefly discussing the assumptions. In most cases, scholars' opinions seem to be unambiguous. These cases made it possible for me to move forward more quickly in the interpretation.

When one looks closely at traditional weights and measures throughout the world, one finds that the number of differently named units tends to be very large and that the absolute size of units of the same name tends to vary, sometimes considerably, from place to place and over time. Last but not least, many people who lived in a specific area have used the same name for different weights and measures. One term may also have been used concurrently for different measures. These facts justify well, in my opinion, an easy-to-survey compilation of all known metrology systems. But has this not already been done? Well, it is generally considered that the interest in historical metrology began with the early antiquarianism movement in Europe during sixteenth–seventeenth centuries, when studies of the measurement systems in various ancient cultures became common, e.g., *De Mensuris et ponderibus Romanis et Graecis*, published in 1533 by Georgius Agricola (1494–1555). Starting in the late eighteenth century and throughout the nineteenth century, a plethora of books, with the aim of collating and clarifying the relationships between different measurement systems and compiling systems used in ancient cultures as well as in modern times, were born. If I do venture to mention specifically any significant publications, the light must fall on Paucton (1780), Gerhardt (1791/92), Kelly (1816 and 1832), Nelkenbrecher (1828), Krüger (1830), Flügel and Grund (1834), Saigey (1834), Döring (1837), Schiebe and Bender (1837–1839), De Luca (1841), Alexander (1850), Noback and Noback (1851), Winslow (1854), Wagner and Strackerjan (1855), Silber (1861), Bleibtreu (1863), Browne (1872), Clarke (1875), Bauer (1882), Martini (1883), Simmonds (1892), Klimpert (1896), Horta and Pardo (1903), and Perez (1932). Research efforts were later also used to investigate measurement systems in certain cultures or countries. Here, it is appropriate to mention Hultsch, who published two monumental works: *Griechische und römische Metrologie* (1862) and *Metrologicorum scriptorium reliquiae, collegit, recensuit, partim nunc primum edidit Fridericus Hultsch* (1864/1866). Other works by scholars worth mentioning here are those by Aravaca y Torrent (Spain, 1867), Balbin (Argentina, 1881), Bogdán (Hungary, 1990), Charbonnier (France, 1990–2006), Cheng-lo (China, 1957), Connor and Simpson (Scotland, 2004), Donaldson (Oman, 1994), Falkman (Sweden, 1884/1885), Ferrand (Portuguese Territories of Indian Ocean, 1920), Grönros et al. (Finland, 2003), Hinz (Islamic world, 1955), Pankhurst (Ethiopia, 1969/70), Petersen (Denmark, 2002), Rasmussen (Denmark, 1967), Shostin (Russia, 1975), Skinner (Britain, 1967), Witthöft (Germany, 1979–1994), Wu (China, 1957), and Zupko (Britain, France, and Italy, 1968–1990). For some countries, principal divisions of executive governments have published reports that formally compile the weights and measures used. For example, this has been done for Bolivia, Great Britain, Costa Rica, Mexico, Portugal, Spain, Tanzania, and the United States. In 1954, 1955, and 1966, the United Nations compiled reports that were aimed at giving an overview of the non-metric units then in use in different parts of the world.

The task of historical metrology can be said to be to clarify the relationships among formerly used units of measurement, to express them in modern units, and to study the origin of their names. The inadequacy of easily accessible material is one of the chief difficulties in writing a book such as this. One must search the literature of many disciplines, such as history, anthropology, archaeology, numismatics, economics, ethnology, linguistics, travel stories, and oral traditions, and still be dissatisfied. Since it is impractical to include all of the numerous local values for the many obsolete units, only the most generally accepted and reported values are included. Here, my personal testimonial received guidance for what should be included. In a world of bamboo tubes, baskets, pots, sewn-up animal skins, and hollowed-out tree trunks, which were first made for transporting and storing different commodities, it is often difficult to judge if some receptacles were designated for measuring. Another main difficulty for historical metrologists is our tendency to see patterns, even when patterns do not exist. One must constantly be aware of this urge and must ask oneself periodically whether there is a pattern or whether you have merely invented it. Of course, I too have fallen into this trap many times, but my hope is that most of these mistakes have been corrected by my colleagues afterwards. Last but not least, the difficulty in specifying the precision in any non-scientific measurement should be emphasized. Except in exceptional circumstances, such as if weighing precious metals or coins and the measurement of building elements, such fine precision was neither practicable nor necessary. We seldom know exactly how measuring and weighing was conducted in the past and we do not even know how well the measuring and weighing equipment was adjusted in relation to standard dimensions. One should also add the fact that the older standardized systems had relatively low precision in terms of modern scientific tolerances, for example, standard units of capacity with a theoretical volume of 5.12 L, which may, in practical use, vary between 4½ and 5½ L. Therefore, the indication of "equal to about 5 L" may well more accurately reflect reality than suggest a possibly spurious accuracy implied by two decimal places. On the other hand, relationships between different measurement units and objectives of standardization are clearer if one uses some "unnecessary" decimals. Throughout the book, I have been guilty of some inconsistency, as I usually have felt myself compelled to follow the zeal for accuracy of my sources to a greater degree than to enter the values used in practice, which are more likely to be less accurate.

Anyhow, the idea for this book was conceived in late 1977 and had been a twinkle in my eye for almost a year before that. The project then became dormant for quite a few years. It finally developed into manuscript form in 1999–2001. My first contacts with the Publisher were in late 2009, and now finally its birth into print has been induced in 2017.

As the aim of this book is to provide understanding of quantitative expressions, it includes not only variant spellings but also abbreviations and symbols used for units and scales and various acronyms. All units are, as far as possible, interpreted into metric and local related units.

After a short introduction to historical metrology as a scientific discipline, the book provides an overview of the measurement systems used mainly in scientific contexts in recent centuries. In the third chapter, *A–Z of metric, scientific and informal measures*, the entries are generally in familiar English alphabetic order, but non-Roman characters are appended to the end of the alphabet, while the numeric digits precede the usual alphabet. Here, the units are generally described under their full names, not under abbreviations or such. Exceptions are when the short forms are virtually names of units themselves, e.g., psi. Etymology is sometimes included, in square brackets, where deemed interesting. In the fourth chapter, *Time measurements and calendars*, I have chosen to describe units of time and some calendars. The fifth chapter, *Ancient Systems of Weights, Measures and Currencies*, covers measurement systems of some ancient cultures, while the sixth chapter, *National Systems of Weights, Measures and Currencies*, covers measurement systems of sovereign states of the modern world, some unrecognized states, other consistent areas, and many nations which no longer exist as independent countries. As the estimated values for the units of measurement presented in the last two chapters usually vary considerably, I have tried to present possible consistent sets of values, based on trustworthy sources. Despite the relative paucity of the available data here, I hope that what is presented will be of value to students of historical metrology, economic history, anthropology, and archaeology. The book is divided into three volumes. Volume one consists of chapter one to five, volume two chapter six, A–I, and volume three chapter six, J–Z.

I conservatively consulted many hundreds of sources, both primary and secondary. To minimize space in footnotes and elsewhere, all sources are provided with a three, four, or five letter reference, written in brackets. Hence, [DOUR] is used instead of writing: "Doursther, Horace. *Dictionnaire universel des poids et mesures anciens et modernes, contenat des tables des monnaies de tous les pays.* Brussels: M. Hayez, Imprimeur de l'Académie Royale, 1840. (Reprinted by Meridian Publishing Company in Amsterdam, 1965)." Furthermore, as it would require too much space to list all sources every time they have been consulted in volume two, I have chosen to mention the sources used consistently at the head of each section. Other sources from which information in this book is drawn are noted in the footnotes and elsewhere in the text as appropriate. Throughout, I usually refer to sources that report abnormal values.

I make no claims to scholarly expertise in the far-ranging fields of metrology, scales, and measurement in general. I would like to underline that neither the publisher nor I guarantee the accuracy or completeness of any information herein, nor will we be responsible for any errors, omissions, or damages arising out of use of this information. I have really tried to make this book a reliable source of general information concerning metrology, and have endeavored to cover its subject both completely and accurately, but I am also aware that a work which roams as widely as the present one will almost inevitably commit errors of fact or interpretation. In either case, I should be glad to hear from readers and, where it is a question of fact, to receive reference to the correct information.

Finally, it is my hope that readers will derive as much pleasure and benefit from perusing and studying this work as I had in preparing it for them.

Lomma, Sweden J. Gyllenbok
April 2017

Acknowledgements

It is with sadness in my heart that I am now forced to realize that the work on the book is completed. Now, others will take over: readers, critics, librarians, researchers, booksellers, yes, all those who act as distributors or recipients of books.

This book is the result of a personal research project that has been carried out thanks to numerous positive circumstances and the contributions of many people to whom I owe a very great deal.

First and foremost, I am grateful to my partner, her daughter, and my son for their love and cheerful attention in everyday life, as well as for sharing all the sacrifices they made to enable me to complete this book. Their presence has been a powerful catalyst and critical source of energy.

In carrying out the research that resulted in this book, I contacted numerous institutions and universities, which gave me the opportunity to be in touch with scholars and professionals from countries from all over the world. Many of them expressed interest in my research and made helpful comments. Furthermore, they gave me access to a range of documents, unpublished studies, and special reports, which proved to be extremely useful to my research. I should like to thank all those who have so readily assisted me with ideas, information, or criticism.

Three workhorses on my manuscript have been Anna Mätzener, Karin Neidhart, and Sarah Annette Goob, editors at Birkhäuser in Basel. How they managed to stay calm and keep their minds intact while working on a book that was constantly delayed because of the undersigned's inability to bring the work to fruition remains a mystery to me. Thanks also to all of you at Birkhäuser who, in a way or another, have been involved in the book.

I would also like to express my deepest gratitude to Professor Leslie Pendrill at the National Testing Institute in Sweden for his guidance and constructive comments and for giving me contacts with researchers from around the world. Finally, I am indebted to the staff of the Library of Lomma, who have met my numerous requests for obscure literature from abroad not only with equanimity but with active and cheerful interest.

October 2016 J. Gyllenbok
Lomma, Sweden

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List of Symbols and Abbreviations

!	A symbol for the factorial expression, i.e., $8! = 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$.
%	A symbol for percentage.
*	An alternative multiply symbol.
cf.	compare
depr.	deprecated
D	Dutch
Dan	Danish
e.g.	for example
Fr	French
Fin	Finnish
G	German
Gr	Greek
Heb	Hebrew
i.e.	that is
Imp	Imperial
L	Latin
N	Norwegian
OE	Old English
OF	Old French
ON	Old Norwegian
OS	Old Swedish
q.v.	which see
Sp	Spanish
Swe	Swedish
UK	United Kingdom
US	United States
W	Welsh

Introduction

Units of measurement have been essential in every single civilisation throughout history. Since the dawn of mankind, man has, through necessity, devised various rudimentary measures to assist him in everyday life. We assume that *homo sapiens* during the Palaeolithic period (*c*. 2,500,000–*c*. 9000 BCE) was capable of experiencing seasons, near and far, heavy and light, big and small, etc. The early weights were simple stones, an empty shell was used for measuring capacity, and parts of the body, like lengths and widths of fingers, cubits, and body spans, were adequate for most needs in length measurement. Time was probably measured by periods of the sun, moon, and other heavenly bodies.

As agriculture and handicrafts developed, and as various gifts of nature were unevenly distributed geographically, it gradually became necessary to open trade. Even if exchanges were made between different countries, provinces, towns, and even between villages, this trading was still infrequent and of comparatively insignificant importance. Hence, each small community often also originated its own traditional measures. We can also assume that these early units of measurement were more or less specified and regulated depending on how important a commodity, a certain distance or a specific area was to the current society. For example, we know that salt was of great importance in Mesoamerican societies, just as gold was in the early West African cultures and the thickness of the ice on a frozen lake in Inuit communities in northern Canada. Unfortunately, artifacts that can provide unequivocal information, since they were made of stone or metal, are relatively rare. Instead, scholars are compelled to refer to indirect sources, such as architecture, standardized pots, coins and various weighed items, for the conversion of a historical unit of measure into our metric system.

The need for standardized units of measurement increased significantly as societies became involved in wide-scale commerce. It soon also became necessary to enact laws to regulate transactions and the accuracy of standards, as the need to combat cheating increased. In the wake of this, the establishment of official weights and measures became an essential element to ensure fair trade and, not least, to ensure that the right amount of tax was paid to the ruling power.

But let me first give a very brief summary of the origins of different types of unit of measurement, how they evolved into systems of measurement, and finally, how they spread across continents.

Main sources: A chronological history of the modern metric system (to 2008) by metricationmatters.com, [JOHN], [KENN], [KISC], [NEB83], and [ZUPK6].

1 Units of Weight

The amount of a certain commodity was usually measured by its weight. Here, three basic

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concepts may be discerned: firstly, two objects could be compared by merely lifting them, or even simply by estimating their weight by sight; secondly, concepts like the maximum weight conveniently carried by a human, a donkey, or a camel could be used; and, thirdly, weight could be determined through the use of some kind of weighing apparatus. As for the use of some kind of weighing equipment, this could be done by balancing one commodity against another, by using natural objects, e.g., various seeds, as weights, and by balancing objects against coins or artificially made weights. When one looks at the weights used in different societies in the past, it is obvious that most units, had they been shaped like a smooth, rounded stone, would have fit comfortably in the palm of a full-grown man. This means that most societies had use for a weight of about 450–600 g. Hence, the oldest unit of weight used by humans were probably weight units of this size. A “mina” weight made of stone from *c*. 2350 BCE, found in Lagasch, Mesopotamia, that weighed about 477 g, supports this theory. When civilizations began trading with precious metals and other precious goods, different grains, e.g., from wheat and barley, came into use for this purpose.

2 Units of Length

A royal master cubit artefact from *c*. 2600 BCE made of black marble and evidence for the use of a royal cubit when constructing the Step Pyramid of Djoser *c*. 2700 BCE are among the earliest attested standard measures of length. A cubit’s length, about 523 mm, was derived from the length of the arm of the ruling Pharaoh, from the elbow to the outstretched tip of the middle finger. It was divided into 28 parts, 7 palms of 4 fingers each. A copper-alloy bar of about 518.6 mm found during excavations at Nippur in 1916 dates from *c*. 2650 BCE and is probably a Sumerian cubit artefact. This Nippur cubit was divided into 24 parts, 6 palms of 4 fingers each. During excavations at Tamil Nadu, an artefact dated from *c*. 2600 BCE and measuring about 838 mm was found. It was divided into 24 parts of about 3.5 mm each. These three units are the first known standards for measuring length.

3 Units of Land Area

When it comes to the desire or ability to calculate the size of a parcel of land, this was particularly characteristic for sedentary civilizations, where land area units reflected the farmer’s experience of the land. There were units representing the amount of land that could be cultivated in a day by hand, without mules or oxen, e.g. the French *ouvrée* and the Anglo-Saxon *daies work*. A more common type of land area units represented the amount of land tillable by one man behind an ox in one day. The Roman *iugerum*, the English *acre* and the German *Morgen* were all derived from this type of measures. There were also land area units based on the amount of land a farmer owning a yoke of oxen could keep in cultivation. Examples are the English *yard-land* and the *oxgang*. Depending on the social conditions, agricultural techniques and the prevailing climate, these measures varied over time.

Finally, there were the measures of land, that only took into account the land’s yield, e.g. the Anglo-Saxon *carcute*, the German *Hufe* and the Baltic *uncus*. These type of units were also used for tax assessment, e.g. the Anglo-Saxon *geld acre* and *ware acre*.

4 Units of Capacity

Capacity was often significantly more difficult to define than weight, length or even area, as there were few universally available measures of volume. For this reason, it was more common in early cultures to weigh goods instead of calculating their capacity. In cases in which units of capacity came into use, there were at least three methods for defining dimensions. Firstly, natural units based on the human body, e.g., a handful; secondly, natural containers, e.g., gourds, horns and bamboos; and thirdly, locally made containers, e.g., made specifically for that purpose out of wood, clay or plant materials, and even holes in the ground. To compare the capacity of containers, they were filled with plant seeds that were then counted to measure the volume. Twined baskets, found during excavations in Oasis America, date back to *c*. 7000 BCE. These represents the oldest known units of capacity.

5 Ancient Systems of Measurement

As sedentary civilizations evolved and the science developed, measurement became more complex and sophisticated. As time progressed, the measures were improved and made more precise, but still referred to by their ancient names. Soon, a need arose to arrange the units into systems of measurement. Among the more commercially-oriented communities, it soon became necessary to standardize to multiple devices according to a mathematical scale, sometimes called metrological systems, which were more or less precisely defined in relation to a standard measurement unit, usually stated through edicts of local or national rulers. These systems of measurement were based on the principle that smaller units make up larger units, which, in turn, make up yet larger units and so on.

As the development of a system of measurement requires a system of counting and the ability to perform such arithmetical operations as multiplication and division, collecting information about the mathematical knowledge and the counting system used during the relevant period is often an important first step towards understanding the metrological system of an ancient culture.

If one looks at the usual way of dividing a unit of measurement into several parts, it turns out that two, three and ten have been the common numbers used by different societies as a base. This gives us three number sequences. First, the *binary sequence*, which uses 2 as its base, with the first numbers in the sequence consequently being 2, 4, 8, 16, 32, and 64. One of the oldest uniform measurement systems that we know of, used by civilizations living in Mohenjo-Daro *c*. 2300 BCE, used polished stone cubes, whose weights doubled in accordance with the binary sequence, with the following multiples of the base unit of c. 13.65 g: 1/16, 1/8, 1/4, 1/2, 1, 2, and 4. Second, the *duodecimal sequence* has 12 as its base. This may be a complicated sequence, but if you think of it as a sequence in which you actually add in the number three somewhere along the way, it becomes more understandable. For example, we can divide a unit of measure into three parts, and then return to sequentially split it into halves. This will give us multiples as 1/3, 1/6, 1/12, 1/24, 1/48, and 1/96. This actually often turned out to be a sufficient subdivision for most cultures in history. Even if one, for example, assumes a fairly large unit of land area, the size of the plot after it has been divided into a 96th part is quite manageable. Thirdly, the *decimal sequence* uses 10 as its base, i.e., 1/10, 1/100, 1/1000, and 1/10000. This sequence was used, for example, by the ancient Chinese and Egyptian cultures. Even if these three sequences were the most commonly used, there were occasions when more ways to divide units of measurement into smaller parts were needed. More often than not, it turns out that one then decided to combine the fundamental sequences listed above, i.e., 1/20 (2×10), 1/60 ($2 \times 3 \times 10$) or 1/360 ($2 \times 2 \times 3 \times 3 \times 3 \times 10$). In fact, the *sexagesimal sequence*, using 60 as its base, was used by several ancient civilizations, such as the Sumerians, Babylonians, and Akkadians. 60 is divisible by 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, and 30, and is also the smallest integer divisible by all integers from 1 to 6.

Anyway, many historical metrological systems were never historically recorded or their records of existence have subsequently been lost. The Sumerian and Egyptian systems are among the earliest known metrological systems in the Mediterranean area. Those systems influenced the Babylonian, Assyrian, Elamite, Ugaritic, Hittite, Phoenician, Arabian, and Hebrew metrologies. As the commercial domination of the Mediterranean passed into the hands of the Greeks, a new system was developed, mainly out of the systems of the Phoenicians and Egyptians. The measurement system later used in the Roman Empire was based on the Greek system. Through daily use over time and language variations, the Roman system proliferated into a great number of national and regional variants. Increased trade with Asia and within Europe also increased the influence of different measurement systems across national borders.

6 Medieval Asia

Large cultures, such as the Vedic and the Chinese, exerted major influence on the measurement systems of surrounding cultures over centuries. However, there were also a variety of more or less isolated cultures, such as those in Papua New Guinea, whose units of measurement and ways of measuring things were preserved well into the modern era.

7 Medieval Africa

The tribes of medieval Africa had a multitude of systems of measurement. The magnitudes of these measures often varied for every marketplace or village in a region, while the local measures in use before the colonization are far beyond listing. For the most part, we do not know how these measurement systems compare to modern systems, or even what names were used for the specific measures. The consensus of today's scholars agree upon that all African cultures used body parts as the inspiration for short measurements. The cubit was usually used for measuring textiles, though the definition of a cubit and its actual length varied. Most African cultures lacked scales for weighing objects. Instead, weight was determined simply by holding two different objects, one on each outstretched palm, and judging their relative weights.

8 Diversity of Systems

From the time of the early ancient cultures to the Middle Ages, the different measurement systems developed into rather complex metrological systems. The reasons for this complexity are many. Firstly, as indicated above, many units of measurement and names for units were borrowed from other civilisations during trade. Secondly, certain units of measurement were employed, for example, in the payment of taxes, others exclusively in the household, while others again served in landlord-tenant relations. Thirdly, certain units of measurement were sometimes associated with certain commodities, e.g., one measure was used for wheat, another for charcoal and a third for butter. Fourthly, certain units of measurement sometimes differed in size depending on what was to be measured, e.g., the volume of a given unit of wheat being different from the same unit of rye. Fifthly, measurements often tended to increase in size during periods of plenty and contract in times of scarcity. Sixthly, there was a gradual tendency towards a proliferation of the number of units of measurement, e.g., older units of measurement were retained even when new storage containers and tubs were introduced.

9 National Systems in Europe

During the eleventh to eighteenth centuries, Kings, Queens and Governments in many European countries realized that they could make money by levying taxes on market transactions, and national systems of weights and measures soon became common, e.g., the English "Magna Carta" of 1215, which sought to establish one measure throughout the land. But people who lived outside cities, in places where government regulators had trouble reaching them, tended to prefer the traditional measures, many of which themselves varied in value depending upon the locality or the particular commodity being bought or sold. For example, at the close of the eighteenth century, there were at least 391 different values of the *foot* measure in Europe. But this diversity between the systems used in each community was probably most striking in France, where, in 1789, about 800 names for different measures were in actual use. Taking into account the different sizes of all these measures in different towns and areas, there were about 250,000 different measures altogether, i.e., more than 200 different values of the *toise* were in use.

This confusing multiplicity of weights and measures in France led Bishop Talleyrand d'Autun to propose a project for developing a unique system of weights and measures to the constituting French National Assembly in 1790. The result of this project, the Decimal Metric System, and the subsequent deposition of two platinum standards representing the metre and the kilogram, on June 22, 1797, in the Archives de la République in Paris, was the first step in the development of an international system of units.

During the period of colonization in America, Africa, Asia and the Pacific Ocean, the respective systems of weights, measures and the calendar of the European colonists were spread around the world. In Africa, standardization measures were the exception rather than the rule before colonization. The degree of standardization of the pre-colonization systems of measurement in America and Asia depended upon the requirements of each individual society. This mixture of different weights and measures all over the world resulted in great difficulties for trade and the development of natural sciences, and led as well to an increased need for international standardization.

10 Modern Systems of Measurement

A system of units must in general fulfil some basic requirements: all people have to use the same units, the set of units must be minimal, the units must be defined as exactly as possible, and the units should be connected with each other in such a way that formulae using them become as simple as possible. These fundamental requirements became increasingly clear during early industrialization, when technology and science made rapid progress. Until the early nineteenth century, standard bars for length measuring were made of brass or bronze with a fairly large coefficient of expansion.

In 1946, the International Committee for Weights and Measures (CIPM) approved a proposal for the adoption of a four-dimensional system based on the metre, kilogram, second and ampere.

The 10th General Conference of Weights and Measures (CGPM), in 1954, approved the introduction of the ampere, kelvin and candela as base units for, respectively, electric current, thermodynamic temperature and luminous intensity. The *Système International d'Unités*, the SI, was finally created by the 11th CGPM in 1960 with the intention of providing a modernized metric system adapted to the needs of science and technology. At the 14th CGPM in 1971, the mole was added as a base unit for amount of substance.

SI today is the ultimate development of the metric system, in which most units are based on the laws of physical science. For example, distance is measured in reference to the speed of light, and time is measured according to the duration of certain atomic vibrations. The simplicity and universality of SI, coupled with its close relationship to the original metric system, has led to its almost immediate acceptance on a broad basis.

Every country is somewhere in the process of going totally metric, though some are much further along than others. Nevertheless, in many countries, the older local and provincial units are still used to some extent, at least in colloquial expressions.

The United States continues to implement the use of SI units for an increasing number of goods and services, but the American public and most private businesses and industries still use the customary U.S. units. Even though federal legislation, the Omnibus Trade and Competitiveness Act, was enacted in 1988 to begin the metrication of the U.S., an executive order was issued in 1991 to augment Public Law 00-418 on metrication, all but one US states, New York, have passed laws permitting metric-only labels for the products they regulate, little progress has been seen.

Other countries where metrication is not yet complete are Australia, Bangladesh, Barbados, Burma, Canada, Chile, China, Guatemala, Guyana, India, Indonesia, Ireland, Jamaica, Japan, Liberia, North Korea, New Zeeland, Peru, South Korea, Thailand, and the United Kingdom.

Systems of Units

In this section, I have compiled comprehensive information on different modern systems of units.

Main sources: [ARMS], [BARR2], [BIGO], [CARN], [CLAR3], [CRC85], [DETH], [DRES], [DRAZ], [DYBK], [FENN], [GUPT], [HAGE], [JAUN], [JERR], [LINK2], [MELA2], [MOUT], [SENA], [STEV4], [TABA], [YOUN], and [WILK]

1 Scientific Systems of Units

By connecting units to measurements, we give meaning to our measures. For example, when measuring the length of my credit card, I found it to be 3⅜ inches by 2⅛ inches. Here, an inch is a definite magnitude of the physical dimension length, a unit, making it easy for anyone familiar with the inch unit to realize the actual size of my credit card. The numbers 3⅜ and 2⅛ are multiples of the unit. The lengths I measured were defined empirically by adjusting the length measured in relation to the predetermined inch unit.

In science and technology, we frequently write equations in the form

$$l = 2.8 \text{ m or } m = 325.624 \text{ g}.$$

The symbols on the left side of the equations represent a *quantity* (length and mass in the examples above), and the symbols on the right side give the value of the quantity expressed as the product of a number (the *numerical value*) and a *unit* (metre and gram in the examples above). The symbols used for quantities are generally single letters printed in an italic font, whereas the symbols for units are in a roman font, as in the examples above.

Another way of expressing a quantity is by entering it as a *dimension*, written with a capital letter in square brackets. Thus, the metre unit is said to have the dimension length [L]. This dimension is generally regarded as *fundamental*, usually along with mass [M] and time [T], which means that it is possible to express more sophisticated physical quantities, e.g., area [L^2], velocity [LT^{-1}], and total pressure [$L^{-1}MT^{-2}$], by using only those dimensions.

If the ratio of two quantities is a pure number, then the two quantities will be said to have the same dimension. According to this terminology, the dimension of any quantity is the same as the dimension of its unit. A dimensional check can therefore be made simply by comparing the units on each side of an equation, which must be consistent with each other.

In science, there is a need to use a wide range of quantities, such as volume, energy, electric charge, molar mass, surface tension, spectral luminous efficacy, and electric dipole moment. In general, there is a recommended symbol, or sometimes two alternative symbols, for each quantity, as illustrated in Table 1. These symbols are single letters of the Latin or Greek alphabet,

J. Gyllenbok, *Encyclopaedia of Historical Metrology, Weights, and Measures*, Science Networks. Historical Studies 56, https://doi.org/10.1007/978-3-319-57598-8_2

Table 1 Examples of quantities and related derived SI units

Quantity	Symbol	Dimension	Derived SI unit	Symbol for derived SI unit
Volume	V	$[L^3]$	cubic metre	m^3
Energy	E, (W)	$[L^2MT^{-2}]$	square metre kilogram per square second	m^2kg/s^2
Electric charge	Q	[TI]	second · ampere	s · A
Molar mass	M	$[MN^{-1}]$	kilogram per mole	kg/mol
Surface tension	γ, σ	$[MT^{-2}]$	kilogram per square second	kg/s^2
Spectral luminous efficacy (at a specified wavelength λ)	$K(\lambda)$	$[L^{-2}M^{-1}T^3J]$	candela · steradian · cubic second per square metre and kilogram	$cd \cdot sr \cdot s^3/(m^2kg)$
Thermal utilization factor	f	[1]	–	–
Electric dipole moment	p,(p_e)	[LTI]	metre · second · ampere	m · s · A

but may sometimes be further specified by subscripts or superscripts. Symbols in parentheses are now obsolete. The examples in Table 1 are given in SI (Système International des Unitès), the modern version of the metric system.

Different systems of units are based on different sets of *fundamental dimensions*, represented by some *base units*. The SI has, in its latest version, adopted seven base units for seven base quantities, namely metre (length), kilogram (mass), second (time), ampere (electric current), kelvin (temperature), mole (amount of substance), and candela (luminous intensity). It is often said that the base units should ideally be defined independently from each other; however, for example, since 1983, the base unit of length, the metre, has been defined as the distance travelled by light in a vacuum over a specified length of time. In a somewhat similar way, [GUGG] showed that we can relate energy to time (through the equation $E = hv$, in which $h=$ the Planck constant and $v=$ frequency), to temperature (through the equation $E = kT$, in which $k=$ the Boltzmann constant), and to electric potential difference (through the equation $E = eU$, in which $e=$ the elementary charge). Anyway, there is every reason to hold on to some base units, not least because otherwise there would not be much point in doing dimensional analysis.

Which units are considered as base units is a matter of choice. Other units that can be expressed in terms of basic units are called *derived units*. Some derived quantities are described as dimensionless in the SI, and therefore values of these quantities are always pure numbers, e.g., the thermal utilization factor in Table 1. In this context, it also becomes interesting to ask for the lowest number of fundamental quantities such that the dimensions of all other quantities can be expressed in terms of the dimensions of the fundamental quantities.

For the purpose of further illustrating and clarifying the relationship between the different concepts, assume that we have only three dimensional quantities (length, time, and velocity), and that we have chosen time and velocity as base quantities. The dimension of velocity is $[LT^{-1}]$, hence the velocity of light in vacuum c_0 likewise has dimension $[c_0] = [LT^{-1}]$. If we assume that we have defined the velocity by assigning a numerical value to c_0, it is possible to define length as a quantity equation:

$l = \{L\} \langle L \rangle \quad c_0 \cdot t = \{c_0\} \langle c_0 \rangle \quad \{T\} \quad \langle T \rangle$, in which $\{L\}$ is the numerical value, $\langle L \rangle$ is the unit for length, and so on.

This equation may be divided into a unit equation: $\langle L \rangle = \langle c_0 \rangle \quad \langle T \rangle$, a measure equation: $\{L\} = \{c_0\}\{T\}$, and a dimensional equation: $[L] = [c_0] \cdot [T]$.

In this example, a constant of proportionality (c_0) is treated as a fundamental quantity. This opens the door to using diverse systems of units, in which not only the units of the fundamental quantities change, but so do the constants of the defining equations.

Since the number of quantities in science is without limit, it is not possible to provide a list of

Table 2 Examples of derived SI units given special names

Quantity	Symbol	Dimension	Derived SI unit	Symbol for derived SI unit
Energy	E, (W)	[L^2MT^{-2}]	joule	J
Electric charge	Q	[TI]	coulomb	C
Surface tension	γ, σ	[MT^{-2}]	newton per metre	N/m
Spectral luminous efficacy (at a specified wavelength λ)	$K(\lambda)$	[$L^{-2}M^{-1}T^3J$]	lumen per watt	lm/W
Electric dipole moment	p, (p_e)	[LTI]	coulomb metre	C · m

derived quantities and derived units. However, some derived units are so frequently used that they have been given special names. These special names should be regarded as nothing more than a shorthand for the corresponding product of base units, e.g., the joule (J) is a special name for the derived SI unit of energy (square metre · kilogram per square second). Table 2 illustrates how some of the derived units in Table 1 can easily be written by using special names.

To establish a system of quantities and units, we need to choose (i) a set of base quantities, (ii) a set of equations to be used to define all other derived quantities in terms of the base quantities, (iii) a base unit for each base quantity, and (iv) derived units defined in terms of the base units, using the chosen equations.

This type of system will generally result in multiple quantities assigned to the same unit, e.g., heat capacity and entropy, both having the SI unit joule per kelvin.

When it comes to classifying and categorizing systems of units, several ways have been proposed for how to do so since the mid-1800s. One way is to divide them by the number of base units, as below.

2 Systems with Three Basic Quantities

2.1 LMT Systems (Base Quantities: Length, Mass and Time)

This category consists of four major systems, namely FPS, MKS, CGS and MTS. Below these, I briefly present some suggested systems belonging to the category.

2.1.1 FPS System (Base Units: foot, pound (avoirdupois), and second)

This system, whose roots can be traced back to the middle Ages, is still used to some extent in Great Britain and the United States.

2.1.2 MKS System (Base Units: metre, kilogram, and second)

This Gaussian system (see below) was developed and distributed by the International Bureau of Weights and Measures (BIPM) in 1889.

During the twentieth century, this system became increasingly used in engineering and commercial transactions.

2.1.3 CGS or c.g.s. System (Base Units: centimetre, gram, and second)

In 1872, a committee of the British Association for the Advancement of Science (BAAS) proposed a three-dimensional coherent system, influenced by James Clerk Maxwell (1831–1879), based on centimetres, grams and seconds. It was formally introduced in 1874, and extended in the same year by the British physicists James Clerk Maxwell (1831–1879) and William Thomson (1824–1907), with a set of electromagnetic units.

It was immediately adopted by many working scientists around the world. In the U.S., it was generally abbreviated as c.g.s., while in the rest of the world, it was CGS. Since 1960, when the CGPM adopted the SI, CGS has become more seldom used in scientific journals and textbooks.

2.1.4 MTS System or TMS System (Base Units: metre, tonne, and second)

This system was invented by French industry, and was the legal system in France from 1919 until 1961. It was also adopted by the Soviet Union in 1933, and was used there until 1955, when it was abolished. The derived unit for force was called the sthène, and was equal to 1 (t · m)/s^2 = 1 kN. The derived unit for pressure was called the pièze, and was equal to 1 t/(m · s^2) = 1 kPa.

2.1.5 Gaussian System (Base Units: millimetre, gram, second; centimetre, milligram, second)

During the early 1830s, Carl Friedrich Gauss (1777–1855) strongly promoted the application of the metric system, together with a system defined in astronomy as a coherent system of units, based on millimetres and grams, for the physical science. In 1832, he added the second as a unit of time.

In 1851, the German physicist Wilhelm Weber (1804–1891) proposed a quite similar system, with centimetres, milligrams and seconds as base units.[1]

2.1.6 Practical CGS Systems (Base Units: centimetre, gram, second; Additional Practical Units: ampere, ohm, volt)

By applying the inverse square law of force between electric charges and magnetic poles separately, two sets of electrostatic and electromagnetic units were obtained. As the sizes of the coherent CGS units in the fields of electricity and magnetism proved to be inconvenient, the BAAS and the International Electrical Congress (IEC) approved a mutually coherent set of practical units in the 1880s.

At the International Electrical Congress in Chicago in 1893, the "international" ampere and ohm were defined by using the metre, the kilogram and the second.

2.1.7 Stroud System (Base Units: foot, pound (avoirdupois), second)

This system was first devised by Professor William Stroud (1885–1901) in the late 1880s, while he was teaching dynamics at Imperial College in London.[2] The distinction between mass and weight was emphasized here, with capital letters being used for forces and small letters for masses.

2.1.8 Shull and Hall System (Base Units: Mass of Electron (m), Charge of Electron (e), Rationalized Planck's Constant ($\hbar$))

In 1959, H. Shull and G. G. Hall suggested this system, in which the unit for length was a derived unit expressed as $b = \hbar^2/(me^2)$.[3]

2.1.9 Kiang System (Base Units: The Charge of an Electron (e), The Speed of Light (*c*), The Gravitational Constant (*G*), A Fourth Unit)

These two systems, both based on the premise that $c = G = 1$, were proposed by T. Kiang in 1987.[4] The fourth unit could either be Hubble time (=15 · 10^9 years) or the mass of a black hole (=1.99 · 10^{36} kg). In the first system, the unit of length is 42 · 10^{26} m and the unit of mass is 1.9 · 10^{53} kg, and in the second system, the unit of length is 1.48 · 10^9 m and the unit of time is 4.93 s.

2.2 Gravitational or LFT Systems (Base Quantities: Length, Force, Time)

The base unit of force depends on a selected gravitational constant, normally an acceleration of 9.80665 m/s^2. Other derived units inherit this factor.

2.2.1 Bullock System, MKpS System, m-kp-s System or m-kgf-s System (Base Units: metre, kilogram-force, second)

This system was suggested by M. Loren Bullock in 1954.[5] The unit of force was defined as the

[1] [WEBE2].

[2] See [JERR, p. 8].

[3] [SHUL].

[4] [KIAN].

[5] [BULL2].

force experienced by a body of mass equal to one kilogram at a location where the acceleration due to gravity is 9.80665 m/s^2. Kilogram-force is sometimes called the kilopond.

2.2.2 Technical FPS System, Gravitational FPS System, or ft-lbs-s System (Base Units: foot, pound-force, second)

This coherent variant of the FPS system is the most common among engineers in the US. The pound-force is used as a fundamental unit of force. The unit of mass here is a derived unit known as the slug =1 pound-force · 1 s^2/ft.

3 Systems with Four Basic Quantities

As length, mass and time are not sufficient to define electric and magnetic quantities, a fourth dimension must be included. Different systems arose from differing choices for the additional dimension. The most influential were the MKSA system, which later became the SI.

3.1 Maxwell System

In 1873, the Scottish scientist James Clerk Maxwell (1831–1879) proposed a system of units in which permeability of free space was taken as unity. The other base units were the earth quadrant, defined as 10^7 m, a mass of 10^{-11} gram and the second.

3.2 Giorgi System or MKSΩ-System (Base Units: metre, kilogram, second, a Fourth Unit (usually the ohm))

In 1901, the Italian electrical engineer Giovanni Giorgi (1871–1950) showed, in a proposal[6] to the Associazione Elettrotecnica Italiana (AEI), that it is possible to form a single coherent four-dimensional system by adding a fourth unit of electrical nature, such as the ampere or the ohm, to the three base units, metre, kilogram and second, and rewriting the equations that occur in electromagnetism in the so-called rationalized form, by giving physical dimensions to ε_0 and μ_0, and eliminating the factor 4π where it does not concern spherical geometry.[7] The system, with ohm as the fourth fundamental unit, was adopted by the International Electrotechnical Commission (IEC) in 1935. According to [JAUN], it has also been called MKOS system.

3.3 Hartree System (Base Units: The Bohr Radius, The Rest Mass of an Electron, The Reciprocal of Angular Velocity of the Electron, The Charge of an Electron)

In 1926, the English physicist Douglas Rayner Hartree (1897–1958) proposed this system of units based upon physical constants. The basic problem with this system was that the base units were too small for quantities encountered in daily life.

3.4 Kalantaroff System (Base Units: metre, second, coulomb, weber)

This system was suggested by Professor P. Kalantaroff in 1929.[8]

3.5 MKSA System (Base Units: metre, kilogram, second, ampere)

This system has also been called an m.k.s.A. system and an m.kg.s.A system. It was adopted in 1946 by the Metre Convention countries and became effective at the beginning of 1948.

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[6] [GIOR].

[7] See also [GIOR2].

[8] [KALA].

3.6 MSAO System or OASM System (Base Units: metre, second, ampere, ohm)

This system was suggested by M. Tarbouriech in 1945. The second was taken as 1/86,400 of the mean solar day. The ampere and ohm were the same as those defined by BASS in 1881.

3.7 MKS°K System or mksK System (Base Units: metre, kilogram, second, kelvin)

This system was established in 1961 in the USSR by GOST (All-Union State Standard) 7664-1 (Mechanical units) and 8550–61 (Thermal Units). It used the term "degree Kelvin" for the unit of thermodynamic temperature.

3.8 Ludovici System (Base Units: Gravitational Constant (G), Permittivity of Free Space (€), Permeability of Free Space (H), Electric Charge of One Electron (Q))

This system was suggested by Bruno F. Ludovici in 1956.[9] The proposed units of length, mass, time and charge in terms of SI units is: $4.88 \cdot 10^{-36}$ m, $6.60 \cdot 10^{-9}$ kg, $1.628 \cdot 10^{-44}$ s and $1.60 \cdot 10^{-19}$ C.

3.9 McWeeny System (Base Units: Mass of Electron (m), Charge of Electron (e), Rationalized Planck's Constant ($\hbar$), Permittivity (κ_0))

The English physicist Roy McWeeny (b. 1924) suggested this system in 1973, in which $\kappa_0 = 4\pi\varepsilon_0$.[10]

[9] [LUDO2].

[10] [MCWE].

3.10 British Engineering System (Base Units: foot, pound (avoirdupois), pound-force, second)

This variant of the FPS system was not coherent, and used both the pound-mass and the pound-force.

There have also been other suggested 4-dimensional systems based on the metric units of measurement, e.g., the **MKSC system** (base units: metre, kilogram, second, coulomb)[11] and the **m-sr-s-cd system** (base units: metre, steradian, second, candela).

4 Systems with More Than Four Basic Quantities

4.1 m-k-s-A-°K-cd System (Base Units: metre, kilogram, second, ampere, degree Kelvin, candela)

This system was adopted by the 10th General Conference on Weights and Measures in 1954.

4.2 SI (Base Units: metre, kilogram, second, ampere, kelvin, candela)

In 1960, the 11th General Conference on Weights and Measures adopted the name International System of Units (SI) for the above system.

In 1967, the degree Kelvin became the kelvin.

5 Chronological History of the Metric System

Historically, the metric system developed for about 200 years before it was first adopted in France during the late eighteenth century. Below, I have made a compilation of the most

[11] See [HARR5].

noteworthy events from the late sixteenth century to the present day.

Main source: [GUPT]

5.1 Early Evolution of the Metric System

1585: The initial idea in modern times for a decimal measuring system of units came from Simon Stevin (1548–1620), a Flemish mathematician who started life as a bookkeeper in Flanders. In 1585, he published his thoughts in a 36-page booklet, in Flemish, called *De Thiende* (Of Tenths).

1668: John Wilkins (1614–1672), an English academic and one of the founders of the Royal Society, devised a "universal measure" and a universal decimal system of measurement in his book *An Essay towards a Real Character, and a Philosophical Language*. It was suggested that the "universal measure" be used to measure length, area, and volume, as well as being the length of each side of a cube that, filled with distilled rainwater, represented the measure of weight. Wilkins also proposed a decimal system to divide large units or to multiply small units, and the use of a pendulum that was 0.994 m in length.

1670: Gabriel Mouton (1618–1694), a French vicar from Lyons, published the book *Observationes diametrorum solis et lunae apparentium*, in which he suggested that a new decimal system of measurement could be based on the circumference of the Earth, calculated by Giovanni Battista Riccioli (1598–1671) of Bologna as being about 32,512,000 Roman paces (= about 48,118 km). Mouton suggested a unit, the *milliare*, equal to a minute of an arc along a meridian arc, and a subunit, virga, = 1,852 mm.

1673: Gottfried Wilhelm Leibniz (1646–1716), a German philosopher and mathematician, published measurement proposals similar to those of Gabriel Mouton in 1670.

1740: César-François Cassini de Thury (1714–1784), a French astronomer and cartographer, carried out a survey to accurately determine the size of the Earth.

1783: James Watt (1736–1819), a Scottish mechanical engineer, promoted the idea of a global decimal measurement system as the basis for any new measuring method after he experienced difficulties in communicating with German engineers.

1784: Thomas Jefferson (1743–1826), then the ambassador to France, promoted the idea for a new decimal currency, 1 dollar = 100 cents = 1,000 mils, for the USA. See *Journals of the Continental Congress*, July 6, 1785.

1787: Arthur Young (1741–1820), an English writer on agriculture and economics, reported: "*In Ireland, the statute barrel of four bushels takes place universally; but in France, the infinite perplexity of the measures exceeds all comprehension. They differ not only in every province, but in every district, and almost every town; and these tormenting variations are found equally in the denominations and contents of the measures of land and corn.*" [YOUN, p. 302].

1789: On January 15, 1790, the House of Representatives requested of Thomas Jefferson (1743–1826), then the first Secretary of State, that he draw up a plan for a uniform system of

								Metric
milliare								~2040 m
10	**centuria**							~204 m
100	10	**decuria**						~20.4 m
1000	100	10	**virga**					~2.04 m
10,000	1000	100	10	**virgula**				~204 mm
100,000	10,000	1000	100	10	**decima**			~20.4 mm
1,000,000	100,000	10,000	1000	100	10	**centesima**		~2.0 mm
10,000,000	1,000,000	100,000	10,000	1000	100	10	**millesima**	~0.2 mm

weights and measures. In mid-1790, Jefferson submitted a report proposing two systems of units, one with mere simplifications of the existing English-based system, the other a decimal-based system with a mixture of familiar and unfamiliar names for the units. He selected the length of a second's pendulum at 45° latitude as the basic reference for his systems. The pendulum was proposed to be a uniform rod estimated as being 39.14912 English inches long, or 1 ½ times that for a vibrating rod (=58.72368 inches).

In the system based on the traditional system, the foot was defined as either three times the pendulum (= about 298.317 mm) or five times the rod (= about 331.463 mm).

Units of length for English-based system

									Metric	Metric
league									5250.374 m	4725.341 m
3	**mile**								1750.125 m	1575.114 m
24	8	**furlong**							218.766 m	196.889 m
960	320	40	**perch** or **pole**						5.469 m	4.922 m
2640	880	110	2¾	**fathom**					1.989 m	1.790 m
4224	1408	176	4⅖	1⅗	**ell**				1.243 m	1.119 m
5280	1760	220	5½	2	1¼	**yard**			994.389 mm	894.951 mm
15840	5280	660	16½	6	3¾	3	**foot**		331.463 mm	298.317 mm
190,080	63,360	7920	198	72	45	36	12	**inch**	27.622 mm	24.860 mm

Units of area for English-based system

			Metric	Metric
acre			4 785.838 m²	3 876.536 m²
4	**rood**		1 196.459 m²	969.134 m²
160	40	**square pole**	29.911 m²	24.228 m²

Units of dry and liquid capacity for English-based system

											Metric	Metric
ton											1456.696 L	1061.957 L
2	**pipe**[a]										728.348 L	530.979 L
3	1½	**tierce**									485.565 L	353.986 L
4	2	1⅓	**quarter**[b]								364.174 L	265.489 L
8	4	2⅔	2	**barrel**[c]							182.087 L	132.745 L
16	8	5⅓	4	2	**strike**[d]						91.043 L	66.372 L
32	16	10⅔	8	4	2	**bushel**[e]					45.522 L	33.186 L
128	64	42⅔	32	16	8	4	**peck**				11.380 L	8.296 L
256	128	85⅓	64	32	16	8	2	**gallon**[f]			5.690 L	4.148 L
512	256	170⅔	128	64	32	16	4	2	**pottle**		2.845 L	2.074 L
2048	1024	682⅔	512	256	128	64	16	8	4	**quart**	711.3 mL	518.3 mL

[a]Also butt or puncheon
[b]Also hogshead
[c]Also coomb
[d]Also kilderkin
[e]Also firkin
[f]One gallon defined as 270 cubic inches

Units of weight for English-based system

				Metric	Metric
pound				441.952 g	397.760 g
16	**ounce**[a]			27.622 g	24.860 g
128	8	**pennyweight**		3.45275 g	3.10750 g
3072	192	24	**grain**	143.86 mg	129.48 mg

[a]One ounce defined as 1/1000 the weight of one cubic inch of rain water at standard temperature

Units of length for decimal-based system

								Metric	Metric
mile								3314.63 m	2983.17 m
10	**furlong**							331.46 m	298.32 m
100	10	**rood**						33.145 m	29.817 m
1000	100	10	**decade**					3.314 m	2.982 m
10,000	1000	100	10	**foot**				331.463 mm	298.317 mm
100,000	10,000	1000	100	10	**inch**			33.146 mm	29.832 mm
1,000,000	100,000	10,000	1000	100	10	**line**		3.314 mm	2.983 mm
10,000,000	1,000,000	100,000	10,000	1000	100	10	**point**	0.331 mm	0.298 mm

Units of area for decimal-based system

	Metric	Metric
rood	1098.724 m^2	889.948 m^2

Units of dry and liquid capacity for decimal-based system

						Metric	Metric
last or **double ton**						3641.829 L	2654.813 L
10	**quarter**					364.183 L	265.481 L
100	10	**bushel**[a]				36.418 L	26.548 L
1000	100	10	**pottle**[b]			3.642 L	2.655 L
10,000	1000	100	10	**demi-pint**[c]		364.2 mL	265.5 mL
100,000	10,000	1000	100	10	**metre**[d]	36.4 mL	26.5 mL

[a]Equal to 1 cubic foot
[b]Equal to 5 in × 5 in × 4 in
[c]Equal to 2 in × 2 in × 2 ½ in
[d]Equal to 1 cubic inch

Units of weight for decimal-based system

									Metric	Metric
hogshead									364.183 kg	265.481 kg
10	**kental**								36.418 kg	26.548 kg
100	10	**stone**							3.6418 kg	2.6548 kg
1000	100	10	**pound**						364.18 g	265.481 g
10,000	1000	100	10	**ounce**					36.418 g	26.548 g
100,000	10,000	1000	100	10	**double-scruple**				3.6418 g	2.6548 g
1,000,000	100,000	10,000	1000	100	10	**carat**			364.2 mg	265.5 mg
10,000,000	1,000,000	100,000	10,000	1000	100	10	**minim**[a]		36.4 mg	26.5 mg
100,000,000	10,000,000	1,000,000	100,000	10,000	1000	100	10	**mite**	3.6 mg	2.6 mg

[a]Also demi-grain

5.2 Units of Length

1790: Marie Jean Antoine Nicolas de Caritat Condorcet, known as Nicolas de Condorcet (1743–1794), a French political scientist who was the Inspector General of the French Mint, asked a friend, Charles Maurice de Talleyrand-Perigord (1754–1838), then the Bishop of Autun, to put a proposal for a new measurement system to the French National Assembly. Condorcet's system was to be based on a length from nature; it was to have decimal sub-divisions; all measures of area, volume, weight, etc., were to be linked to the fundamental unit of length; and the basic length should be that of a pendulum, for which one complete swing back and forth was equal to two seconds, at the latitude of Paris, 45°N. Taleyrand-Perigord also suggested that the Academy of Sciences in Paris collaborate with the Royal Society of London in defining the new base unit of length, but nothing came out of it.

1791: Jean Charles, chevalier de Borda (1733–1799), a French political scientist, sailor and the Chairman of the French Commission of Weights and Measures, was appointed by the Academy to lead a Commission, which also included Condorcet, Joseph-Louis Lagrange (1736–1813), an Italian mathematician and astronomer, Pierre-Simon, marquis de Laplace (1749–1827), a French mathematician and astronomer, and Gaspard Monge, Comte de Péluse (1746–1818), a French mathematician, as members. They resolved the pendulum problem by proposing, in a report to the French Academy on March 19, that the new standard length, the *mètre*, be 1/10,000,000 of the length of the line of longitude passing through Paris at sea level, determined from the North Pole to the equator. This definition, despite some resistance, became approved on March 26 as the first standard for the metre, and was used to determine all other units, both subdivisions and multiples. A provisional metre, to be used until the results of the survey were in, was set to equal 3 pied, ½ pouce and $5^{11}/_{25}$ lignes of the *toise du Pérou* (=974.518 mm). The word *mètre* was derived from the Greek μέτρον καθολικόν (*métron katholikón*; "a universal measure").

1792/1798: The experimental determination of the base for the new unit of length, the distance between the North Pole and the equator, was deemed too impractical. But if one could measure a significant piece of a meridian, the rest could be calculated. Now, it was simply a matter of finding a distance where the two ends of the line to be measured were at sea level, and somewhere near the middle of the pole-to-equator quadrant. As it happens, the meridian that ran through Dunkirk in France and Barcelona in Spain met these requirements. In 1792, the Academy appointed Jean Baptiste Joseph, chevalier Delambre (1749–1822), a French mathematician who was then director of the Paris Observatory, to be in charge of the northern expedition, with its mission to measure the meridian from Dunkirk to Rodez. In 1798, Pierre François André Méchain (1744–1804), a French surveyor, led the southern expedition responsible for measuring the meridian from the Dunkirk belfry in France to Montjuïc Castle in Barcelona, Spain.

1793: Borda, Lagrange, and Laplace computed a provisional value for the metre based on the survey carried out by César-François Cassini de Thury (1714–1784) in 1740. The metric system was passed into law by the French National Assembly, and metre bars, together with a kilogram mass, were dispatched to the USA, expecting that the country would adopt the new measures. The US Congress hesitated because the standards were provisional, and Britain and Germany became hostile to the metric system because of the changed definition of the metre.

1795: The French Assembly decreed that the new "Republican Measures" were to be legal measures in France. The official base units were: the metre (for length), the are (for area), the litre (for volume), the gram (for mass), and the bar (for pressure). The former royal jeweller began to produce provisional metre bars of platinum, 4 mm thick and 25.3 mm wide, with plane parallel ends.

1797: In the fall, Delambre reached Rodez, the destination of the survey.

1798: An International Commission began work with the goal of replacing the provisional values with more precise standards.

1798: In September, Méchain finally reached Rodez, and the survey mission was completed. Up to this point, except for the sides of two triangles, only angles of contiguous triangles, stretching all the way from Dunkirk to Barcelona, had been measured. The French then convened an international meeting of experts to calculate the metre from the measurements made by Delambre and Méchain. They all agreed, and the metre was established at 0.144 lignes of the toise de Pérou shorter than the provincial metre.

1799: The length of the platinum bars, produced based on the provincial metre, were now compared with the length of the metre as determined by the data collected by Delambre and Méchain. The one nearest that length, at 0 °C, was deposited in the National Archives on June 22, and has been known ever since as the *Mètre des Archives*. This standard bar was a metre long, from end to end; any simple way of measuring its length required touching the ends, which caused wear and shortened the standard. Such a standard is called an end measure. On December 10, the metric system itself became legalized.

1870/1872: Two international conferences (*Commission Internationale du Mètre*) discussed the international standardization of the metre. The attendees favored replacing the *Mètre des Archives* with a new prototype block made of a platinum-iridium alloy (10% iridium, to within 0.0001%). It was suggested that it should be a line measure, which means that the unit of length would be the distance between a pair of scratches on the metal bar. Such a standard is called a line measure because the lines' location can be determined visually. The actual length of the *Mètre des Archives* was taken, "in the state in which it is found", as the standard metre.

1875: At the third international conference, eighteen countries subscribed to a treaty (the *Convention du Mètre*), which gave authority to set up Conférence Général des Poids et Mesures (CGPM), Comité International des Poids et Mesures (CIPM), and Bureau International des Poids et Mesures (BIPM).

1877: The difficulties in manufacturing a prototype bar were evident, and the bars from the first casting of the alloy were all rejected. The main problem was that iridium, besides having an extremely high melting point (2443 °C), had not yet been produced in purities greater than 50%. The manufacturing task was now turned over to the London firm Johnson, Matthey & Co. They succeeded, and one of the resulting alloy bars was made the provisional standard, even though it was 0.006 mm shorter than the *Mètre des Archives*.

1882: France ordered thirty more bars, one of which (No. 6) turned out to be, as nearly as could be ascertained, exactly the length of the *Mètre des Archives*.

1889: In September, the First General Conference on Weights and Measures (1st CGPM) was held in Paris. At that time, prototype bar no. 6, at the temperature of melting ice, was declared to be the International Prototype of the metre. Copies of this standard bar, supplied with a correction factor, were made for the countries signing the treaty. The accuracy was set to 0.01 mm.

1892/93: Albert A. Michelson (1852–1931) and Jean-René Benoît (1844–1922) succeeded in measuring the metre in terms of the wavelength of red light given off by excited cadmium atoms. They gave the metre a value of 1,553,164.13 times the wavelength of the red spectral line of cadmium at 760 mm of atmospheric pressure at 15 °C.

1905–1907: Jean-René Benoît and others re-specified the metre as 1,000,000/0.64384696 wavelengths in air of the red line of the cadmium spectrum.

1907: The International Union for Solar Research defined the international angstrom, a unit of distance to be used in measuring wavelengths, by making 6438.4696 international angstroms equal to the wavelength of the red line of cadmium. This value was chosen so that one angstrom was approximately 10^{-10} m.

1927: The 7th CGPM defined the metre as the distance, at 0 °C, between the axes of the two central lines marked on the bar of platinum-iridium kept at the BIPM, and declared as the prototype of the metre by the 1st CGPM. This bar, being subject to standard atmospheric pressure and supported on two cylinders of at least one centimetre diameter, was symmetrically placed in the same horizontal plane at a distance of 571 mm from each other. Despite the red line of cadmium having been found to be composed of many lines, which affected how precisely the light's wavelength could be determined, the conference provisionally sanctioned measuring distances in terms of the red line, taking its wavelength to be 0.64384696 micrometres.

1948: It had now become clear that pure isotopes with an even number of protons, and an even sum of protons and neutrons, gave light with a single line spectrum. Thus, three isotopes had been intensively investigated to see which would be most suitable as the basis for a standard of length: krypton-86 (36 protons), cadmium-114 (48 protons), and mercury-198 (80 protons). The advisory committee at the 9th CGPM, in charge of following these developments, recommended that any new definition be stated in terms of the wavelength in a vacuum instead of in air, and that the length of the wavelength should be specified by comparing it with the already determined wavelength of the red line of cadmium, not with the International Prototype of the Metre.

1954: The 10th CGPM accepted that the metre was defined in terms of light, in effect making the angstrom exactly 10^{-10} metre.

1957: The advisory committee of the CGPM declared that krypton-86 was the most suitable basis for a standard of length.

1960: The 11th CGPM named the new MKSA-based metric system the Système International d'Unités (SI). The hertz, lumen, lux and tesla units were adopted, and the prefixes pico-, nano-, micro-, mega-, giga- and tera- were confirmed.

The 11th CGPM (Resolution 6) redefined the metre as "the length to 165,076,373 wavelengths in a vacuum of the radiation corresponding to the transition between the levels $2p_{10}$ and $5d_5$ of the krypton 86 atom."

1975: The 15th CGPM (Resolution 2) approved a conventional value of the speed of light as being exactly 299,792,458 m/s.

1983: On October 21, the 17th CGPM (Resolution 1) redefined the metre as being equal to the length of the path travelled by light in a vacuum during a time interval of 1/299792458 of a second.

2002: The International Committee for Weights and Measures (CIPM) considered the metre to be a unit of proper length, and thus recommended the definition to be restricted to lengths which are sufficiently short for the effects predicted by general relativity to be negligible with respect to the uncertainties of realization.

5.3 Units of Mass

1793: A metallic reference standard, called a grave (name derived from the word "gravity"), of one thousand grams was defined as the weight of one cubic decimetre of pure water at its freezing point.

1795: An order established the names now in use, including the gram, and ordered resumption of the survey. On April 7, the "gramme" was decreed in France to be equal to "the absolute weight of a volume of pure water equal to a cube of one hundredth of a metre, and at a temperature of the melting ice".

1799: An all-platinum standard, known as the "Kilogramme des Archives," was fabricated as closely as was feasible to the mass of a cubic decimetre of pure water at 4 °C. On December 10, 1799, it was declared as the standard of the kilogram.

1879: Johnson, Matthey & Co. manufactured three metallic prototypes of the kilogram.

1880: The kilogram prototypes were compared with the Kilogram des Archives.

1883: CIPM declared that the prototype, made of 90% platinum and 10% iridium by mass, whose mass was closest to that of the Kilogram de Archives was the international prototype kilogram (IPK), and a letter K was engraved on it.

1889: The 1st CGPM approved the magnitude of the kilogram as being the mass of the IPK.

1901: The 3rd CGPM redefined the litre as the volume of one kilogram of pure water. It was also clarified that the kilogram was the unit of mass of the IPK, kept in the custody of the BIPM.

1907: The 4th CGPM defined the carat as 200 milligram.

1989: CIPM declared that the kilogram is the mass of the IPK just after cleaning and washing according to the BIPM procedure,[12] and that to deduce the mass at the time of use, the measured change in mass of +0.0368 μg/day must be used.

2007: The kilogram was proposed to be such that the Planck constant, a fundamental constant of quantum mechanics that relates the energy of electromagnetic radiation to its frequency, is exactly $6.626069\,3 \cdot 10^{-34}$ J/s.[13]

2011: The 24th CGPM accepted a resolution to take note of an intention that the kilogram be defined in terms of the Planck constant. Today, the Watt balance is used to measure precise values for the Planck constant. A precise value for the Planck constant yields a precise value for the Avogadro constant and a fixed value for the elementary charge. This would also anchor the definition for current to the rest of the SI units.

5.4 Units of Time

1832: Carl Friedrich Gauss (1777–1855) proposed the second, equal to 1/60 of an hour, as the base unit in his system of units.

1862: The British Association for the Advancement of Science (BAAS) stated that "all men of science are agreed to use the second of mean solar time as the unit of time."[14]

1874: The second, defined as 1/86,400 of the mean solar day, was adopted by the BAAS as the base unit for time in the CGS system.

1940s: The MKS system adopted the second, as 1/86,400 of the mean solar day, as the base unit for time.

1960: The definition, first made in 1955 by the International Astronomical Union (IAU), of a second as the fraction 1/31,556,925.9747 of the tropical year for January 0, 1900 at 12 hours ephemeris time, was also adopted by the 11th CGPM.

1967: The 13th CGPM defined the second as the duration of 9,192,631,770 periods of the radiation corresponding to the transition between two hyperfine levels of the ground state of the cesium-133 atom.

1997: It was affirmed by the CIPM, that the definition of the second refers to a cesium-133 atom in its ground state at a temperature of 0 K.

5.5 Units of Electric Current

1832: Carl Friedrich Gauss (1777–1855) succeeded in measuring the strength of the Earth's magnetic field in terms of length, mass and time.[15]

[12] BIPM, 1989: Proc.—Verb.Com. Int. Poids et Mesures, **57**, 104–5; BIPM, 1990: Proc.—Verb.Com. Int. Poids et Mesures, **58**, 95–7; Girard, G. Le nettoyage-lavage des prototypes du kilogramme au BIPM (*The washing and cleaning of kilogram protoypes at the BIPM*). BIPM, Monographie 90/1, 1990.

[13] New Scientist, 22 September 2007.

[14] [JENK2].

[15] [GAUS].

1851: Wilhelm Eduard Weber (1804–1891) succeeded in measuring an induced electric current in terms of length, mass and time, and recommended a complete system of electric units.

1872: A committee on standards of electrical resistance of the British Association for the Advancement of Science (BAAS) recommended the use of the CGS system of units, but made the unit of resistance, which they named the "ohm", 10^9 times larger than the CGS absolute unit of resistance.

1881: The 1st International Conference of Electricians adopted the BAAS definition of the ohm and added definitions for the ampere, coulomb, farad and volt. This became a system of units known as the absolute practical system of electrical units. This was practical, as the sizes were much more convenient than the cgs units, and absolute, because the units were defined solely in terms of length, mass and time. The ampere was a derived unit here, defined as the quantity of electricity which will pass, during one second, through a circuit having a resistance of one ohm, when the electromotive force is one volt between its ends. This quantity of electricity had formerly been called one farad per second, one weber and one örsted, but was now established as an ampere. The ampere had also been estimated as the quantity of current which is capable of depositing 4.025 g of silver per hour.[16]

1893: The 4th International Conference of Electricians defined three base units: the international ampere (A_{int}; also sometimes called the silver ampere), the international ohm (Ω_{int}) and the international volt (V_{int}). The units were designated "international" to distinguish them from their predecessors.

The international ampere: "the unvarying current which, when passed through a solution of silver nitrate in water, deposits silver at the rate of 0.001118000 g/s." The amount of silver was chosen to make the international ampere equal to the absolute practical ampere within the limits of precision of the day. Public Bill 105, passed July 12, 1894, made this the legal definition of the ampere in the United States.

The international ohm: "the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14.4521 grams in mass, of a constant cross-sectional area and of the length of 106.300 centimetres."[17]

The international volt: "1000/1434 of the electromotive force of a Clark cell at a temperature of 15 °C." Later estimated as being equal to 1.00034 V.

However, the method of defining these three base units experimentally was a mistake' as standard laboratories in America, Britain and Germany made ever more precise measurements, they soon found that the definitions were inconsistent.

1908: At an international conference in London, the number of base units was reduced from three to two by redefining the international volt as a derived unit. The international ampere and the international ohm were defined in terms of the corresponding CGS electromagnetic units.

The preferred realization of the international volt was defined in terms of the electromotive force of a Weston cell at 20 °C, as this had a lower temperature coefficient than the Clark cell.

The international coulomb was defined as the electric charge transferred by a current of one international ampere in one second.

The international farad was defined as the capacitance of a capacitor charged to a potential of one international volt by one international coulomb of electricity.

The henry was defined as the inductance in a circuit when an electromotive force induced in this circuit is one international volt, while the inducing current varies at the rate of one ampere per second.

[16] [POPE].

[17] [GRAF, p. 389].

1948: The 9th CGPM abandoned the international ampere and reverted to an absolute definition of the ampere (Resolution 2 and 7). The ampere was now defined as that constant electric current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 m apart in a vacuum, would produce a force between these conductors =0.2 μN/m in length. The expression "MKS unit of force," which occurred in the original text written in 1946, has been replaced here by "newton," a name adopted for this unit by the CGPM in 1948.

Investigations showed that this new definition gave a value for the ampere that was 1.00015 times the mean international ampere previously used by various national standard laboratories. The factor was 1.000165 for the ampere of the U. S. National Bureau of Standards.

2007: The ampere was proposed to be such that the elementary charge is exactly $1.60217653 \cdot 10^{-19}$ coulombs.[18]

5.6 Units of Luminous Intensity

1937: The unit *bougie nouvelle* or *new candle* was defined by the International Commission on Illumination (CIE), but because of World War II CIPM did not promulgate the definition until 1946.

1946: CIPM defined the new candle so that the value of it is such that "the brightness of the full radiator at the temperature of solidification of platinum is 60 new candles per square centimetre."

1948: The 9th CGPM ratified the new candle as defined above, and also defined the new lumen as the luminous flux emitted in a unit solid angle by a uniform point source having a luminous intensity of one new candle.

1968: The 13th CGPM changed the name from new candle to candela, and defined it as the luminous intensity, in the perpendicular direction, of a surface of 1/600,000 m^2 of a black body (a perfect radiator of energy) at the temperature of freezing platinum (2042 K) under normal standard pressure of 101,325 N/m^2.

1979: The 16th CGPM, Resolution 3, defined the candela (cd) as the luminous intensity in a given direction of a source that emits monochromatic radiation of frequency 540 THz and that has a radiant intensity in that direction of 1/683 W/sr, or 18.3988 mW over a complete sphere centered at the light source. The frequency of 540 THz corresponds to a wave length of about 555.17 nm.

5.7 Units of Temperature

1913: The 5th CGPM proposed the International Temperature Scale.

1948: The 9th CGPM established the degree absolute with the symbol °K.

1960: The 11th CGPM changed the name to degree Kelvin.

1967/1968: The 13th CGPM defined the temperature of the triple point of water (the temperature at which water exists simultaneously in gaseous, liquid, and solid states) to be exactly 273.16 K, and changed the name of the unit to the kelvin, with the symbol K (without the degree symbol). The usage of the older name continued to be allowed for the time being.[19] Since the temperature of the triple point of water is 0.01 °C, the temperature in kelvins is always equal to 271.15 plus the temperature in degree Celsius.

1980: CIPM stated that it was not to use "degree Kelvin."

2005: CIPM asserted that the water in the definition established in 1967/68 was Vienna Standard Mean Ocean Water (V-SMOW) having the following isotopic compositions:

Deuteron heavy hydrogen ^2H is 0.00015576 ^2H mole per mole of ^1H

[18] New Scientist, 22 September 2007.

[19] [METR2].

Oxygen of atomic mass 18 ^{18}O is 0.0020052 mole of ^{18}O per mole ^{16}O

Oxygen of atomic mass 17 ^{17}O is 0.0003799 mole of ^{17}O per mole of ^{16}O.

2007: The kelvin was proposed to be such that the Boltzmann constant is exactly $1.3666505 \cdot 10^{-23}$ J/K.[20]

2018: A new definition of the kelvin, based on a fixed value for the Boltzmann constant, is expected to be adopted at the 26th CGPM.[21]

5.8 Units of Amount of Substance

1967: CIPM defined the mole as the amount of substance of a system that contains as many elementary entities as there are atoms in 0.012 kg of carbon-12. The actual number of "elementary entities" in a mole is called Avogadro's number. Careful measurement determines Avogadro's number to be about $602.214199\ (47) \cdot 10^{21}$ entities per mole.

1971: The 14th CGPM, Resolution 3, adopted the mole by the definition above.

1980: CIPM approved a report by the CCU (1980) which specified that it is understood that the unbound atoms of carbon-12 referred to in the definition are at rest and in their ground state.

2007: The mole was proposed to be such that the Avogadro constant is exactly $6.0221415\ 10^{23}$ per mole. [22]

6 Main Variants of the Metric System

Scientists soon adopted the metric system to simplify calculations and to promote international communication. The first system to come into wider use was the CGS-system. For the three fundamental units of length, mass and time, F. Gauss chose the units of millimetre, milligram and second. To show the difference between the CGS and the other two common systems before the SI, some quantities are listed in Table 3.

All mechanical units of the CGS system (see Table 4) were unambiguously derived from the three fundamental units: centimetre, gram and second.

All electric and magnetic units were also derived directly from the centimetre, gram, and second, but based on physical laws that relate electromagnetic phenomena to mechanics. When it comes to the electromagnetic field, there are two laws relating the magnetic field to mechanical quantities and electric charges:

Lorentz force:

$\mathbf{F} = \alpha_L q\ v\, \mathbf{B}$, in which $\mathbf{F}$= the Lorentz force, $\mathbf{B}$= magnetic field, q= charge, and v=velocity.

Biot-Savart law:

$d\mathbf{B} = \alpha_B \frac{I\ d\boldsymbol{l}\ \widehat{r}}{r^2}$, in which $\mathbf{B}$= a static magnetic field, I=an electric current, $d\boldsymbol{l}$ = a finite length, r= the length, and $\widehat{\boldsymbol{r}}$ = the unit vector in the direction of vector $\boldsymbol{r}$.

There are also two independent laws that relate the electric charge to a mechanical quantity.

Coulomb's law:

$F = k_c \frac{q\,q'}{d^2}$, in which the electrostatic force F between electric charges q and q', separated by distance d. k_c is a constant which depends on how the unit of charge is derived from the CGS base unit.

Ampère's force law:

$\frac{d\boldsymbol{F}}{d\boldsymbol{L}} = 2k_A \frac{I\,I'}{d}$, in which the magnetic force F per unit length L between currents I and I', flowing in two straight parallel wires of infinite length, is separated by a distance d that is much greater than the wire diameters. The constant k_A depends on how the unit of charge is derived from the CGS base unit.

The fact that there are several ways to relate electromagnetic phenomena to mechanics gave rise to four different CGS systems, namely:

1. CGSm system, CGS-emu system, e.m.u. system, CGSB system or c.g.s.Bi. system (electromagnetic CGS system),

[20] New Scientist, 22 September 2007.

[21] Wood, B. "Report on the Meeting of the CODATA Task Group on Fundamental Constants". *BIPM*, 3–4 November 2014, p. 7.

[22] New Scientist, 22 September 2007.

Table 3 Some mechanical units in the absolute systems CGS, MKS, and MTS

Quantity	CGS	MKS	MTS
Length	centimetre (cm)	metre (m)	metre (m)
Mass	gram (g)	kilogram (kg)	tonne (t)
Time	second (s)	second (s)	second (s)
Velocity	centimetre per second (m/s)	metre per second (m/s)	metre per second (m/s)
Acceleration	gal (Gal)	metre per square second (m/s^2)	metre per square second (m/s^2)
Force	dyne (dyn)	newton (N)	sthene (sn)
Pressure	barye (Ba)	pascal (Pa)	pieze (pz)
Energy	erg (erg)	joule (J)	kilojoule (kJ)
Thermal energy	calorie (cal)[a]	joule (J)	kilojoule (kJ)
Power	erg per second (erg/sek)	watt (W)	kilowatt (kW)
Dynamic viscosity	poise (P)	pascal · second (Pa · s)	pieze · second (pz · s)

[a]Defined as the energy required to raise the temperature of one gram of water from 15.5 °C to 16.5 °C

Table 4 Mechanical units of the CGS system

Quantity	CGS unit	Definition	SI unit
Length (L)	centimetre (cm)	1/100 metre	10^{-2} m
Mass (m)	gram (g)	1/1000 kilogram	10^{-3} kg
Time (t)	second (s)	1 second	1 s
Velocity (v)	centimetre per second (cm/s)	1 cm/s	10^{-2} m/s
Acceleration (a)	gal (Gal)	1 cm/s^2	10^{-2} m/s^2
Force (F)	dyne (dyn)	1 g cm/s^2	10^{-5} N
Energy (E)	erg (erg)	1 g cm^2/s^2	10^{-7} J
Power (P)	erg per second (erg/s)	1 g cm^2/s^3	10^{-7} W
Pressure (p)	barye (Ba)	1 g/($cm{\cdot}s^2$)	10^{-1} Pa
Dynamic viscosity (μ)	poise (P)	1 g/(cm · s)	10^{-1} Pa · s
Kinematic viscosity (v)	stokes (St)	1 cm^2/s	10^{-4} m^2/s
Dynamic fluidity	rhe (–)[a]	1 cP^{-1}	10^3 Pa^{-1} s^{-1}
Kinematic fluidity	rhe (–)	1 cSt^{-1}	10^6 s/m^2
Wavenumber (k)	balmer, kayser or rydberg (cm^{-1})	1 cm^{-1}	100 m^{-1}
Acoustic impedance	acoustic ohm or acoustical ohm (ac ohm)	1 dyn · s/cm^5	10^5 Pa · s/m^3

[a]Rhe has been used as a unit for dynamic fluidity (as the reciprocal centipoise) as well as a unit for kinematic fluidity (as the reciprocal centistokes)

Definition: *An acoustic impedance (including acoustic resistance and reactance) has a magnitude of 1 cgs acoustic ohm when a sound pressure of 1 barye produces a volume velocity of 1* cm^3/s

2. CGSe system, CGS-esu system, e.s.u. system, CGSF system, or c.g.s.Fr. system (electrostatic CGS system),
3. CGS-Gaussian system or Gaussian unit system, and
4. Lorentz-Heaviside system of units, Heaviside-Lorentz system of units or CGS-HLU system.[23]

In Table 5 below, the basic constants used in the four laws described above are specified for the four different CGS systems, as well as for the SI.

A simple overview and comparison of some of the units of measure in the absolute systems CGS, MKS, and MTS can be found in Table 3. In Table 4, the mechanical units of the CGS system are defined in SI units.

[23] This system, often used in relativistic calculations, is named for Hendrik Anton Lorentz (1853–1928), a Dutch physicist, and Oliver Heaviside (1850–1925), an English electrical engineer and physicist. Lorentz-Heaviside units differ by factors of $\sqrt{4\pi}$ in the definition of the electric charge, as well as in the definition of the electric and magnetic fields.

Table 5 Basic constants

System of units	k_C	α_B	ε_0	μ_0	k_A	α_L	λ	λ'
CGSe	1	c^{-2}	1	c^{-2}	c^{-2}	1	4π	4π
CGSm	c^2	1	c^2	1	1	1	4π	4π
CGS-Gaussian	1	c^{-1}	1	1	c^{-2}	c^{-1}	4π	4π
CGS-HLU	$1/4\pi$	$1/4\pi c$	1	1	$1/4\pi c^2$	c^{-1}	1	1
SI	c^2/b	$1/b$	$b/4\pi c^2$	$4\pi/b$	$1/b$	1	1	1

Below, the electromagnetic units of the CGSm and the CGSe systems are listed in Tables 6 and 7. Conversions are also listed for the quantities in CGS base units and SI units.

Both the CGSm and the CGSe systems also had specific units with unique names. Those are listed below in Tables 8 and 9, along with conversions into SI units.

Finally, some additional units were also proposed to be used along with the CGS system by various researchers and committees. These units are listed in Tables 10, 11 and 12 below.

7 SI: The Ultimate System

The Conference on the Metre in 1879 led to the formation of permanent international bodies (the CGPM, BIPM, and CIPM) with a commitment to the metre and kilogram, and a mandate to standardize and improve the world's weights and measures. In the early years, the organizations' attention was focused mainly on units, rather than systems of units. In the late nineteenth and early twentieth centuries, most scientists used centimetre-gram-second systems, which proliferated because there were various ways of handling electromagnetic quantities. Alongside these systems were others, also ostensibly "metric," which defined other electric and magnetic units for practical use. A subject which involved both electric and magnetic quantities required treatment in two and possibly three different systems of units. Furthermore, as new sciences developed, they tended to extemporize new units, for example, the study of radioactivity led to nuclear physics, and thus to curies, rads, rems, barns, and other units, all "metric."

In 1901, the Italian physicist Giovanni Giorgi (1871–1950) proposed a metre-kilogram-second-electrical unit system, and presented it to the International Electrotechnical Commission (IEC) in 1904. Giorgi originally suggested that the electric unit be a unit of resistance, but that was later replaced by a unit of current, the ampere. The great advantage of Giorgi's proposal was that it used familiar units of mass, length, and time and, with rationalized units (and the right choice of a value for the permeability of free space), it preserved the sizes of the practical electric units, even though they were defined in absolute rather than material terms. It was an absolute practical system.

In 1935, the IEC passed a resolution adopting the Giorgi system (but without deciding whether or not the units should be rationalized) and recommending it be named after him. But it was too late; almost everywhere, it was already being referred to as the MKSA system. Also in 1935, the Commission on Symbols, Units and Nomenclature of the International Union of Pure and Applied Physics (IUPAP) recommended basing a system on the metre and kilogram, and proposed the name newton for the unit of force based on the kilogram, second and metre. The IEC confirmed their 1935 decision in 1938 (still without deciding the rationalization issue), and the IUPAP repeated their recommendation in 1948.

The 9th CGPM (in 1948), prodded by the French government and noting that the IUPAP had asked the CIPM "to adopt for international use a practical international system of units" and had recommended "the MKS system and one electric unit of the absolute practical system," formally requested the CIPM "to make recommendations on the establishment of a

Table 6 Electromagnetic units of the CGSm system

Quantity	CGSm unit	In CGS base units	In SI units
Magnetic vector potential (A)	abweber/cm	$(g \cdot cm)^{1/2}/s$	10^{-6} Wb/m
Magnetic flux density (B)	gauss	$g^{1/2}/(s \cdot cm^{1/2})$	10^{-4} T
Capacitance (C)	abfarad	s^2/cm	10^9 F
Electric displacement (D)	abcoul/cm^2	$g^{1/2}/cm^{3/2}$	10^5 C/m^2
Electric field (E)	abvolt/cm	$(g \cdot cm)^{1/2}/s^2$	10^{-6} V/m
Vacuum permittivity (ε_0)	abfarad/cm	s^2/cm^2	10^{11} F/m
Magneto motive force (F)	gilbert	$(g \cdot cm)^{1/2}/s$	$10/(4\pi)$ A
Magnetic flux (Φ_B)	maxwell	$(g^{1/2} \cdot cm^{3/2})/s$	10^{-8} Wb
Conductance (G)	abohm^{-1}	s/cm	10^9 Ω
Magnetic field (H)	abamp/cm	$g^{1/2}/(s \cdot cm^{1/2})$	10^3 A/m
Current (I)	abamp	$(g \cdot cm)^{1/2}/s$	10 A
Volume current density (J)	abcoul/(cm^2 · s)	$g^{1/2}/(cm^{3/2} \cdot s)$	10^5 C/(m^2 · s)
Surface current density (J_S)	abcoul/(cm · s)	$g^{1/2}/(cm^{1/2} \cdot s)$	10^3 C/(m · s)
Inductance (L)	abhenry	cm	10^{-9} H
Permanent-magnet dipole moment (m_H)	abweber · cm	$(g^{1/2} \cdot cm^{5/2})/s$	10^{-10} Wb · m
Current-loop magnetic dipole moment (m_I)	abamp · cm^2	$(g^{1/2} \cdot cm^{5/2})/s$	10^{-3} A · m^2
Permanent-loop magnetic dipole moment (M_H)	abweber/cm^2	$g^{1/2}/(s \cdot cm^{1/2})$	10^{-4} T
Current-loop magnetic dipole moment (M_I)	abamp/cm	$g^{1/2}/(s \cdot cm^{1/2})$	10^3A/m
Magnetic permeability (μ)	abhenry/cm	1	10^{-7}H/m
Magnetic permeability in vacuum (μ_0)	abhenry/cm	1	10^{-7} H/m.
Magnetic pole strength (p_H)	maxwell	$(g^{1/2} \cdot cm^{3/2})/s$	10^{-8} Wb
Electric dipole moment (p)	abcoul · cm	$g^{1/2} \cdot cm^{3/2}$	10^{-1} C · m
Electric dipole density (P)	abcoul/cm^2	$g^{1/2}/cm^{3/2}$	10^5 C/m^2
Permeance (P)	abweber/abamp	cm	10^{-9} Wb/A
Charge (Q)	abcoul	$g^{1/2} \cdot cm^{1/2}$	10 C
Resistance (R)	abohm	cm/s	10^{-9} Ω
Reluctance (R)	gilbert/maxwell	cm^{-1}	$10^9/(4\pi)$A/Wb
Volume charge density (ρ_Q)	abcoul/cm^3	$g^{1/2}/cm^{5/2}$	10^7 C/m^3
Resistivity (ρ_R)	abohm · cm	cm^2/s	10^{-7} Ω · m
Elastance (S)	abfarad^{-1}	cm/s^2	10^{-9} F
Surface charge density (S_Q)	abcoul/cm^2	$g^{1/2}/cm^{3/2}$	$10^5/(4\pi)$ C/m^2
Conductivity (σ)	abohm^{-1} · cm^{-1}	s/cm^2	10^{11} Ω^{-1} · m^{-1}
Electric potential (V)	abvolt	$(g^{1/2} \cdot cm^{3/2})/s^2$	10^{-8} V
Magnetic scalar potential (Ω_H)	oerstedt · cm	$(g^{1/2} \cdot cm^{1/2})/s$	$10/(4\pi)$ A

practical system of units of measurement suitable for adoption by all signatories" (Resolution 6).

In July 1950, the IEC's Technical Committee No. 24 on Electrical and Magnetic Magnitudes and Units chose the ampere to be the fourth electric unit and finally recommended rationalized units.

The 10th CGPM (in 1954) adopted as base units the metre, kilogram, second, ampere, degree Kelvin, and candela, thus adopting the Giorgi system.

The 14th CGPM (in 1971) added the remaining base unit, the mole (Resolution 3).

The 11th CGPM (in 1960) named the new system the "International System of Units"; adopted the "international abbreviation" SI and the prefixes from tera- through pico-; and added two supplementary units and 27 derived units, 13 of which had special names. Since then, one base unit, 11 derived units (including five with special names) and eight prefixes have been added; the second, metre and candela have been

Table 7 Electromagnetic units of the CGSe system

Quantity	CGSm unit	In CGS base units	In SI units
Magnetic vector potential (A)	statweber/cm	$g^{1/2}/cm^{1/2}$	10^{-6} Wb/m
Magnetic flux density (B)	statweber/cm^2	$g^{1/2}/cm^{3/2}$	10^{-4} T
Capacitance (C)	statfarad	cm	10^9 F
Electric displacement (D)	statcoul/cm^2	$g^{1/2}/(cm^{1/2} \cdot s)$	about $3.33564 \cdot 10^{-6}$ C/m^2
Electric field strength (E)	statvolt/cm	$g^{1/2}/(cm^{1/2} \cdot s)$	about $2.99792 \cdot 10^4$ V/m
Vacuum permittivity (ε_0)	statfarad/cm	1	$1/(c_0^2 \cdot \mu_0)$ = about $8.854188 \cdot 10^{12}$ F/m
Magneto motive force (F)	statamp	$(g^{1/2} \cdot cm^{3/2})/s^2$	$10/(4\pi)$ A
Magnetic flux (Φ_B)	statweber	$g^{1/2} \cdot cm^{1/2}$	10^{-8} Wb
Conductance (G)	statohm^{-1}	cm/s	about $1.11265 \cdot 10^{-12}$ Ω^{-1}
Magnetic field (H)	statamp/cm	$(g^{1/2} \cdot cm^{1/2})/s^2$	about $3.33564 \cdot 10^{-8}$ A/m
Current (I)	statamp	$(g^{1/2} \cdot cm^{3/2})/s^2$	about $3.33564 \cdot 10^{-10}$ A
Volume current density (J)	statamp/cm^2	$g^{1/2}/(cm^{1/2} \cdot s^2)$	about $3.33564 \cdot 10^{-6}$ A/m^2
Surface current density (J_S)	statamp/cm	$(g^{1/2} \cdot cm^{1/2})/s^2$	about $3.33564 \cdot 10^{-8}$ A/m
Inductance (L)	stathenry	s^2/cm	about $8.98755 \cdot 10^{11}$ H
Permanent-magnet dipole moment (m_H)	statweber · cm	$g^{1/2} \cdot cm^{3/2}$	10^{-10} Wb · m
Current-loop magnetic dipole moment (m_I)	statamp · cm^2	$(g^{1/2} \cdot cm^{7/2})/s^2$	about $3.33564 \cdot 10^{-10}$ A · m^2
Permanent-loop magnetic dipole moment (M_H)	statweber/cm^2	$g^{1/2}/cm^{3/2}$	10^{-6} Wb/m^2
Current-loop magnetic dipole moment (M_I)	statamp/cm	$(g^{1/2} \cdot cm^{1/2})/s^2$	about $3.33564 \cdot 10^{-8}$ A/m
Magnetic permeability (μ)	stathenry/cm	s^2/cm^2	about $8.98755 \cdot 10^{13}$ H/m
Magnetic permeability in vacuum (μ_0)	stathenry/cm	cm^2/s^2	$4\pi \cdot 10^7$H/m = about $1.25663706144 \cdot 10^{-6}$ H/m
Magnetic pole strength (p_H)	statweber	$g^{1/2} \cdot cm^{1/2}$	10^{-8} Wb
Electric dipole moment (p)	statcoul · cm	$(g^{1/2} \cdot cm^{5/2})/s$	about $3.33564 \cdot 10^{-12}$ C · m
Electric dipole density (P)	statcoul/cm^2	$g^{1/2}/(cm^{1/2} \cdot s)$	about $3.33564 \cdot 10^{-6}$ C/m^2
Permeance (P)	statweber/statamp	s^2/cm	about $8.98755 \cdot 10^{11}$ H
Charge (Q)	statcoul	$(g^{1/2} \cdot cm^{3/2})/s$	about $3.335\,64 \cdot 10^{-10}$ C
Resistance (R)	statohm	cm/s	about $8.98755 \cdot 10^{11}$ Ω
Reluctance (R)	statamp/statweber	cm/s^2	about $8.98755 \cdot 10^{-11}$ H
Volume charge density (ρ_Q)	statcoul/cm^3	$g^{1/2}/(cm^{3/2} \cdot s)$	about $3.33564 \cdot 10^{-4}$ C/m^3
Resistivity (ρ_R)	statohm · cm	s	about $8.98755 \cdot 10^9$ $\Omega \cdot$ m
Elastance (S)	statfarad^{-1}	cm^{-1}	about $1.11265 \cdot 10^{12}$ F
Surface charge density (S_Q)	statcoul/cm^2	$g^{1/2}/(cm^{1/2} \cdot s)$	about $3.33564 \cdot 10^{-6}$ C/m^2
Conductivity (σ)	statohm^{-1}·cm^{-1}	s^{-1}	about $1.11265 \cdot 10^{-9}$ $\Omega^{-1} \cdot m^{-1}$ (= S/m)
Electric potential (V)	statvolt	$(g^{1/2} \cdot cm^{1/2})/s$	about $2.99792 \cdot 10^2$ V
Magnetic scalar potential (Ω_H)	statamp	$(g^{1/2} \cdot cm^{3/2})/s^2$	about $3.33564 \cdot 10^{-10}$ A

Table 8 CGSm units

CGSm unit	Quantity	Conversion
abampere (αA, abA, or abamp) [absolute ampere]	Electric current intensity	10 A = 0.000103632 Faradays (chemical)/s = 0.000103604 Faradays (physical)/s = $2.997930 \cdot 10^{10}$ statamperes
Definition: *The constant current that produces, when maintained in two parallel conductors of negligible circular section and of infinite length placed 1 centimetre apart in a vacuum, a force of 2 dynes per centimetre between the two conductors*		
abampere centimetre squared ($\alpha A \cdot cm^2$ or $abA \cdot cm^2$)	Electromagnetic moment	10^{-3} $A \cdot m^2$
abampere per centimetre (αA/cm or abA/cm)	Surface charge density	10^3 A/m = 25.4 ampere-turns/in about $5.0670748 \cdot 10^{-5}$ A/circ. mil about $2.997930 \cdot 10^{10}$ statamp/cm
abampere per square centimetre ($\alpha A/cm^2$ or abA/cm^2)	Current density	10^5 A/m^2 64.516 A/in^2 $2.997930 \cdot 10^{10}$ $statamp/cm^2$
abampere-turns (αAt or abAt)	Surface charge density	12.566371 Gilberts 10 ampere-turns
abampere-turns per centimetre (αAt/cm or abAt/cm)	Magnetic field strength	12.566371 Gilberts/cm 10 At/cm 25.4 At/in
abcoulomb (αC, abC, or abcoul) [absolute coulomb]	Electric charge	10 C 0.0027777 ampere-hours
abcoulomb centimetre ($\alpha C \cdot cm$ or $abC \cdot cm$)	Electric dipole moment	10^{-1} $C \cdot m$
abcoulomb per cubic centimetre ($\alpha C/cm^3$ or abC/cm^3)	Volume density of charge	10^7 C/m^3
abcoulomb per square centimetre ($\alpha C/cm^2$ or abC/cm^2)	Electric polarization and electric flux density	10^5 C/m^2 $10^5/(4\pi)$ C/m^2
abdaraf (αD or abD) [absolute daraf]	Electric elastance	1 abV/abC = 1 abF^{-1} = 10^{-9} darafs
abfarad (αF or abF) [absolute farad]	Electric capacitance	10^9 farads $9 \cdot 10^{20}$ statfarad
Definition: *The capacitance of a condenser such that a charge of 1 abcoulomb produces a potential difference between the terminals of 1 abvolt.*		
abhenry (αH or abH)[a] [absolute henry]	Electric inductance	10^{-9} H
Definition: *A circuit has an inductance of 1 abhenry if a current changing at the rate of 1 abampere per second induces an electromotive force (EMF) of 1 abvolt in it.*		
abmho ($\alpha\Omega^{-1}$, ab Ω^{-1}, αS, abS, α℧, or ab℧) [absolute mho]	Electric conductance	1 absiemens 10^9 mhos 10^9 siemens
abmho per centimetre ($\alpha\Omega^{-1}$/cm or $ab\Omega^{-1}$/cm)	Conductivity	10^9 mhos/cm
abohm (αΩ or abΩ) [absolute ohm]	Electric resistance	10^{-9} ohm
abohm centimetre ($\alpha\Omega \cdot cm$ or $ab\Omega \cdot cm$)	Electric resistivity	10^{-11} $\Omega \cdot m$
absiemens (αS or abS) [absolute siemens]	Electric conductance	10^9 siemens =1 abmho
absiemens per centimetre (αS/cm or abS/cm)	Electric conductivity	10^{11} S/m
abtesla (αT or abT) [absolute tesla]	Magnetic flux density	1 Mx/cm^2 10^{-4} tesla 1 gauss
abvolt (αV or abV) [absolute volt]	Electric potential, electric potential difference, and electromotive force	10^{-8} V
Definition: *The difference in electric potential between two points in a conductor carrying a constant current of 1 abampere when the power dissipated between them is =1 erg/s.*		

(continued)

Table 8 (continued)

CGSm unit	Quantity	Conversion
abvolt per centimetre (αV/cm or abV/cm)	Electric field strength	10^{-6} V/m
abwatt (αW or abW) [absolute watt]	Power	10^{-7} W
abweber (αWb or abWb) [absolute weber]	Magnetic induction flux	10^{-8} weber 1 maxwell
gilbert (Gb or Gi)	Magnetic potential difference and magneto motive force	No equivalent unit in SI
Definition: *The magnetomotive force around a closed path enclosing a surface through which flows a current of 1/(4π) abamperes = 10/(4π) ampere-turns =0.7957747 ampere-turns.*		
The unit is named for the English physicist William Gilbert (1540–1603).		
gilbert per centimetre (Gb/cm)	Magnetic field strength	1 oersted
gilbert per maxwell (Gb/Mx)	Reluctance	$7.95775 \cdot 10^{7}$ H^{-1}
maxwell (Mx or M) (This unit was formerly called a **line** or **abweber**)	Magnetic flux	about 10^{-8} Wb (Mx and Wb are not strictly comparable)
Definition: *The magnetic flux which, linking a circuit of 1 turn, produces in it an electromotive force of 1 abvolt as it is reduced to zero in 1 second.*		
It was adopted by the 5th International Electrical Congress held in Paris in 1900,[e] and was confirmed again when the Advisory Committee on Nomenclature of the International Electrotechnical Commission adopted the name maxwell for the unit of magnetic flux at its meeting in Stockholm in 1930. The corresponding practical unit is the pramaxwell $=10^{8}$ maxwell.		
The unit is named for the British physicist James Clerk Maxwell (1831–1879), who presented the unified theory of electromagnetism in 1864.		
oersted (Oe)	Magnetic field strength	about $10^{3}/(4\pi)$ A/m about 79.577472 A/m
First defined as: *The magnetic field intensity in a vacuum at a distance of 1 centimetre from a straight conductor of infinite length and negligible circular cross section which carries a current of 0.5 abamperes.*		
Later definition: *A magnetic field of one oersted generating a magnetomotive force of 1 Gb/cm of conductor.*		
In 1927,[b] the IEC set up a subcommittee to unravel the conflicting uses of the term gauss. The subcommittee decided that flux density (B) and magnetizing force (H) should have different units. Flux density would be measured in gauss, and a new unit of magnetic field strength, to be called the oersted, would be added to the cgs system. The committee's recommendation was adopted by the IEC plenary convention at Oslo in 1930,[c] and was subsequently endorsed by the IUPAP.[d]		
The unit is named for the Danish physicist Hans Christian Ørsted (1777–1851), who discovered electromagnetism in 1820.		

Based on [DRAZ], [FOGI, p. 786], [GREE, p.25] and [LANG2, p. 1333]

[a]Use of the abhenry unit was being discouraged by the 1940s

[b]I.E.C. report on meetings held at Bellagio, Italy, Advisory Committee No. 1, 1927

[c]Resume of plenary meeting of IEC in Scandinavia, 1930. Magnetic Units, document R.M. 77

[d]International Electrotechnical Commission. *Recommendations in the field of quantities and units used in electricity*. 1st ed. Geneva, 1964. p. 27. *Series*: IEC Publication 164

[e][NATUR7]

redefined; the litre and micron have been discarded; and the "degree Kelvin" has been changed to "kelvin."

The 21st CGPM (in 1999) adopted the "katal".[24]

[24] Bureau International des Poids et Mesures. *The International System of Units (SI)*. 7th ed. Organisation Intergouvernementale de la Convention du Mètre, 1998.

To summarize, the *International System of Units* (SI) is the modern form of the metric system. It defines seven base units, 22 named and an indeterminate number of unnamed coherent derived units. The SI is an evolving system, the unit definitions being modified through international agreement as the technology of measurement progresses and the precision of measurements improves.

Below I have listed the base units as well as supplementary units and derived units in the SI.

Table 9 CGSe units

CGSe unit	Quantity	Conversion
statampere (βA, sA, or statA) or **esampere**	Electric current intensity	$3.335635 \cdot 10^{-10}$ A
statampere centimetre squared ($sA \cdot cm^2$)	Electromagnetic moment	$3.335635 \cdot 10^{-14}$ $A \cdot m^2$
statampere per square centimetre (sA/cm^2)	Current density	$3.335635 \cdot 10^{-6}$ A/m^2
statcoulomb (βC, sC, or statC) or **escoulomb**	Electric charge	$3.335635 \cdot 10^{-10}$ C
Definition: *A point charge which repels an equal point charge at a distance of 1 centimetre with a force of one dyne.*		
statcoulomb centimetre ($sC \cdot cm$)	Electric dipole moment	$3.335635 \cdot 10^{-12}$ $C \cdot m$
statcoulomb per cubic centimetre (sC/cm^3)	Volume density of charge	$3.335635 \cdot 10^{-4}$ C/m^3
statcoulomb per square centimetre (sC/cm^2)	Electric polarization	$3.335635 \cdot 10^{-6}$ C/m^2
	Electric flux density	$2.65442 \cdot 10^{-7}$ C/m^2
statdaraf (βD, sD, or statD)	Electric current	1 $statF^{-1}$
statfarad (βF, sF, or statF)	Capacitance	$1.112646 \cdot 10^{-12}$ F
Definition: *The capacitance of a capacitor such that a charge of 1 statcoulomb increases the potential difference between its plates by 1 statvolt.*		
stathenry (βH, sH, or statH)	Inductance	$8.987552 \cdot 10^{-11}$ H
Definition: *The self-inductance of a circuit or the mutual inductance between two circuits if there is an induced electromotive force of 1 statvolt when the current is changing at a rate of 1 statampere per second.*		
statmho (β℧, s℧, or stat℧)	Conductance, admittance, and susceptance	see *statsiemens*
statohm (βΩ, sΩ, or statΩ)	Resistance, reactance, and impedance	$8.987552 \cdot 10^{11}$ Ω
Definition: *The resistance between two points in a conductor when a constant potential difference of 1 statvolt applied between the points produces in the conductor a current of 1 statampere, the conductor not being the source of any electromotive force.*		
statohm centimetre ($s\Omega \cdot cm$)	Resistivity	$8.987552 \cdot 10^{9}$ $\Omega \cdot m$
statsiemens (βS, sS, or statS)	Conductance, admittance, and susceptance	$1.112646 \cdot 10^{-12}$ S
Definition: *The conductance between two points in a conductor when a constant potential difference of 1 statvolt applied between the points produces in the conductor a current of 1 statampere, the conductor not being the source of any electromotive force.*		
statsiemens per centimetre (sS/cm)	Conductivity	$1.112646 \cdot 10^{-10}$ S/m
Definition: *A magnetic flux density of 1 statweber per square centimetre.*		
stattesla (βT, sT, or statT) or **estesla**	Magnetic flux density	$2.997925 \cdot 10^{6}$ T
statvolt (βV, sV, or statV) or **esvolt**[a]	Electric potential	$2.997925 \cdot 10^{2}$ V
Definition: *The potential difference between two points such that the amount of work needed to transport 1 statcoulomb of electric charge from one point to the other is 1 erg.*		
statvolt per centimetre (sV/cm)	Electric field strength	$2.997925 \cdot 10^{4}$ V/m
statwatt (βW, sW, or statW)	Power	10^{-7} W
statweber (βWb, sWb, or statWb)	Magnetic flux	$2.997925 \cdot 10^{2}$ Wb
Definition: *The magnetic flux which, linking a circuit of one turn, produces in it an electromotive force of 1 statvolt as it is reduced to ero at a uniform rate in 1 second.*		

[a]The esvot is used in [BLAC2]

In Table 13 below, in descending order of the successive powers of the base and supplementary units, combinations of units for some common physical quantities is listed.

Base units in SI:
length: metre
mass: kilogram
time: second
electric current strength: ampere
thermodynamic temperature: kelvin
luminous intensity: candela
amount of substance: mole

Supplementary units in SI:
plane angel: radian
solid angle: steradian

Table 10 Some units associated with the CGS system, proposed in 1921 by the French engineer and physicist André-Eugène Blondel (1863–1938)[a]

CGS unit	Quantity	Conversion
lambert (L, la, or Lb) (the millilambert was more commonly used)	Illuminance	1/π cd/cm^2 about 3183.099 cd/m^2
The unit was replaced by the apostilb in 1949.[b] It was named for the Swiss photometrician and physicist Johann Heinrich Lambert (1728–1777)[c], who showed that the illumination of a surface is inversely proportional to the square of the distance from the light source.		
phot (ph)[d] (the milliphot was more commonly used)	Illumination	1 lm/cm^2 10^4 lx
stilb (sb)[e] (the millistilb was more commonly used)	Illuminance	1 cd/cm^2 10^4 nits There is no corresponding SI unit.

[a]International Labour Office. *Studies and reports*. Series F, Industrial hygiene. Geneva: International Labour Office, 1921
[b][WALS, p. 138]
[c][LÖWE]
[d]From the Greek word for "light." The name is usually pronounced so as to rhyme with "not" rather than "note"
[e]The name is a shortening of the Greek *stilbein* = "to glitter"

Table 11 Some units recommended for the CGS system in 1930 by the Sub-Committee 2 of the Advisory Committee on Nomenclature of the International Electrotechnical Commission, at a meeting in Oslo[a]

Proposed CGS units	Quantity	Conversion
pragilbert (practical gilbert)	Magneto motive force	1/4π A-turns
pramaxwell (practical maxwell)	Magnetic flux	10^3 Mx
praoersted (practical oersted)	Magnetic field-strength	1/4π A-turn/m.

[a]See International Electrotechnical Commission. *Recommendations in the field of quantities and units used in electricity*. 1st ed. Geneva, 1964, p. 27. *Series*: IEC Publication 164. Anyhow, this recommendation went no further, as a number of national delegations objected to the term

Table 12 Some other units related to the CGS system

Proposed CGS units	Quantity	Conversion
abmho per inch ($\alpha\Omega^{-1}$/in or abΩ^{-1}/in)	Conductivity	10^9 mhos/in
abohm inch (αΩ in or abΩ in)	Electric resistivity	0.00254 μΩ - cm
promaxwell (professional maxwell)	Magnetic flux	10^8 Mx

Derived units in SI:
degree Celsius = K for temperature
coulomb = A· s for electric charge and quantity of electricity
newton = m · kg/s^2 for force
pascal = N/m^2 for pressure and stress
joule = N · m for energy and quantity of heat
watt = (N · m)/s for power and radiant flux
volt = (N · m)/(A· s) for voltage, electromotive force and potential difference
farad = C/V for electric capacitance
ohm = V/A for electric resistance
siemens = A/V for electric conductance
weber = V · s for magnetic flux
tesla = (V · s)/m^2 for magnetic flux density
henry = (V · s)/A for electric inductance
gray = (N · m)/kg for absorbed radiation
sievert = (N · m)/kg for dose equivalent
lumen = cd · sr for luminous flux
lux = lm/m^2 for illuminance
hertz = (cycles)/s for frequency
becquerel = (distintegrations)/s for activity of a radionuclide.

Table 13 SI units and dimensions for some common quantities

Quantity	m	kg	s	A	K	cd	mol	rad	sr	SI unit
Volume	3									cubic metre (m^3)
Energy, work, quantity of heat	2	1	−2							joule (J)
Moment of force	2	1	−2							newton · metre (Nm)
Molar energy	2	1	−2				−1			joule per mole (J/mol)
Entropy, heat capacity	2	1	−2		−1					joule per kelvin (J/K)
Molar entropy, molar heat capacity	2	1	−2		−1		−1			joule per mole · kelvin (J/(mol·K)
Magnetic flux	2	1	−2	−1						weber (Wb)
Electromagnetic inductance	2	1	−2	−2						henry (H)
Apparent power	2	1	−3							volt · ampere (VA)
Power, radiant flux	2	1	−3							watt (W)
Radiant intensity	2	1	−3						−1	watt per steradian (W/sr)
Electromotive force, potential difference, voltage	2	1	−3	−1						volt (V)
Electric resistance	2	1	−3	−2						ohm (Ω)
Area	2									square metre (m^2)
Kinematic viscosity	2		−1							square metre per second (m^2/s)
Specific energy	2		−2							joule per kilogram
Radiation dose equivalent	2		−2							sievert (Sv)
Absorbed radiation dose	2		−2							gray (Gy)
Specific entropy, specific heat capacity	2		−2		−1					joule per kilogram · kelvin (J/(kg·K))
Absorbed radiation dose rate	2		−3							gray per second (Gy/s)
Force	1	1	−2							newton (N)
Magnetic permeability	1	1	−2	−2						henry per metre (H/m)
Thermal conductivity	1	1	−3		−1					watt per metre · kelvin (W/m·K)
Electric field strength	1	1	−3	−1						volt per metre (V/m)
Length	1									metre (m)
Velocity	1		−1							metre per second (m/s)
Acceleration	1		−2							metre per second-squared (m/s^2)
Mass		1								kilogram (kg)
Surface tension		1	−2							newton per metre (N/m)
Magnetic flux density		1	−2	−1						tesla (T)
Heat-flux density, irradiance		1	−3							watt per square metre (W/m^2)
Radiance		1	−3						−1	watt per square metre · steradian ($W/m^2 \cdot sr$)
Electric charge, quantity of electricity			1	1						coulomb (C)
Quantity of light			1			1			1	lumen · second (lm · s)
Time			1							second (s)
Magneto motive force				1						ampere · turn (A · turn)
Electric current strength				1						ampere (A)
Temperature					1					kelvin (K)

(continued)

Table 13 (continued)

Quantity	m	kg	s	A	K	cd	mol	rad	sr	SI unit
Luminous flux						1			1	lumen (lm)
Luminous intensity						1				candela (cd)
Amount of substance							1			mole (mol)
Plane angle								1		radian (rad)
Solid angle									1	steradian (sr)
Catalytic activity			−1				1			katal (kat)
Angular speed			−1					1		radian per second (rad/s)
Frequency			−1							hertz (Hz)
Activity of a radionuclide			−1							becquerel (Bq)
Angular acceleration			−2					1		radian per second-squared (rad/s^2)
Exposure to gamma rays		−1	1	1						coulomb per kilogram (C/kg)
Dynamic viscosity	−1	1	−1							newton second per square metre (Ns/m^2)
Energy density	−1	1	−2							joule per cubic metre (J/m^3)
Pressure, stress	−1	1	−2							pascal (Pa)
Magnetic field strength	−1			1						ampere per metre (A/m)
Wave number	−1									wave per metre (wave/m)
Electric flux density	−2		1	1						coulomb per square metre (C/m^2)
Illuminance	−2					1			1	lux (lx)
Electric capacitance	−2	−1	4	2						farad (F)
Electric conductance	−2	−1	3	2						siemens (S)
Luminous efficacy	−2	−1	2			1			1	lumen per watt (lm/W)
Mass density	−3	1								kilogram per cubic metre (kg/m^3)
Electric charge density	−3		1	1						coulomb per cubic metre (C/m^3)
Catalytic concentration	−3		−1				1			katal per cubic metre (kat/m^3)
Dielectric permittivity	−3	−1	4	2						farad per metre (F/m)

A–Z of Scientific and Informal Measures

This chapter covers abbreviations, measurement instruments, some often seen informal units and various new, suggested, and obsolete scientific units of measurement, as well as definitions of many dimensionless numbers, names for prefixes and names for large numbers. Only some types of measurement scale, used to categorize and/or quantify variables, are included.

1 A

A A hexadecimal notation for 10, as the first digit after 9.

A An abbreviation for ampere, ampere-turn, are and the SI prefix atta.

A* An abbreviation for angstrom star.

A_{abs} An abbreviation for absolute ampere.

A_{int} An abbreviation for international ampere.

Å An abbreviation for angstrom or ångström.

Å* An abbreviation for ångström star.

a [<L: *annum* = "year"] An international symbol, suggested by NIST[1] and ISO 31-1[2], for year. The symbol is often seen in combinations such as Ma (million years), and Ea (10^{18} years).

a An abbreviation for the prefix ab, denoting a CGSm unit, and for the prefix atto.

a_0 An abbreviation for bohr radius.

[1] [NIST].

[2] [ISO311].

aA An abbreviation for abampere and attoampere.

aA/cm An abbreviation for abampere per centimetre.

aAcm² An abbreviation for abampere square metre.

aA/cm² An abbreviation for abampere per square metre.

aAt An abbreviation for abampere-turn.

aAt/cm An abbreviation for abampere-turn per centimetre.

ab- or **abs-** **(a)** A prefix indicating that an electrical unit was part of the CGS absolute electromagnetic system (CGSm). These units were also indicated by the notation emu (as in "volt emu").

abA An abbreviation for abampere.

abamp An abbreviation for abampere.

abbe A unit suggested in 1973 by W. Thomas Cathey[3] and Peter William Hawkes,[4] as the SI unit of linear spatial frequency, =1 Hz/mm. The unit is named after the German physicist, instrument maker and astronomer Ernst Abbe (1840–1905),[5] whose theoretical and technical innovations in optical theory led to great improvements in microscope design.

Abbe refractometer or **laboratory refractometer** An optical instrument used to measure

[3] [CATH].

[4] [HAWK2].

[5] [ROHR].

J. Gyllenbok, *Encyclopaedia of Historical Metrology, Weights, and Measures*, Science Networks. Historical Studies 56, https://doi.org/10.1007/978-3-319-57598-8_3

the index of refraction of an unknown sample of optical glass. Designed by Ernst Abbe (1840–1905)[6] in the early 1900s, this instrument will typically yield index accuracy of two units in the fourth decimal place.[7]

abC An abbreviation for abcoulomb.

abD An abbreviation for abdaraf.

aberration A broad term covering several types of image defects in a lens or lens system.

abF An abbreviation for abfarad.

abH An abbreviation for abhenry.

abridged spectrophotometer An instrument used to measure transmission or reflection as a function of wavelength, using narrow bandpass filters rather than the more conventional dispersive element.

abS An abbreviation for absiemens.

abs- See *ab-*.

absolute ampere (A_{abs}) See *ampere*.

absolute bolometric magnitude The name of the bolometric magnitude a star would have if it were at a distance of 10 parsecs.

absolute centesimal thermodynamic scale See *kelvin*.

absolute joule See *joule*.

absolute practical system of units A system defined by the First International Congress of Electricians in Paris, 1881, that included the volt, ohm, ampere, coulomb and farad. The joule, watt and quadrant were added at the Second International Congress of Electricians in Paris, 1889. These units and this system of units have been obsolete since 1947. The word "absolute" may have been first used in this sense by the German mathematician Carl Friedrich Gauss (1777–1855) at the Goettingen Gesellschaft der Wissenschaften on December 15, 1832.[8]

absolute pressure The name of the actual pressure on a confined gas, irrespective of the atmosphere on the outside. Absolute pressure = gage pressure + atmospheric pressure.

absolute system A system of units in which a small number of units is chosen as fundamental and all other units are derived from those.

absolute temperature A temperature measured from absolute zero, as in the Kelvin and Rankine scales. See *kelvin* and *degree Rankine*.

absolute zero An alternative name for the thermodynamic null = the temperature at which the volume of an ideal gas would become zero. The value calculated from the limited value of the coefficient of expansion of various real gases is −273.15°C.

absolute zero The name of the temperature at which all thermal (molecular) motion ceases; zero point in absolute temperature scale = −273.15° in Celsius, −459.67° in Fahrenheit, 0 in Kelvin and 0° in Rankine.

absorbance unit (AU) A logarithmic unit used to measure optical density, the absorbance of light transmitted through a partially absorbing substance. If T is the percentage of light transmitted, then the absorbance is defined to be $-\log^{10} T$ absorbance units.

absorptiometer An instrument equipped with a filter system or other simple dispersing system to measure the absorption of nearly monochromatic radiation in the visible range by a gas or a liquid, and so determine the concentration of the absorbing constituents in the gas or liquid.

absorptiometer An instrument for measuring the solubility of gases in liquid.

absorption The name of the loss of energy in traveling through a medium; i.e., a red filter absorbs all wavelengths except red, just as yellow paint will absorb all colors except yellow, which is reflected.

absorption The name of the internal taking up of one material by another.

absorption A transformation of radiant energy into other forms of energy when passing through a material substance.

absorption meter A measuring device that uses a light-sensitive cell or detector to determine the amount of light transmitted by a substance.

abstat. . . See *ab-*.

abT An abbreviation for abtesla.

abV An abbreviation for abvolt.

[6] For more information see: [GERT].

[7] See also [BROW4] and [PAVI].

[8] Sizes.com

abv An abbreviation for alcohol by volume. 1% abv = 1% v/v.

abw An abbreviation for alcohol by weight. 1% abw = 1% w/v.

abΩ An abbreviation for abohm.

ac or **Ac** An abbreviation for acre.

ac An informal abbreviation for acoustic ohm.

aC An abbreviation for abcoulomb.

aC An abbreviation in SI for attocoulomb.

AC An abbreviation for Alternating Current.

acceleration The rate of change in velocity per unit time. Positive acceleration means an increase in velocity, while negative acceleration means a decrease in velocity per unit time.

acceleration The time rate of change of velocity in either magnitude or direction.

acceleration of free fall or **acceleration of gravity (g)** See *standard gravity*.

accelerometer A mechanical or electromechanical instrument that measures acceleration. The two general types of accelerometer measure either the components of translational acceleration or angular acceleration.

aCcm An abbreviation for abcoulomb centimetre.

aC/cm² An abbreviation for abcoulomb per square centimetre.

aC/cm³ An abbreviation for abcoulomb per cubic centimetre.

accommodation The changes in focus of the crystalline lens to adjust the eye for various object distances.

accredited laboratory A laboratory with third party approval of the laboratory's technical competence, the quality assurance system it uses, and its impartiality.

accuracy (of measurement) The closeness of a test result to an accepted reference value.

accuracy (of a measuring instrument) The ability of a measuring instrument to give responses close to a true value.

acd An abbreviation in SI for attocandela.

Achtel-cicero In Germany, a premetric unit of type size, = 1/8 Cicero = 1½ German punkt = about 0.564 mm.[9]

Achtel-petit or **German punkt** In Germany, during the nineteenth–twentieth centuries, a unit of type size, = 1/8 Petit = 1/2 660 m = about 0.376 mm.

ac ft An abbreviation for acre foot.

ac ft/d An abbreviation for acre foot per day.

ac ft/h An abbreviation for acre foot per hour.

ac in An abbreviation for acre inch.

acid number, **acidity**, **acid value**, **neutralization number**, or **Total Acid Number (TAN)** The amount of potassium hydroxide (KOH) in milligrams that is needed to neutralize all the acid constituents present in 1 g of fat, oil or wax.

A x circular mil An abbreviation for ampere x circular mil.

ac/lb An abbreviation for acre per pound.

a–c meter A instrument used to perform in-situ measurements of the amount of chlorophyll in water. See also *fluorometer*.

ac ohm An abbreviation for acoustic ohm.

acoustic ohm or **acoustical ohm (ac ohm)** Name for any one of several units measuring acoustic impedance. These units got their name by analogy with electric impedance, which is measured in ohms. In the CGS system, the acoustic ohm equals a sound pressure of 1 barye that produces a volume velocity of 1 cm^3/s = 1 $\mu bar \cdot s/cm^3$ = 1 $dyne \cdot s/cm^5$ = 10^5 $Pa \cdot s/m^3$. In the MKS system, the acoustic ohm = the **SI** unit 1 $Pa \cdot s/m^3$. The CGS acoustic ohm equals 10^5 MKS acoustic ohms. The acoustic impedance was first used by the American physicist Professor George W. Stewart (1876–1956)[10] in 1926. See also *rayl*.

acre-foot (acre-ft, ac ft or **af)** In Britain and the U.S., a premetric unit of capacity used in irrigation engineering to measure the capacity of reservoirs. One acre foot = the area in acres multiplied by depth in feet = 326,851 gal = 43,560 ft^3 = about 1233.481 837 m^3. See also *U.S. Survey acre-foot*.

acre-foot per day (af/d) In the U.S., a unit of volume flow rate = 43,560 cu ft per day = about 0.014 276 4 m^3/s.

[9] See also [DEVI].

[10] [STEW].

acre-foot per hour (af/h) In the U.S., a unit of volume flow rate = 43,560 cu ft/h = 1233.48 m^3/h.[11]

acre·ft An abbreviation for acre-foot.

acre·ft/d An abbreviation for acre-foot per day.

acre·ft/h An abbreviation for acre-foot per hour.

acre-in An abbreviation for acre-inch.

acre-inch (ac in or **acre-in)** In the U.S., a premetric unit of volume, typically for use in irrigation, defined as the volume of water required to cover 1 acre of land 1 inch deep = 1/12 acre foot = 3630 ft^3 = about 102.790 755 375 m^3.

acre/lb An abbreviation for acre per pound.

acre per pound (ac/lb) In the U.S, a premetric unit of specific area = 100.892 179 ha/kg.

acre per pound (acre/lb or **ac/lb)** An obsolete unit of specific area = 0.892 179 ha/kg.

acre-yield The average quantity of oil, gas, or water recovered from one acre of a reservoir.

actinometer An instrument used to measure the heating power of radiation, usually terrestrial and solar radiation.

activation energy The energy necessary to start a particular reaction.

actual value or **true value** A theoretically possible value of a measured quantity, derived by taking the average of an infinite number of measurements assuming that the conditions contributing to deviations act in a completely free and random manner.

ac U. S. Surv. An abbreviation for U. S. Survey acre.

-ad A suffix added to a number to create a unit of quantity = that number: for example, a 24ad is a unit of quantity = 24. Units of quantity = 1 through 8 are known, respectively, as the monad, dyad, triad, tetrad, pentad, hexad, heptad, and octad, terms coined by adding -ad to the Greek numbers 1–8.

Addis number or **Addis-Hamburger number** A quantitative estimation of urinary cellular excretion. Method for counting the sediment in a 12-h (15 or 24 h) urine sample.[12] The estimation technique is named after the English–American nephrologist Thomas Addis (1881–1949) and the Dutch physiologist Hartog Jakob Hamburger (1859–1924).

adjustment (of a measuring instrument) The operation of bringing a measuring instrument into a state of performance suitable for its use.

adm mile An abbreviation for admiralty mile.

admiralty knot A unit of velocity, used at sea, = 6080 ft/h.

admiralty mile (adm mile) See *nautical mile*.

Adsorbable Organically bound Halogens (AOX) A unit defined as the equivalent amount of chlorine, bromine and iodine contained in organic compounds, expressed as a chloride when determined according to the European Standard.[13]

adsoption Term for the adhesion of one substance to the surface of another.

advantage A term used in colonial America to modify a quantity in the same way that someone in the late twentieth century might use "plus," as in, "He received thirty plus dollars for the part." A 1776 advertisement in Connecticut says: "a two year and advantage steer," that is, a steer two plus years old.[14]

AE A German abbreviation for *Astronomische Einheit* = astronomical unit, and a Swedish abbreviation for *astronomisk enhet (=astronomical unit)*.

aeolian frequency See *Strouhal number*.

aerometer An instrument for measuring the weight or density of gases.

af An abbreviation for acre-foot.

aF An abbreviation for abfarad.

af/d An abbreviation for acre-foot per day.

af/h An abbreviation for acre-foot per hour.

AFUE An abbreviation for annual fuel utilization efficiency.

[11] [CHIU] and [DRAZ].

[12] [HAMB].

[13] As mentioned in the October 1996 European Standards ISO/CEN prEN 1485.

[14] [LEDE, p. 18].

A.G. A German abbreviation for *Atomgewicht* = atomic weight.

AG amp or **Ag ampere** An abbreviation for Silver ampere. See *ampere*.

agate, **typography agate**, or **ruby** A traditional unit of length used in printing. The agate is usually considered = 1/14 in = about 1.814 285 7 mm, since the traditional type size called agate set 14 lines to the inch. In the more modern measuring system based on points, agate type has a height of 5½ points = 1.940 278 mm. In the U.S., also = 4 points = about 1.405 842 mm.

agate line A standard unit of area used to calculate the cost of advertising space in newspapers and magazines. An agate line measures 11/140 in depth (height) by one column in width. There are 14 agate lines to a column inch.

ah An abbreviation for ampere hour (A · h).

aH, **a–h** An abbreviation for abhenry.

Ah An abbreviation for ampere hour (A · h) and Ampère heure.

AIM An abbreviation for Association Internationale de Métrologie.

A/in² An abbreviation for ampere per square inch.

air mass A unit used in astronomy in measuring the absorption of light from the stars by the atmosphere. One air mass is the amount of absorption of light from a star at the *zenith*. The absorption of light from other stars is greater, because their light must pass obliquely through the atmosphere. If Z is the *zenithal angle*, the angle between the star and the zenith, then the absorption of its light is estimated to be sec Z air masses, with "sec" being the secant trigonometric function.

air watt An engineering unit used to express the effective cleaning power of a vacuum cleaner or central vacuum system. According to ASTM (the American Society for Testing and Materials), the vacuum power is computed: 8.5·F·S, in which F is the air flow in the system in cubic feet per minute (CFM) and S is the suction pressure in inches of water column (in WC) = 0.999 2 W.

Al An abbreviation for Alfvén number.

a.l. A French abbreviation for *année de lumière* = light year.

Alb See *albert*.

albert (Alb) A unit of photosynthetically active radiation, suggested in 1985[15] by Professor Roger A. Lewis, = 1 μE/(m² s). The unit is named after the physicist Albert Einstein (1879–1955).[16]

alcoholometer A special type of hydrometer, used for determining the alcoholic strength of liquids.

Alfvén number A dimensionless quantity characterizing steady fluid flow past an obstacle in a uniform magnetic field parallel to the direction of flow. It has a partial analogy to the Mach number. The Alfven number is given by $vl(\rho\mu)^{1/2} B^{-1/2}$ in which v is the velocity of flow, l is the length of obstacle, ρ is density, μ is permeability and B is magnetic flux density. The number is named after the Swedish astrophysicist and Nobel Prize winner Hannes Alfven (1908–1995).

Alfvén speed Term for the speed at which transverse waves (Alfvén waves), in a magnetohydro-dynamic field in which the driving force is the tension introduced by the magnetic field along the lines of force, are propagated along the magnetic field: $V_A = B/(4\pi\rho)^{1/2}$. For a perfectly conducting fluid with a mass density of 1 kg/m³ in a magnetic field of 10,000 gauss, the Alfvén speed is about 1000 m/s.

algebra Term for the continuation of arithmetic in which letters and symbols are used to represent definite quantities whose actual values may or may not be known.

algebraic number Name for a number defined as a root of a non-zero polynomial with rational coefficients.

algorithm Name for a list of instructions which are carried out in a fixed order to find the answer to a problem.

alidade An optical surveying instrument used in conjunction with a plane-table and stadia-rod to produce detailed large-scale topographic maps. It was constructed by the Canadian

[15] [NATUR5].

[16] [EINS].

Westinghouse Co. Ltd. and used between the 1940's and early 1950's.

alif or **aleph** The name of א; the first letter of the Hebrew alphabet, with numerical value 1.

alignment telescope A telescope specifically designed to be mounted and used in conjunction with an end target in order to form a fixed line of sight.

aliquant part, **aliquant**, or **aliquot** [<L: *aliquot* = "some"] **part** Aliquot is another name for an integer that is not an exact divisor of a given quantity. So, for example, the aliquot parts of 10 are 1, 2 and 5. These occur since $1 = 10/10$, $2 = 10/5$, and $5 = 10/2$. All numbers greater than half of a given quantity are aliquants of the given quantity.

alkalimeter A instrument for ascertaining the strength of alkalies, or the quantity of alkali in potash and soda.

Allen-Doisy unit or **Mouse** In the Allen-Doisy test, the least amount of estrogen capable of producing a characteristic change in the vaginal epithelium of a spayed laboratory mouse.[17] It is named after the American anatomist and physiologist Edgar Allen (1892–1943)[18] and the American biochemist and physiologist Edward Adalbert Doisy (1893–1986), who shared the 1943 Nobel Prize for Physiology or Medicine with Henrik Dam (1895–1976).

alloa (N_{al}) An obsolete system in Scotland for numbering woolen yarns by fineness, = the number of spyndles, each of 11,520 yd, needed to make up 24 lbs.

allowable annual cut (AAC) An average annual volume of timber which the holder of a licence from the Province of British Columbia may harvest on Crown land under the licence in a 5-year control period.

allowance The difference between the maximum shaft size limit and the minimum hole size limit.

Almquist's unit or **Almquist-Klose unit** An obsolete unit for vitamin K, based on a profylactic test developed by the American farmer Hermann James Almquist.[19] The unit is named after Almquist (b. 1903) and an unknown A. A. Klose.

almuncantar or **parallel of altitude** A circle on the celestial sphere that is parallel to the horizon. It consists of all points at a given altitude; if two points are on the same almucantar, they have the same altitude.

alpha A current amplification factor when connected in a common base configuration.

alpha particle A helium nucleus, consisting of two protons and two neutrons, with a double positive charge. Its mass is 4.002 764 amu.

alpha TE An abbreviation for alpha tocopherol equivalent, a measure of vitamin E used in nutrition. The activity of vitamin E in a food or food supplement is measured by the quantity (in milligrams) of alpha tocopherol (the most active of the forms of the vitamin). 1 mg alpha TE = 1.5 international units.

alpha particle mass A unit of weight, used in sub-atomic physics, $= 6.644\,657\,230(82) \cdot 10^{-27}$ kg.[20]

alphanumeric A set of all alphabetic and numeric characters.

alt h A traditional abbreviation in pharmacy for *alternis horis*, every other hour, a unit of frequency sometimes used in medical prescriptions.

alternation The name of one half of a complete cycle, consisting of a complete rise and fall of voltage or current in one direction. There are 240 alternations per second in a 120 Hz alternating current.

altimeter An instrument used to measure the altitude of an object above a fixed level.[21]

AM An abbreviation for Amplitude Modulation.

A/m An abbreviation for ampere per metre and Ampère par mètre.

Am^2 An abbreviation for ampere square metre.

[17] enacademic.com

[18] [ALLE].

[19] [ALMQ].

[20] [MOHR2].

[21] The aneroid altimeter or pressure altimeter refers to sea level, while an electronic altimeter or radar altimeter uses the radar method to indicate distance above the ground.

amagat or **amagat units** The name of units used by physicists to express the relative molecular volume and density of gases. The amagat volume unit is about 22.413 6 L/mol = 0.022 413 6 L/m^3, the volume occupied by a gas at 0.01°C and 1 atmosphere. The amagat density unit represents the corresponding relative density, = one kilomole per standard volume = 44.615 768 mol/m^3 = 0.044 615 768 mol/L, at standard temperature and pressure. The units are named after the French physicist Emile Hilaire Amagat (1841–1915).[22] Amagat units have been used extensively in the Netherlands since the time of Johannes Diderik van der Waals (1837–1923) but were not used in Britain until 1939.[23]

ambient temperature The temperature of the air in the immediate vicinity.

amboceptor unit A name of, in complement fixation tests, "the smallest amount of anti-RBC antibody (amboceptor) that produces complete red cell lysis in the presence of an excess of complement."[24]

American run See *run*.

Am^2/Js An abbreviation for ampere square metre per joule second.

amici prism A direct vision prism, where a beam of light is dispersed into a spectrum without mean deviation.

AMMAC An abbreviation for Asociación Mexicana de Metrología.

ammeter A instrument used for measuring the rate of flow of electricity, usually expressed in amperes. A meter that indicates the current value in milli-amperes is a milli-ammeter, and one that indicates values in micro-amperes is a micro-ammeter.

amp or **Amp** A deprecated abbreviation for ampere.

ampere (**A** or **amp** (informal abbreviation)) A base SI and MKSA unit of electric current and SI unit of current linkage, magnetic potential difference and magnetomotive force. The ampere is that constant electric current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 m apart in a vacuum, would produce a force between these conductors = 0.2 μN/m in length.[25]

ampere See *international ampere*.

ampere x circular mil (A x circular mil) An obsolete U.K. and U.S. unit of electromagnetic moment = 5.067 07 · 10^{-10} A · m^2.

ampere-foot (A·ft) A unit used in figuring motor circuits or circuits designed to carry a mixed load. One ampere-foot is the product of one ampere multiplied by one foot.

ampere hour (A·h or **amp hr** (informal abbreviation)) or **ampere-hour** A commercial and obsolete SI unit of electric charge, often used to state the capacity of a battery. One ampere hour is the charge accumulated by a steady flow of one ampere for 1 h, = exactly 3600 C.

ampere metre squared (A·m^2) An SI unit of electromagnetic moment.

ampere minute (A·min) An obsolete SI unit of electric charge = exactly 60 C.

ampere per inch (A/in) An obsolete U.K. and U.S. unit of magnetic field strength = 33.970 1 A/m.

ampere per kilogram (A/kg) See *coulomb per kilogram second*.

ampere per metre (A/m) or **ampere-turn per metre (At/m)** An **SI** derived unit of magnetic field strength, lower/upper/thermodynamic field strength, magnetization and linear current density. The ampere per metre is the magnetic field strength which is created tangentially at a distance of one metre from a straight conductor, of infinite length and with negligible cross section, by a circulating current of one ampere. One ampere per metre = π/250 oersteds (12.566 371 millioersteds) in **CGS** units. As a magnetic dipole moment per unit volume, 1 A/m = 0.001 emu/cm^2.

ampere per square inch (A/in^2 or **a.p.s.i.)** An obsolete U.K. and U.S. unit of electric current density = 1555.000 310 A/m^2.

[22] [ESCA].

[23] [FOWL].

[24] enacademic.com

[25] CIPM, 1946 and 9th CGPM, 1948, resolution 2 and 7.

ampere per square metre **(A/m^2)** An SI derived unit of current density. The ampere per square metre is the electric current density = an electric current of one ampere which circulates in a homogeneous conductor having a section area of one square metre.

ampere per square metre kelvin squared **($A/(m^2\ K^2)$)** An SI unit of Richardson constant.

ampere per volt (A/V) A unit = 1 siemens.

ampere per weber (A/Wb) A unit = 1 reciprocal henry.

ampere second (A˙s) A unit = 1 coulomb.

ampere square metre **($A{\cdot}m^2$)** An SI unit of magnetic moment of a particle, Bohr magneton and nuclear magneton.

ampere square metre per joule second **($A \cdot m^2/(J \cdot s)$)** An SI unit of gyromagnetic coefficient = C/kg.

ampere-turn (At, A.T., or A-turn) The MKS unit of magneto-motive force, sometimes used in the description of the electrical circuits of electromagnets. Electric current passing through a coil of wire generates a magnetic field. The ampere turn is the product Ni, in which N is the total number of turns in a coil through which a current of i amperes is passing. One ampere-turn = $4\pi/10$ = 1.256 637 Gb. The unit was first used in 1892.[26]

ampere-turn per metre (At/m) A unit = 1 A/m. See also *ampere per metre*.

amplitude The name for an extent of a vibrator movement measured from the mean position to an extreme.

amu, a.m.u., or AMU An abbreviation for atomic mass unit.

analemma figure The name of an 8-shaped diagram that shows the angular offset of a celestial body (usually the Sun) from its mean position on the celestial sphere as viewed from another celestial body (usually the Earth).

ananillion See *zillion*.

anceps [<L: = "two-headed"] The final syllable of a hexameter verse, anceps can be either long or short, noted either as ˘̲ or X.

[26] [BARK].

anemometer An instrument for measuring the force and velocity of the wind.

ångström (Å), **aangstroem** (official transliteration), **angstrom (A)**, or **tenth metre** The CGS and metric unit of length = 100,000 fermis = 1000 X-units = 0.1 nanometre = 10^{-10} m. The unit is mainly used by spectroscopists and others studying the waves of light and electricity. A unit of this length was employed by the Swedish physicist Anders Jonas Ångström (1814–1874) in 1868 in a description of the solar spectrum, which is why his name is so often attached to it. In 1907, the International Union for Solar Research[27] defined the international angstrom by making the wavelength of the red line of cadmium in air = 6438.4696 international angstroms. This particular value was chosen so that, within the limits of measurement at the time, the angstrom would be 10^{-10} m. The BIPM endorsed the unit in 1927, it was defined by the CGPM in 1960, and accepted by the International Astronomical Union in 1961. One Ångström was then said to be = 1/6,438.469 6 of the wavelength of the red cadmium line in dry air at standard atmospheric pressure, 15°C and 0.03% by volume of carbon dioxide.

angstrom star (Å* or A*) A unit used to measure the wavelength of X-rays. Because it's easier to measure the ratio between two X-ray wavelengths than it is to measure the wavelengths themselves, the wavelengths are usually stated as multiples of a standard wavelength. The X unit and the angstrom star are the units used for this purpose. Å* was defined by Professor Joyce Alvin Bearden (1903–1987) in 1965[28] and is based on the wavelength of the $K\alpha_1$-line of tungsten, which he took to be 0.209 010 Å*, in which Å* = 1 000 014 81 Å = 1.000 014 81 $\cdot 10^{-10}$ m. Later measurements have shown that, in fact, Å* = 1.000 001 501 (90) $\cdot 10^{-10}$ m.[29]

angular acceleration (α) The time rate of change of angular velocity either in angular

[27] [IUSR, p. 28].

[28] [BEAR].

[29] Sizes.com

speed or in the direction of the axis of rotation (precession). The units of a are typically rad/s^2 and rev/min^2.[30]

angular mil See *mil*.

angular velocity (ω) The speed of a rotating object measured in radians per second.

ANSI An abbreviation for American National Standards Institute.

antilog An abbreviation for antilogarithm.

antilogarithm (antilog) A number from which the log was derived. Obtained as a result of using the inverse procedure of obtaining a log.

antimeter An optical instrument for measuring angles.

AOX An abbreviation for Adsorbable Organically-bound Halogens.

ap or ap. An abbreviation for apothecaries' or apothecary.

apc An abbreviation for attoparsec.

ap dr or **ap dram** An abbreviation for dram apothecary.

ap gr or **ap grain** An abbreviation for grain apothecary.

api An abbreviation for ampere per inch.

ap lb or **ap pound** An abbreviation for pound apothecary.

APLMF An abbreviation for Asia Pacific Legal Metrology Forum.

APMP An abbreviation for Asia Pacific Metrology Program.

apostilb (asb) or **blondel** The MKS unit of luminance, formerly also called blondel, representing the brightness of a surface uniformly radiating 1 **lumen**/m^2. This is the brightness produced by 1/π **candela** or 1 lux of light. The German Illuminating Engineering Society (DLTG) defined one apostilb as 1/π cd/ m^2 = about 0.318 310 cd/m^2. Since the apostilb basically measures the same situation as the lux, it is rarely used.[31] The name of the unit is pseudo-Greek for luminance; it combines the ancient Greek *stilbein*, meaning "glitter," with the prefix *apo*-, meaning "away from."

apoth or apoth. An abbreviation for apothecaries' or apothecary.

ap oz or **oz ap** An abbreviation for apothecary ounce.

apparent power A power value obtained in an alternating current circuit by multiplying the effective values of voltage and current. The result is expressed in volt-amperes.

ap pound or **pound ap** An abbreviation for apothecary pound.

APR An abbreviation for annual percentage rate.

apses A point at which an orbiting body is at the greatest or least distance from the center of attraction. The greatest distance is called the higher apses and the least distance is called the lower apses.

a.p.s.i. An abbreviation for ampere per square inch.

Ar A symbol for Relative Atomic mass.

arbitrary unit A unit defined by a physical prototype, rather than being a natural unit theoretically reproducible anywhere.[32]

arc A portion of the circumference of a circle.

arc deg or **arc degree** An abbreviation for degree.

arc min or **arc minute** An abbreviation for minute of arc.

arc s or **arc second** An abbreviation for second of arc.

Archimedes' constant The name of an approximation, carried out by Archimedes on one occasion around 225 BCE. He used geometrical methods and a 96-sided polygon inscribed and circumscribed in/on a circle, to approximate pi to the following range: 3 + 10/71 < pi < 3 + 1/7.

Archimedes number (Ar) A dimensionless number used in momentum transfer in general and buoyancy, fluidization, and motion due to density difference calculations in particular, defined as $(g\ \rho_s\ L^3\ (\rho_s - \rho_f))/\mu^2$, in which g = gravitational acceleration, L = characteristic length, ρ_s = solid density, ρ_f = fluid density, and μ = viscosity.

[30] [SEEL, p. 242] and [JEWE, p. 272].

[31] Though it was authorized in 1935. See 1935: *CIE Proc.*, **9**, 164.

[32] [GLAZ].

arcminute (′ or **min**) A unit of angular measure = 60 arcseconds = 1/60 degree. There are 21,600 arcminutes in a circle.

arcsecond (″, **sec,** or **s**) A unit of angular measure = 1/60 arcminute. There are 1,296,000 arcseconds in a circle. The SI defines s as the symbol for the time unit and recommends ″ as the symbol for the arcsecond. In astronomy, very small angles are often stated in milliarcseconds (mas).

are (a) [pronounced the same as "air"] A metric unit of area, used for agrarian measurements only, = 100 m^2 = about 0.024 711 acre. The are is not used as often as its multiple, the hectare (1000 ares). The unit was approved by the CIPM in 1879, but appeared in an English text as early as 1810.[33] In France = 10 deciare.

areometer [<Gr: *árēs* = "the planet Mars"] An instrument for measuring the specific gravity of liquids.

armillary sphere A instrument from the 1500s that was used to determine the relative positions of the celestial equator, the ecliptic, the planetary orbits, etc. This device consisted of a series of concentric rings.

arm's-length A term figuratively used to mean "a distance discouraging familiarity or conflict." In many cultures, the length of a human arm was standardized as a unit of length = 70 cm.

army group A grouping of two, or more, numbered armies.

Arrhenius number (α) A dimensionless number used in mass transfer in general and reaction rate calculations in particular. $\alpha \equiv E_0/(R \cdot T)$, in which E_0 = activation energy, R = gas law constant, and T = temperature.

artefact An object fashioned by a human being.

As An abbreviation for ampere second.

aS An abbreviation for absiemens.

asb An abbreviation for apostilb.

ASBC An abbreviation for American Standard Building Code.

acension See *minute*.

aS/cm An abbreviation for absiemens per centimetre.

ash A measure of the amount of inorganic material in lubricating oil. Determined by burning the oil and weighing the residue. Results expressed as percent by weight.

A.S.H.R.A.E. An abbreviation for the American Society of Heating, Refrigeration and Air-conditioning Engineers.

Ashman's unit An obsolete unit in electrocardiography, = 4 μVs.[34] The unit is named after the American physiologist Professor Richard Ashman (1890–1969).

ASME An abbreviation for American Society of Mechanical Engineers.

assay ton (AT) and **assay value** Specialized U.S. units of mass used by minerologists in assaying ores for the presence of gold, silver, platinum, uranium, or other valuable metals. Assay value is the reciprocal of assay ton. "If *w* avoirdupois tons of ore yield one troy ounce of precious metal then *w* tons is said to be the assay ton of the ore. If one avoirdupois ton of ore yields *t* troy ounces of precious metal then *t* ounces is the assay value of the ore; . . ."[35] One assay ton = (7/240) g = about 583.333 3 quarters = about 450.109 83 grains = about 18.754 6 pennyweights = about 0.937 7 oz. = about 29.166 7 g. In Britain, the assay ton is based on the long ton and thus equals (2.24 · (7/480)) = 32⅔ g.

association candle See *Vereinskerze*.

ASTM An abbreviation for American Society for Testing and Materials.

astrolabe A historical astronomical instrument, used to locate and predict the positions of heavenly objects and measure their altitudes.

astrometer An alternative name in the early 1900s for the parsec. See also *astron*, *macron*, and *parsec*.[36]

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33 [DAVI7. p. 147].

34 [ASHM].

35 [JERR, p. 13].

36 See also: [CURT].

astrometry A precise measurement of the position and motion of astronomical objects, often with respect to standard star catalogues.

astron An alternative name in the early 1900s for the parsec. See also *astrometer*, *macron*, and *parsec*.

astronomic(al) unit (ua, au, AU, or UA) A unit of length, used in astronomy for describing planetary distance, accepted for use with SI units. It was recognized at the first meeting of the International Astronomical Union in 1922[37] and adopted by the International Astronomical Union in 1964. In August 31, 2012, the IAU (International Astronomical Union) adopted the current definition of one astronomical unit as exactly 149,597,870,700 m.

at An abbreviation for technical atmosphere.

a.t., **At**, **A.T.**, or **A–T** An abbreviation for ampere-turn or assay ton.

aT An abbreviation for abtesla.

AT An abbreviation for assay ton.

A–T An abbreviation for ampere-turns.

at. no. An abbreviation for atomic number.

at. wt. or **at wt** An abbreviation for atomic weight.

ata An obsolete German abbreviation for technical atmosphere, used for measuring absolute pressure.

At.-Gew. The German abbreviation for *Atomgewicht* (=atomic weight).

At/m An abbreviation for ampere-turn per metre.

atm or **Atm** An abbreviation for standard atmosphere.

atmo-meter, **atmo-metre (atmo-m)**, or **metre-atmosphere** A unit used in atmospheric physics to compare the "depth" or total volume of atmospheres, or components of atmospheres. The depth in atmo-metres is = the depth (in m) the atmosphere, or one gas component of the atmosphere, would have if it formed a uniform layer at 0 °C and 1 atmosphere. One atmo-metre represents $2.686\,99 \cdot 10^{25}$ (Loschmidt's number) molecules of gas per square metre of planetary surface; thus if the partial pressure of two gases are *x* and *y* atmo-metre, every m^2 of the mixture will contain $2.686\,99x \cdot 10^{25}$ and $2.686\,99y \cdot 10^{25}$ molecules of each gas and their partial pressures will be in the ratio *x*:y.

atmometer, **evaporimeter**, or **evaporometer** [<L: *vapor* = "steam"] An instrument to measure the quantity of exhalation from a wet surface in a given time. It was invented by the Scottish mathematician and engineer Sir John Leslie (1766–1832).

atmos An abbreviation for standard atmosphere.

atmosphere (atm or **atmos)** A unit of pressure designed to equal the average pressure of the Earth's atmosphere at sea level. In other pressure units, one atmosphere equals exactly 1013.25 mb = 101.325 kPa = about 29.92 in Hg = about 14.695 9 lb/in^2. This is the standard atmosphere and equals 1.033 2 technical atmosphere.

atö A unit of pressure = an "absolut" value = (x + 1) at. See also *psi*.

atomic mass unit (amu, **a.m.u.**, or **AMU)** An obsolete unit of weight used by chemists and physicists for measuring the masses of atoms and molecules. The general idea was that atoms of hydrogen, known to be the lightest element, should have a mass of 1 amu, and all the other atoms should have masses which are whole-number multiples of this mass of the hydrogen atom. For a long time, physicists and chemists disagreed on the details of this definition.[38] The **old chemical atomic mass unit** (sometimes called the **atomic weight unit**): 1/16 of the mass of an atom of oxygen of the naturally occuring isotopic composition (^{16}O:^{18}O:^{17}O in the abundance 506:1:0.204) = 1 u./1.000 043 = about $1.660\,26 \cdot 10^{-27}$ kg; the **old physical atomic mass unit**[39] (sometimes abbreviated as **amu**): 1/16 of the mass of an atom of nuclide ^{16}O = 1 u./1.000 317 937 = about $1.659\,81 \cdot 10^{-27}$ kg. In 1960, they agreed on the definition of the unified atomic mass unit (sometimes abbreviated as **u**, and known as **the international amu**) as

[37] [NATUR12].

[38] [ASTO, p. 333].

[39] This expression was suggested in 1885 by the Russian–German chemist Wilhelm Ostwald (1853–1932).

being 1/12 the rest mass of a neutral atom of the nuclide ^{12}C in the ground state. The currently accepted value is 1.660 539 040 (20) · 10^{-27} g. In addition, 1 amu equals about 931.494 028 MeV. In biochemistry, the atomic mass unit is called the *dalton* (Da).

atomic number The number of protons in the nucleus of an atom, as well as the number of electrons in the neutral atom. Atoms with the same atomic number make up a chemical element. In 1864, the English analytical chemist John Alexander Reina Newlands (1837–1898) defined an index describing the position of an element in a so-called periodic table. The English physicist Henry Gwyn Jeffreys Moseley (1887–1915) later arranged the elements in an order based on certain characteristics of their X-ray spectra and then numbered them accordingly.[40] The elements are now arranged in the periodic table in the order of their atomic numbers. The Periodic law, formulated by the Russian chemist Dimitri Mendeleev (1834–1907), was originally based on atomic weights.

atomic unit of weight [^{12}C] (u, uma, Da (^{12}C) AMU) A unit equal to the fraction 1/12 of the mass of the carbon (^{12}C) atom = about 1.660 540 210 · 10^{-27} kg.

atomic unit of weight [^{16}O] (u, uma, Da (^{16}O) AMU) A unit equal to the fraction 1/16 of the mass of the oxygen (^{16}O) atom = about 1.660 001 243 2 · 10^{-27} kg.

atomic unit of weight [^{1}H] (u, uma, Da (^{1}H) AMU) A unit equal to the fraction 1/1 of the mass of the hydrogen (^{1}H) atom = about 1.673 533 995 · 10^{-27} kg.

atomic units (a.u.) A system of atomic units, proposed in 1927 by Douglas R. Hartree (1897–1958) with a view to simplifying calculations in problem-solving concerning the basic structures of atoms and molecules. The fundamental units of the system were based on five universal constants: the electron rest mass (m_0), the elementary electrostatic charge (e), the first orbit Bohr radius (a_0), the first ionizing energy of hydrogen atom in its ground state, and the rationalized Planck constant (h). The a.u. system is regarded as being composed of “natural units” for calculations involving electronic structure in quantum chemistry.

atomic weight Relative weight of the atom of an element based on an atomic weight of 16 for the oxygen atom as the usual chemical standard. The sum of protons plus neutrons is the approximate atomic weight of an atom.

atomic weight unit (awu) Name sometimes used for the old chemical atomic mass unit. See *atomic weight*.

atomo Name adopted for the *millimetre* in Milan in 1803.

att A contracted form of atto-.

atta (A-) An informal prefix denoting 10^{18}. See also *exa*.

atto- (a-) [Danish and Norwegian: *atten* = 18 (to honor Niels Bohr)] SI prefix denoting 10^{-18}. The General Assembly of the International Union for Pure and Applied Physics approved a proposal of its Commission on Symbols, Units and Nomenclature in 1960. Use of the atto- with SI units was officially authorized by resolution 8 of the 12th CGPM.

attogram (ag) Submultiple of the SI base unit kilogram and = 10^{-21} kg.

attometre (am) Submultiple of the SI base unit metre and = 10^{-18} m.

attoparsec (apc) Submultiple of the unit parsec, used in astronomy to measure interstellar distances. One apc = about 3.085 cm.

attoparsec per microfortnight A jocular unit of speed = 2.55 m/s = about 1.004 3 in/s = nearly 1 in/s.

attosecond (as) Submultiple of the SI base unit second and = 10^{-18} s.

atu An obsolete German abbreviation for technical atmosphere, used for measuring pressure below (=G: “unter”) atmospheric pressure.

atü An obsolete German abbreviation for technical atmosphere, used for measuring gauge (=G: “über”) pressure.

A-turn An abbreviation for ampere-turn.

at. wt. An abbreviation for atomic weight.

AU An abbreviation for absorbance unit.

AU An abbreviation for animal unit.

[40] [MOSE].

AU or **A.U.** An abbreviation for astronomical unit.

ÅU An abbreviation for ångström unit.

au An abbreviation for astronomical unit.

audiometer Instrument for measuring hearing activity for pure tones of normally audible frequencies. See also *sonometer*.

av US An abbreviation for avoirdupois.

A/v An abbreviation for ampere per volt.

AV/cm An abbreviation for abvolt per centimetre.

avdp A British abbreviation for avoirdupois.

avg An abbreviation for average.

average value Value obtained by dividing the sum of a number of quantities by the number of quantities represented.

average value The average of many instantaneous amplitude values taken at equal intervals of time during an alternation. The average value of an alternation of a pure sine wave is 0.637 times its maximum or peak amplitude value.

Avogadro's constant or **Avogadro's number (L** or $\mathbf{N_A}$**)** A unit of relative quantity = the number of atoms or molecules per mole of a substance. The currently accepted value is 6.022 140 857 (74) · 10^{23} per mole. The unit is named after the Italian chemist and physicist Amadeo Avogadro[41] (1776–1856).[42]

avogram A unit of weight equal to 1 g/Avogradro's number = about 1.660 539 040 · 10^{-24} g.

avoir An abbreviation for avoirdupois system.

avoirdupois, **avoirdupoise**, **avoirdupoys**, **avoirdupoiz** or **avoyrdepoyce (av** (in the US) or **avdp** (in the UK)) A common traditional system of weights in all English-speaking countries. These weights continue to be used for most items of retail trade in the U.S., and they remain in some use in Britain despite the SI being the only legal system there.[43]

Aw or **A.W.** A German abbreviation for *Amperewindung* = ampere turn.

aWb An abbreviation for abweber.

[41] [MORS2].

[42] Sizes.com

[43] [ZUPK5, pp. 14–18].

A/Wb An abbreviation for ampere per weber.

AWG or **A.W.G.** An abbreviation for American Wire Gauge.

awu or **a.w.u.** An abbreviation for atomic weight unit.

azimuth The horizontal direction or bearing of one object with respect to another, expressed as an angle measured in a horizontal plane and in a clockwise direction from the north.

aΩ An abbreviation for abohm.

aΩcm An abbreviation for abohm centimetre.

2 B

B An abbreviation for bel, brewster and byte, e.g., kB = kilobytes.

B Informal abbreviation for "billion," generally meaning the American billion 10^9. This abbreviation is non-metric: the metric abbreviation for 10^9 is G, standing for the prefix giga-. The B form has been used in such units as Bcf (billion cubic feet) and BeV (billion electron volts).

b An abbreviation for bar, barn and bit, e.g., Mb = megabits.

B dose See *pastille dose*.

B.A. unit A unit of resistance, proposed by a committee of the British Association for Advancement of Science in the 1860s,[44] that later became known as the *ohm*.[45]

ba An abbreviation for barye.

backlash The maximum magnitude of the input that produces non-measurable output upon reversing the sense of the input.[46]

baculometry [<L: *baculum* = "staff" (especially one used to assist in walking)] Name of the act of measuring distance of altitude with a staff, rods, or staves.[47]

bagillion See *zillion*.

[44] Papers on the subject were published in 1846, 1852 and 1856.

[45] [GRAY5, p. 590].

[46] [LÓPE4, p. 14].

[47] See also: [SCHW4].

Bagnold number (Ba) A dimensionless number[48] used in the study of friction. Ba $\equiv$ (m · D^2 γ)/(2γ_e μ), in which m = mass, D = grain-diameter, γ = surface tension, and μ = interstitial fluid viscosity.[49] It is named after the first commander of the British Army's Long Range Desert Group during World War II, Ralph Alger Bagnold (1896–1990), also known for his contributions in fluvial geology.

bäi [<Mandarin-WG: = "hundred"], **ba**, **baak**, **pai**, or **pak** In South East Asia, a prefix used as an equivalent to "hecto…".

Bairstow number Term formerly used to signify a Mach number. The number was named after Sir Leonard Bairstow (1880–1963).

bajillion See *zillion*.

baker's dozen or **devil's dozen** Informal unit of quantity = 13. Bakers often toss in an extra item for each dozen bought, making a total of 13. This custom is very old, dating at least from the thirteenth century, when the weights and prices of loaves of bread were strictly regulated by royal proclamations called *assizes*, and bakers could be jailed if they failed to provide fair weight at the listed prices.

BAL An abbreviation for blood alcohol level.

Balling A unit of density. See *degree Plato*.

balmer The CGS-unit of wavenumber, based on the number of electromagnetic waves in 1 cm of length. The unit was proposed in 1951.[50] The names **kayser** and **rydberg** are also applied to this unit. The balmer is named after the Swiss spectroscopist and mathematician Johann Jacob Balmer (1825–1898).

ban A logarithmic unit which measures information or entropy, based on base 10 logarithms and powers of 10, = 3.32 bits ($\log_2(10)$), or about 2.30 nats (ln(10)). The more commonly used *deciban* = about 0.33 bits. The unit was presented by the British mathematician, logician, and cryptographer Alan Mathison Turing (1912–1954) and the British statistician and cryptographer Irving John Good (1916–2009) in 1940, to measure the amount of information which could be deduced by the codebreakers at Bletchley Park using the Banburismus procedure, towards determining each day's unknown setting of the German naval Enigma cipher machine. See also *bit*, *hartley*, and *shannon*.

bandwidth Name for the difference between the upper and lower cutoff frequencies of, for example, a signal spectrum, a communication channel, or a filter. Typically measured in hertz.[51]

bank cubic metre (BCM) A traditional unit of volume in coal mining = the contents of a cubic metre of rock in place, before it is drilled and blasted.

Bar An occasionally used abbreviation for barrel.

bar (b)[52] [<Gr: *báros* = "weight"] A metric unit of atmospheric pressure of fluid = 100 kPa = 1.0 · 10^6 dyne/cm^2 = 750.062 torr = 67 197 poundal/ft^2 = 0.986 923 phys. atm = 1.019 716 kgf/cm^2 = about 14.503 78 lbf/in^2.[53] The unit was proposed by the Norwegian meteorologist Vilhelm Firman Koren Bjerknes (1862–1951), the founder of and inspiration for the Bergen School of Meteorology.[54]

bar In the CGS absolute system of units, a unit of pressure = 1 dyne/cm^2.[55] See also *barad*.

bar In France, during the eighteenth–nineteenth centuries, a term for 1000 kg. In the French Law of August 1, 1793, it was defined as the mass of a cubic metre of distilled water at its maximum density. It was discarded in the Law of April 7, 1795, but continued to be in use until the mid-nineteenth century, when it was replaced by the millier and the tonneau.[56] See also *millier*.

barad A proposed unit of pressure in the CGS absolute system of units = 1 dyne/cm^2.[57] See also *bar* and *barye*.

48 Introduced in: [HILL4].

49 See also: [KISH, p. 387].

50 [BLAD].

51 en.wikipedia.org

52 The symbol mb is usually used for the millibar in meteorology. In SI, the symbol for the millibar is mbar.

53 [TUMA, p. 287].

54 See also: [RMS] and [FRIE2, p. 251].

55 [GLAZ2, p. 584].

56 Currently, a tonneau refers to a cask smaller than a tonne.

57 [CLAR3, p. 11].

barg [symbol for bar gauge] A common unit of pressure in engineering. The term "gauge" means that the pressure has been read from a gauge which actually measures the difference between the pressure of the fluid or gas and the pressure of the atmosphere.

barge Informal unit of volume used in the U.S. energy industry. The barges used on American rivers customarily carry about 25,000 barrels of oil. This is equivalent to about 1.05 million gallons = about 3 975 m^3.

barkhausen In acoustics, during the early 1920s, a unit of loudness of magnitude unknown today, but probably almost = the *phon*.[58] It is named after the German physicist Heinrich Georg Barkhausen (1881–1956).

bar liter or **bar litre** A metric unit of energy, used to measure the potential energy of gases under pressure. The energy is computed by multiplying the volume of gas in litres by the pressure in bars. One bar litre equals exactly 100 J = about 73.756 2 foot pounds.

barn (b) or fermi A unit used in nuclear physics to measure cross-sections of subatomic particles. The unit was named by Marshall Glecker Holloway (1912–1991) and C. P. Baker in December 1942, while they were eating dinner in the Union Building of Purdue University.[59] A value of 10^{-24} cm^2 was already being used as a unit for nuclear cross-sections in their work for the Manhattan Project, the secret American effort to construct the first atomic bomb, but it had no name. Holloway and Baker considered and rejected the names "bethe," "john," "oppenheimer," and "manley," finally arriving at "barn" because, for nuclear processes, an area of 10^{-24} cm^2 really was "as big as a barn". The first use of the barn in a publication seems to have been in Los Alamos Research Report LAMS-2 (June 28, 1943).[60] One barn is = 10^{+24} sheds = 1000 millibarns = 10^{-28} m^2 = 100 fm^2. This surface unit is sometimes called a *fermi*. The International Union for Pure and Applied Physics recommended the use of the barn at its Tenth General Meeting in 1960.[61] In July 1976, it was abolished by the Council of Ministers of the EEC, and then again by the IEEE in 2002.[62] In 1978, the CIPM said it was acceptable to be used with SI units. See also *sheds* and *millibarn*.

barnmegaparsec (bMpc) A jocular unit of volume, = 2/3 teaspoon = about 3 mL.

barn per electrovolt (b/eV) A unit of spectral cross-section, used in nuclear physics, = 6.241 46 · 10^{-21} m^2/J.

barn per erg (b/erg) A unit of spectral cross-section, used in nuclear physics, = 10^{-21} m^2/J.

barn per steradian (b/sr) A unit of angular cross-section, used in nuclear physics, = 10^{-28} m^2/sr.

barn per steradian electronvolt (b/sr · eV) A unit of spectral angular cross-section, used in nuclear physics, = 6.241 46 · 10^{-10} m^2/(sr · J).

barn per steradian erg (b/sr · erg) A unit of spectral angular cross-section, used in nuclear physics, = 10^{-21} m^2/(sr · J).

barometer An instrument for measuring atmospheric pressure. There is a direct relationship between atmospheric pressure and altitude and many barometers are equipped with an altitude scale. Two types of barometer are "mercury" and "aneroid." An aneroid barometer with an altitude scale is an **altimeter**.

baromil A unit of length, used by the American Meteorological Society (AMS) for graduating mercury barometers. It is defined as the increment in the height of the barometer that results from an increment of atmospheric pressure of one millibar if the barometer is at 0°C at sea level and at 45° latitude = about 0.750 1 mm.[63]

barr See *bar*.

barrels of oil per day (B/D) A unit used in the energy industry to measure the rate at which oil is pumped from a well.

barrer or **Barrer** The CGS unit of gas permeability for membranes, contact lenses, and

[58] See: [SACE].

[59] [HOLL2].

[60] [HOLL3].

[61] [IUPAP].

[62] [IEEE, Sect. 3.3.3].

[63] [HUSK, p. 60].

similar thin materials = 10^{-10} $cm^2 \cdot s^{-1} \cdot cmHg^{-1}$ = 7.500 5 · 10^{-18} $m^2 \cdot s^{-1} \cdot Pa^{-1}$. The unit is named after the New Zealand chemist Richard Maling Barrer (1910–1996).

baromil [barometer mil] In the U.S., a unit of length used in graduating a mercury barometer in the CGS-system. If the barometer is located at 45° latitude at sea level and its temperature is 0°C, a length increment of one baromil will correspond to a pressure increment of one millibar. Corrections must be applied at other locations.

barye (ba), (sometimes) **bar**, **barad**, **barie**, or **bary** [<Gr: *barys* = "weight"] The CGS unit of pressure = 1 dyne/cm^2 = 0.1 Pa = 1 μb = 14.5 · 10^{-6} lb/in^2.[64] The unit was named by the British Association in 1887[65] and adopted at the International Congress on Physics[66] in 1900, but it never became a common term owing to the very small measure of the unit. See also *bar*.

barye An occasionally used name for *bar* = 100 kPa.

basal area (g) A cross-sectional area of a tree stem (usually at breast height) or of a range plant stem (usually at ground level). Basal area = diameter of tree squared, times 0.005 454.[67]

base box (in the U.S.), **basis box** (in Britain) A unit of area, widely used in the tin plate industry before metrification, formed by the area of both sides of 112 plates each of size 10 × 14 in = 31 360 in^2. It was used to give the mass per unit area of coating as a measure of thickness. Thickness was expressed in terms of mass in pounds deposited per base box, 1 lb/box = about 22.419 g/m^2.[68]

base pairs The size of a DNA molecule is measured by the number of nucleotides or simply the number of bases. The common unit for double-stranded DNA is the base pair (bp).[69]

64 Barad was never abbreviated, which is why centibarad = cbarad.

65 *Rep. Brit. Ass.*, 1888, p. 28.

66 See also: [BJER].

67 [FORD] and [WENG]. See also: [BIGI], [CHAC2] and [MATÉ].

68 [HOAR].

69 [WONG, p. 19].

base units A meaning, in a system of units, indicating that minimal set of units from which all the other units can be derived algebraically.

basis point (bp) A unit of proportion = 0.01% = 10^{-4}. The basis point is used in finance to measure small fluctuations in interest rates, bond yields, zero-coupon yield, and the rates of return on investments. Prior to the introduction of the basis point, these fluctuations were measured clumsily in 64ths of a percent.

basis point value or **dollar duration** A measure of a change in the price of a bond compared with a given change in interest rates. Quoted in U.S. cents. A bond with a basis point value of 0.03 would indicate the bond price will change by 3 cents per 1 basis point shift (0.01%) in the yield curve.

basis weight A unit used in the U.S. by the paper industry to express the actual weight in avoirdupois pounds of a ream of paper, boxboard, etc., cut to its basic size. A ream of paper normally equals 500 sheets, but at times, 480 or 516, and for paperboards, 1000.

battalion A self-administered[70] tactical military unit of around 500–1500 men, usually consisting of between two and seven companies, (artillery) batteries or troops of cavalry as operational elements, plus a headquarters. See also *battalion group*.

battalion group or **battlegroup** Name for a military group somewhat larger than a battalion.

baud (Bd) A unit used in engineering for measuring the modulation rate or the rate of data transmission over a line, originally a telegraph/telephone line. The baud rate is the number of times per second the signal carrying the communication varies in strength or frequency. The unit was proposed at the International Telegraph Conference in Berlin in 1927, and is named after the French telegraph engineer Jean Maurice Emile Baudot (1845–1903), the inventor of the first teleprinter and the International Telegraph Code No. 1 (also known as the Baudot code) sometime around 1880.

70 Many armies have smaller units that are self-sustaining.

Baumé A measure of relative density. See *degree Baumé*.

bazillion See *zillion*.

bbl An abbreviation for dry barrel.

bbl/d An abbreviation for barrels per day.

bboe See *B.O.E*.

Bcf or **b.c.f.** An abbreviation for billion cubic feet (gas flow).

Bcfd An abbreviation for billion cubic feet per day (gas flow).

Bcfy An abbreviation for billion cubic feet per year (gas flow).

BCM An abbreviation for billion cubic metres. This unit is used for measuring water flow.

Bd An abbreviation for baud.

bd. ft An abbreviation for board foot.

B/D An abbreviation for barrels of oil per day.

BDL An abbreviation for Bureau des Longitudes.

becquerel (Bq) The SI unit of activity of a radionuclide = the radiation caused by one disintegration per second = $1/(3.7 \cdot 10^{10})$ Ci = about 27.027 0 pCi. The unit is named after a French physicist, Antoine-Henri Becquerel (1852–1908), the discoverer of radioactivity. The CGPM adopted the becquerel in 1975[71] on the advice of the International Commission on Radiation Units and Measurement and the International Commission on Radiological Protection. It replaced the **curie**, whose temporarily continued use was sanctioned.

becquerel per cubic metre (Bq/m^3) The SI unit of volume activity (of a radionuclide) = $1\ m^{-3}s^{-1}$.

becquerel per kilogram (Bq/kg) The SI unit of volume activity (of a radionuclide) = $2.702\ 70 \cdot 10^{-11}$ Ci/kg.

becquerel per metre (Bq/m) The SI unit of linear activity (of a radionuclide) = $1\ m^{-1}s^{-1}$.

becquerel per mole (Bq/mol) The SI unit of molar activity (of a radionuclide) = $1\ s^{-1}mol^{-1}$.

bee space An informal unit of length used in beekeeping. A hive can be disassembled to remove the honey if the individual comb frames are carefully spaced one bee space apart. This discovery was made by the American beekeeper Lorenzo Longstroth (1810–1895) in 1852. The exact size of the bee space varies somewhat with the strain of bees being raised, but it is generally very close to ¼ in = 6.5 mm.

beer or **beere** A unit indicating a count of warp threads in the British textile industry during the eighteenth and nineteenth centuries. The unit varied with locality: In Bradford = 40 threads; in Leeds = 38 threads. Some sources[72] say that a "beere" consisted of 19 ends.

Behnken's unit (R) An obsolete unit of x-ray exposure, being that quantity which, when applied in 1 cm^3 of air at 18°C and 760 mm Hg of pressure, engenders sufficient electric conductivity to equal one electrostatic unit, as measured by the saturation current. The unit is named after the German physicist Hermann Behnken (1889–1945).

bei [= "times"] An erroneous spelling of *bai* = "hundred," frequently seen in Southeast Asia.

bel (B) A unit of sound intensity, invented by engineers of the Bell telephone network in 1923. The unit is named after the Scottish-born scientist Alexander Graham Bell (1847–1922), the inventor of the telephone. If one sound is 1 bel louder than another, this means the louder sound is 10 times more intense than the fainter one. The beginning of the scale, 0 bels, can be defined in various ways, originnally intended to represent the faintest sound which can be detected by a person who has good hearing. 1 bel = 1.151 293 Np.

bel See *decibel*.

benz A proposed unit of velocity = 1 m/s. The unit is named after the German automotive engineer and inventor Karl Benz (1844–1929).[73]

b/erg An abbreviation for barn per erg.

bes A unit of weight proposed by the Italian Professor Giovanni Polvani (1892–1970) in 1951[74] and = 1 kg to eliminate the kilogramme

[71] 15th CGPM, *Resolution 8*.

[72] [WORL].

[73] [WILL9].

[74] [POLV].

from the MKSA system. See also *brieze* and *stathm*.

beta Name for a current amplification factor of a transistor when connected in a common-emitter configuration.

Bethesda unit (Bu) A unit that corresponds to the amount of antibody that halves coagulation factor VIII activity of normal plasma following incubation of 2 h at 37°C.[75]

b/eV An abbreviation for barn per electronvolt.

BeV An informal symbol for 10^9 eV sometimes used in the U.S. The correct symbol is GeV.

Bg. Cem. An abbreviation for bag of cement.

BHP An abbreviation for British horsepower.

B.H.P., **bhp** or **b.h.p.** An abbreviation for brake horse power. The brake horsepower of an engine is the effective power output, sometimes measured as the resistance the engine provides to a brake attached to the output shaft. See *horsepower*.

bi- A common English prefix meaning 2. For something that happens twice per time unit, use semi-.

BI or **B.I.** An abbreviation for British Imperial system.

Bi A metric and CGS abbreviation for biot.

biannually A confusing expression of frequency. The word is used both for twice a year and for once every 2 years, so it should be avoided. Twice a year is semiannually and once every 2 years is biennially.

bicron (μμ) or **stigma** An obsolete metric and SI-deprecated unit of length, defined as 10^{-12} m. Coined after the micron, the bicron has been replaced by the picometre (pm).

b.i.d. or **BID** [L: *bis in die* = "twice a day"] A unit of frequency traditionally used by doctors in writing medical prescriptions.

bikron See *mikrometre*.

billiard A unit of quantity = 10^{15}. The name was coined to parallel milliard, which has long been a name for 1000 million.

billion A unit of quantity. In most European countries, it is = 10^{12} (cf. *tera*), but the U.S. value is being accepted in some fields (e.g., economy and finance). In the U.S., Canada and France, it is = 10^9 (cf. *giga*).

billion cubic metres of natural gas A unit of quantity, used for natural gas, = 0.9 million toe = 36 trillion Btu = 6.29 million boe.

billionth A unit of quantity. In most European countries, it is = 10^{-12} (cf. *pico*). In the U.S., Canada and France, it is = 10^{-9} (cf. *nano*).

Bingham number (Bm or **Bin)** A dimensionless number used in momentum transfer in general and flow of bingham plastics calculations in particular. $Bm \equiv (\tau_y \cdot g_c \cdot L)/(\eta \cdot v)$, in which τ_y = stress, g_c = dimensional constant, L = characteristic length, η = viscosity, and v = velocity.[76] It is named after the American Professor Eugene Cook Bingham (1878–1945) from Lehigh University.

biot (Bi) Another name for the abampere, a CGSB unit of electric current = 10 A. It is defined as that constant current intensity that, maintained in two infinitely long parallel rectilinear conductors of negligible cross-section, 1 cm apart in a vacuum, would produce a force of 2 dynes/cm of length between them. This unit, which was proposed by SUN in 1961, honors the French mathematician and physicist Jean-Baptiste Biot (1774–1862), one of the founders of the theory of electromagnetism. According to the current national standard in the U.S., the ampere should be used instead.[77]

biot An obsolete unit of optical rotary power, used in spectroscopy. It serves to express rotary power of matter which has circular dichroism. The unit is named after the French mathematician and physicist Jean-Baptiste Biot (1774–1862).

biot centimetre squared (Bi · cm²) The CGSB unit of electro-magnetic moment = 10^{-3} $A \cdot m^2$.

Biot number (Bi) A dimensionless number used in heat transfer in general and unsteady state calculations in particular. $Bi \equiv (h_T \cdot \Delta_x)/k_b$, in which h_T = heat transfer coefficient, Δ_x = mid-plane distance, and k_b = thermal

[75] [LICH2, p. 1948].

[76] See also: [MCEW].

[77] [IEEE, Sect. 3.3.3].

conductivity of the body. It is named after the French physicist, astronomer and mathematician Jean-Baptiste Biot (1774–1862). See also *Nusselt number*.

biot per centimetre (Bi/cm) The CGSB unit of magnetic field strength = 79.577 5 A/m.

biot second (Bi · s) The CGSB unit of electric charge = 10 C.

BIPM (acronym for Bureau International des Poids et Mesures) The international organization created by the Metre Convention signed by seventeen nations in Paris on May 20, 1875, during the last session of the Diplomatic Conference of the Metre.[78]

bips An informal name for bit per second.

bit (b) A basic unit of information content. Each bit records one of the two equally possible answers to a single question: "0" or "1," "true" or "false," "yes" or "no," "on" or "off." Logically, this is the smallest quantity of information that can exist. The word "bit," coined by the American statistician, polymath and computer scientist John Tukey (1915–2000) in 1946,[79] is an acronym for binary digit, but clearly also stems from its most common meaning, as in "he ate the last bit."

bit (b) A logarithmic unit of storage capacity = the base-2 logarithm of the number of possible states of the storage device or location. If data is stored as binary digits, this reduces to definition: an 8-bit storage location, for example, has $2^8 = 256$ possible states, so its capacity is $\log_2 2^8 = 8$ bits. If, however, a storage location stores one letter, then it has 26 possible states, and its storage capacity is $\log_2 26 = 4.700\,4$ bits.

bit (b) A unit of information content, now known properly as the *shannon*.

bite Name of a stack of ten bricks placed face to face, standing on the end in a row 25 in long for carrying purposes.

bit per second (b/s, bit/s, or **bps)** A unit of bit rate or data transmission rate in computer science = reciprocal second. The symbol bps is often pronounced "bips." Modem transmission rates are often stated in kilobits per second (Kbps or kb/s).

bit per unit area (e.g., **bit/mm^2**, **bit/cm^2**, **bit/in^2**) A unit of surface bit (or information) density.

bit per unit length (e.g., **bit/mm**, **bit/cm**, **bit/in)** A unit of linear bit (or information) density.

blanchimeter An instrument for measuring the bleaching power of oxymuriate [chloride] of lime and potash.

blean A jocular unit of luminosity = 1/100,000 glimmer.[80]

Blindwatt (bW or **BW)** An informal German unit of reactive power. See *var*.

block or **square** An informal unit of length popular in the U.S. A block is the average distance between street intersections in the rectangular street grids common in most American cities. The length of a block varies from about 1/20 mile (80 m) in New York to about 1/16 mile (100 m) in many midwestern cities to about 1/10 mile (160 m) in cities of the South and West.

bloit A jocular unit used in the Zork series of games[81] = the distance the king's favorite pet could run in 1 h = about 2/3 mile.[82]

blondel Another name for an apostilb = 1/π cd/m^3. Proposed in 1942,[83] this unit is named after the French physicist André E. Blondel (1863–1938) to honor his pioneering work in photometry.

blustrug A unit invented and mentioned by Jonathan Swift (1667–1745), Irish writer and novelist, in his novel *Gulliver's Travels* (1726). One blustrug was said to equal about 4660 m^2.[84] See also *drurr* and *glumgluff*.

bMpc An abbreviation for barnmegaparsec.

bn. See *billion*.

[78] See also: [PAGE].

[79] David Leonhardt. John Tukey, 85, Statistician; Coined the Word "Software". *New York Times*, 29 July 2000, page A19. Obituary.

[80] [ADAM, pp. 18–19].

[81] One of the first interactive fiction computer games.

[82] [RUFF].

[83] [MOON, p. 356]: "*The unit is pi times the lumens per square meter per steradian. Such a name is impossibly cumbersome, so a new name is proposed, the blondel, after André Blondel who did pioneer work in photometric nomenclature.*"

[84] See also: [PROJ, p. 608] and [SWAI, p. 54].

BNM An abbreviation for Bureau National de Métrologie.

board foot (bd ft, **fbm**, or **BF)**, **foot board measure (FBM)**, or **superfoot** In the English-speaking world, during the seventeenth–twenty-first centuries, a unit of volume used for measuring sawn lumber. One board foot is the volume of a one-foot length of a "standard board" 12 in wide and 1 in thick = 1 ft × 1 ft × 1 in = 144 in^3 = 1/12 ft^3 = about 2.359 74 L. The symbol fbm is an abbreviation for "foot, board measure."

board lot A standardized number of shares defined by a stock exchange as a trading unit. In most cases, this means 100 shares.

Board of Trade unit (of supply) The British name, during the late nineteenth century, for the *kilowatt hour*. According to a letter from Lord Kelvin to Sir Courtney Boyle on May 6, 1892, the Board of Trade proposed naming this unit the kelvin, but Lord Kelvin demurred, saying he might go into the metre manufacturing business himself and it would be unfair to competitors to have every manufacturer's metres marked with the name of his company.[85]

Board of Trade unit or **B. T. u. ohm** A unit of electrical resistance, used during the nineteenth century, = the standards kept by the Board of Trade.

Bodansky unit A name of the quantity of alkaline phosphatase that liberates 1 mg of phosphate ion from glycerol 2-phosphate in 1 h at 37°C and under other standardized conditions.[86] The unit is named after the American biochemist Aaron Bodansky (1887–1961).

Bodenstein number (Bo or **Bs)** A dimensionless number, used in diffusion in reactor calculations, defined as $(v \cdot L)/D_{v,a}$, in which v = velocity [m/s], L = reactor length [m], and $D_{v,a}$ = effective axial diffusivity [m^2/s].

Bode's relationship A relationship that gives an approximate indication of the comparative distances of the planets from the sun. According to the Titius-Bode Rule, it is obtained by adding 4 to the appropriate numbers in the series 0, 3, 6, 12, 24. . .The relationship, considered by many to be coincidental, was promulgated by the German astronomer Professor Johann Daniel Titius (1729–1796) at Wittenberg in 1792 but was publicized by the German astronomer Johann Elert Bode (1747–1826), after whom it is known today.[87]

body measures Collective name for various primitive measuring systems. Despite its considerable variability, always widely used. Body measures include:[88]

finger or digit (fingerwidth)	= about 1.5 cm;
thumb (thumbwidth)	= about 2 cm;
palm (handwidth exclusive of thumb)	= about 7.5 cm;
hand (handwidth inclusive of thumb)	= about 9.5 cm;
shaftment (width of hand plus thumbshaft)	= about 16 cm;
span (tip-to-tip handspan)	= about 22 cm;
foot unclad or natural foot	= about 24.5 cm;
foot clad or shoe	= about 30 cm;
cubit (forearm length to fingertip)	= about 44 cm;
step (walking step)	= about 73.5 cm;
ell (various points across chest to fingertip)	= about 59–133 cm;
pace of 2 steps	= about 150 cm;
fathom (tip-to-tip arm-reach)	= about 180 cm.

See also *natural units*.

B.O.E., **bboe**, **BOE**, or **boe** [barrel of oil equivalent] A commercial unit of energy, based on the approximate energy released by burning

85 [TUNB, p. 60] and *The Electrical engineer*. London: Biggs & Co, 1889, p. 85.

86 enacademic.com

87 Neptune was not observed until after the death of Bode.

88 List inspired by [FENN, p. 51].

one barrel of crude oil.[89] The US Internal Revenue Service defines it as about 6.117 863 2 · 10^9 J = about 5.8 · 10^6 Btu = about 1700 kWh = about 6 m.c.f. of natural gas[90] = about 170 m^3 of natural gas. Some sources[91] say about 9.5 GJ = about 10 m.c.f. of natural gas. A commonly used multiple of the bboe is the kilo barrel of oil equivalent (kbboe or kBOE).

BogoMips [derived from "bogus" and MIPS] An unscientific measurement of CPU speed made by the Linux kernel when it boots, to calibrate an internal busy-loop. It is often defined as "the number of million times per second a processor can do absolutely nothing."[92]

Bohr, **Bohr length**, or **Bohr radius (a_0)** A unit of length used in particle physics. The bohr radius represents the mean distance between the proton and the electron in an unexcited hydrogen atom. It equals about 5.291 772 106 7 (12) · 10^{-11}.[93] The unit, proposed by Douglas Rayner Hartree (1897–1958) in 1928,[94] is named after the Danish physicist Niels Bohr (1885–1962), who explained the structure of atoms in a famous paper in 1913.

Bohr magneton (β or μ_B) or **Bohr unit** A unit of magnetic moment, used in atomic physics, defined as being = the moment of one electron spinning about its own center, or $\mu_B = eh/4\pi m_e c$, in which e = charge, h = Planck's constant, m_e = rest mass, and c = the velocity of light. The unit is named after the Danish atomic physicist Niels Bohr (1885–1962).[95] The name magneton was proposed in 1911[96] by the French physicist Pierre-Ernest Weiss (1865–1940). This unit, which is experimentally derived, is now known as the **Weiss magneton** = about 1/5 Bohr magneton = about 1.854 801 999 · 10^{-24} J T^{-1}. The definition above was first used by Herbert Stanley Allen (1873–1954) in 1915.[97] One Bohr magneton equals 9.274 009 994 (57) · 10^{-24} J T^{-1} according to CODATA 2014.

boiler horsepower or **horsepower** A unit measuring the power delivered by a boiler. The earliest measure of boiler output, called the "rated boiler horsepower," was simply based on the area of the boiler's heating surface. Each 10 ft^2 of surface represented 1 boiler horsepower. In 1876, the Committee of Judges adopted a "developed boiler horsepower," defined as the ability to turn 30 lb (13.61 kg) of 100°F (37.78°C) feedwater per hour into steam at 70 lb/in^2. In 1884, the Committee on Boiler Tests of the American Society of Mechanical Engineers defined the boiler horsepower as that amount of power that can convert 34.5 lb of water per hour from feedwater at 212°F to dry, saturated steam at the same temperature. In 1899, the committee adopted the unit as the "unit of commercial horsepower." The unit was defined by the Boiler Code Test Committee of the American Society of Mechanical Engineers (ASME) in 1915, as the power required to convert 30 lb (13.61 kg) of water at 100 °F (37.78 °C) to steam at 212 °F (100 °C) at a pressure of 70 lb/in^2 gauge (482.6 kPa gauge) = about 33,478.8 Btu/h = about 9809.5 W. One boiler horsepower has also been defined as being the power required to evaporate 34.5 lb (15.65 kg) of water to steam at 212 °F (100 °C) = about 33,471 Btu/h = 9807.2 W.[98]

bole Name suggested in 1888[99] by the British Association for the CGS unit of momentum (g cm/s).

bolometer A thermometric instrument used for the detection and measurement of radiant energy. Its essential component is a short narrow strip covered with a dead black absorbing coating and mounted at the lower end of a long cylindrical tube having a stop across it to exclude

[89] "By giving a BOE figure, analysts, investors and management can assess the total amount of energy the firm has access to, without breaking it down into barrels of crude oil, or the cubic feet of natural gas." (www.investopedia.com).

[90] Even refined gas varies in energy content per unit volume, which is why gas is normally priced on an energy basis.

[91] [FENN].

[92] en.wikipedia.org

[93] CODATA 2014.

[94] [HART].

[95] [RÖSE].

[96] [WEIS3].

[97] [ALLE3].

[98] Sizes.com, see also [MARK2].

[99] *Rep. Brit. Ass.*, 1888, p. 28.

unwanted radiation. The electrical resistance of the strip changes with the changes in temperature that arise from absorbing varying amounts of radiant energy.

bolometric magnitude Name of magnitude that takes into account all the radiation emitted by a star, whatever its wavelength. Because earth's atmosphere blocks some wavelengths, determining bolometric magnitudes is extremely difficult, and they have been found for only a few stars.

Boltzmann constant, **Boltzmann universal conversion factor**, or **universal conversion factor (*k* or k_B)** Name of the physical constant relating temperature to energy, or name of the ratio of the universal gas constant to Avogadro's number, = 1.380 648 52(79) · 10^{-23} J/K, according to CODATA 2014. It is named after the Austrian physicist Ludwig Eduard Boltzmann (1844–1906).

Bond number (Bo) A dimensionless number used in motion of bubbles and droplets calculations, normally defined as $[g(\rho - \rho_f) d^2]/(g_c \sigma)$, in which g = gravitational acceleration, g_c = dimensional constant, ρ = drople/bubble density, ρ_f = surrounding fluid density, d = droplet/bubble diameter, and σ = surface tension.

bone-dry ton (bdt) A unit used in the forest products industry to measure bulk products such as wood chips. One bone-dry ton is a volume of wood chips that would weigh 2000 lb = about 0.907 2 tonne.

bone-dry unit (bdu) A unit used in the forest products industry to measure bulk products such as wood chips. One bone-dry unit is a volume of wood chips that would weigh 2400 lb = about 1.088 6 metric ton if all the moisture content were removed.

B.O.T. or **B.o.T.** An abbreviation for Board of Trade.

bougie de l'étoile [F: = "star candle"] A unit of luminous intensity, during the nineteenth century, mainly used in France. The unit was sometimes referred to in English as a **French star candle**. It was defined as the luminous intensity of a standardized candle made of stearin burning at the rate of 10 g/h with a flame height of 52.4 mm = about ⅐ carcel.

bougie décimale (bd) In France, during nineteenth century, a unit of luminous intensity known as the **decimal candle**, originally defined in 1889 as 1/20 violle = 1/10 carcel = about 0.98 cd.

bougie nouvelle [F: = "new candle"] The name of a unit of luminous intensity, defined by the International Commission on Illumination (CIE) and the CIPM before 1937, but not promulgated by the CIPM until 1946, owing to World War II. Defined as the brightness of the full radiator at the temperature of solidification of platinum being 60 bougie nouvelle/cm^2. This definition was ratified by the ninth CGPM in 1948, and the name of the unit was changed to **candela**.

Boussinesq number (*Bo*) A dimensionless number, named after the French mathematician Joseph Boussinesq (1842–1929), used in the theory of convection. $Bo \equiv v/(2gL)^{1/2}$, in which v = speed of fluid flow, g = gravitational acceleration, and L = length.

BP An abbreviation for boiling point.

bpd An abbreviation for barrels per day, a unit of production used in the petroleum industry.

bpi An abbreviation for bit per inch.

bpp A French abbreviation for *bit par pouce* = bit per inch.

Bps or **B.p.s.** An abbreviation for bytes per second and *byte par seconde*.

bps or **b.p.s.** An abbreviation for bits per second and *bit par seconde*.

Bq The SI abbreviation for becquerel.

Bq/kg The SI abbreviation for becquerel per kilogram.

Bq/m The SI abbreviation for becquerel per metre.

Bq/m³ The SI abbreviation for becquerel per cubic metre.

Bq/mole The SI abbreviation for becquerel per mole.

brace [<L: *bracchia* = "both arms", that literally means "one for each arm"] or **lease** Another name for a pair. The word, known since the late sixteenth century, is used mostly in England in hunting and shooting. Hunters may speak of a brace of black game, pointers, setters, hares, grouse, partridges, pheasants, greyhounds,

quails, shotguns, or foxes.[100] The term brace is sometimes used in cricket for the act of taking two wickets with two successive deliveries of the ball. In mathematics, brace used to denote that there is a pair of something.

Brace-Lemon spectrophotometer Name for a spectrophotometer having a pair of identical collimators with two Glan polarizing prisms, one fixed in azimuth and the other rotatable, set in one collimator. A Brace prism serves as the dispersive element.

brake horse-power (bhp) See *horsepower*.

brick In the U.S., during the twentieth century, slang for a large quantity (often about 1 kg) of compressed street drugs, usually marijuana.

brick In the U.S., during the twentieth century, slang for a package of firecrackers containing 80 packs. A pack generally has 16 firecrackers.

brick In the U.S., during the twentieth century, military slang for a small unit in the military.

brieze [<Gr: = "heavy"] Name proposed for the kilogram in 1951 by the Italian Professor Giovanni Polvani (1892–1970). See also *bes* and *stathm*.

brig Name of the ratio of two quantities expressed logarithmically to the base 10, e.g., for quantities Q_1 and Q_2, the number of brigs = $\log_{10} Q_1/Q_2$.[101] Hence, 1 brig represents a ten-fold ratio. The brig is a generalization of the bel. It is named after the British mathematician Henry Briggs (1561–1630).

brigade A military unit, typically composed of two to five regiments or battalions, = 3500–5500 men. Usually, a brigade is a sub-component of a division. The brigade was invented during the Thirty Years' War as a tactical unit by the Swedish king Gustavus Adolphus (1594–1632).

briggsian logarithm An alternative name for the common logarithm. It is named after the British mathematician Henry Briggs (1561–1630). See *logarithm*.

[100] [SKIN2, pp. 74–75] and [JOHN4, p. 393].

[101] [MOOR].

bright, brightness A unit describing surface brightness, or reflectivity, especially of paper. The fraction of light reflected by a surface is called its *albedo*, and its brightness is the albedo expressed as a percentage.

bril A unit used to express the "brilliance" or subjective brightness of a source of light. A luminance of 1 lambert = 10,000 lux is defined as having a brilliance of 100 brils. Mathematically, the brilliance in brils equals (log L)/log 2 + 100, in which L is the luminance in lamberts. The bril scale was proposed by Robert M. Hanes (1890–1959) in 1949.[102]

British gravitational system A system of units, used by engineers in the English-speaking world, during the nineteenth–twentieth centuries. In the British gravitational system, the three base units are the foot, the second, and the pound-force.

British Parliamentary candle see *British standard candle*.

British standard candle or **British Parliamentary candle** A unit of luminous intensity legalized by the 1860 Metropolitan Gas Act[103] as = the luminous intensity of an actual standardized candle, made from spermaceti with a melting point of 112–115°F, with a bit of beeswax added to control brittleness. The length was 10 in. the bottom diameter 0.9 in and the top diameter 0.8 in. It burned at a rate of 120 ± 6 gr/h. Some sources describe the British standard candle as ⅞ inch in diameter, weighing ⅙th of a troy pound.[104]

British thermal unit (Btu, B.Th.U., or BTU) or **the heat unit** An obsolete unit of heat energy, defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. In America, the British thermal unit is sometimes called the heat unit. In defining the Btu, it is necessary to specify the temperature of the water; thus, there have been several definitions over the years. Originally, it was defined as the quantity of heat needed to raise the temperature of 1 pound avoirdupois

[102] [HANE].

[103] 23 & 24 Victoria, ch. 125, § 25 (1860).

[104] Sizes.com

of air-free water 1°F under a constant pressure of 1 atmosphere, starting at the temperature at which water is most dense, 39.1°F. Since the calorie is also defined in terms of a temperature interval and the mass of water heated, any definition of a calorie implies a definition of a Btu. One Btu is = 251.996 (small) calories = 0.251 996 of the (kilo)calories counted by dieters.

Other values of a Btu:

mean Btu (1/180 of the quantity of heat needed to raise the pound of water from 32° F to 212° F)	= about 1055.87 J;
International Table Btu (Btu_{IT}) (Based on the definition of the International Table calorie, exactly 4.1868 J, at the Fifth International Conference on the Properties of Steam, London, July 1956)	= exactly 1055.055 852 62 J;
thermochemical Btu (Btu_{th}) (Based on the definition of the thermochemical calorie, exactly 4.1840 J, by the U.S. Bureau of Standards in 1953)	= about 1055.350 J;
Btu, water	= 1054.54 J;
Btu, 39°F	= about 1059.67 J;
Btu, 59°F	= about 1054.80 J;
Btu, 60°F	= about 1054.68 J.

British thermal unit foot per square foot hour degree Fahrenheit (Btu · ft/(ft^2 · h · °F)) Anobsolete unit of thermal conductivity = about 1.073 073 W/(m · K).

British thermal unit foot per square foot hour degree Rankine (Btu · ft/(ft^2 · h · °R)) An obsolete unit of thermal conductivity = about 1.073 073 W/(m · K).

British thermal unit inch per square foot hour degree Fahrenheit (Btu · in/(ft^2 · h · °F)) An obsolete unit of thermal conductivity = about 0.144 228 W/(m · K).

British thermal unit inch per square foot hour degree Rankine (Btu · in/(ft^2 · h · °R)) An obsolete unit of thermal conductivity = about 0.144 228 W/(m · K).

British thermal unit per cubic foot (Btu/ft^3) An obsolete unit of calorie value (volume basis) = about 3.725 89 · 10^4 J/m^3.

British thermal unit per cubic foot hour (Btu/(ft^3 · h)) An obsolete unit of heat release rate = about 10.349 7 W/m^3.

British thermal unit per foot hour degree Fahrenheit (Btu/(ft · h · °F)) An obsolete unit of thermal conductivity = about 1.730 73 W/(m · K).

British thermal unit per foot hour degree Rankine (Btu/(ft · h · °R)) An obsolete unit of thermal conductivity = about 1.730 73 W/(m · K).

British thermal unit per foot second degree Fahrenheit (Btu/(ft · s · °F)) An obsolete unit of thermal conductivity = about 6230.64 W/(m · K).

British thermal unit per foot second degree Rankine (Btu/(ft · s · °R)) An obsolete unit of thermal conductivity = about 6230.64 W/(m · K).

British thermal unit per hour (Btu/h) An obsolete unit of heat flow rate = about 0.293 071 W.

Brix, **BRIX** or **degree Brix** (°**Bx** or °**Brix**) (or **Bailling** in Europe) In the U.S.,[105] a unit of proportion = percent, used in measuring the concentration of sugar in unfermented grape juice, fruit syrups, maple syrup, and similar solutions. One brix equals 1% = about 0.004 specific gravity points, so that a Brix of 0 equals 1.000 specific gravity. The unit is named after the German engineer Adolf Ferdinand Wenceslaus Brix (1798–1870), who invented a hydrometer that directly reads the percentage of sugar in the juice, provided the reading is taken at a specified temperature. See also *Bailling*.

brontobyte (BB) Term used in the world of computing to describe data storage space and

[105] In Germany, the Oechsle scale is used, and in France, they use the Baumé scale.

system memory. When referring to a brontobyte for disk storage, the hard drive manufacturers usually use the standard that a brontobyte is 1000 YB = 10^{27} bytes. When brontobyte is used for real and virtual storage, then 1024 YB is the appropriate notation.[106]

bruno A jocular[107] unit conceived by MIT students in 1972, equal to the volume of the indentation made in an asphalt pavement by an upright piano falling from a height of six stories. It has been determined experimentally to be about 1158 cm^3.[108]

Brun's constant A certain number to which the sum of the reciprocals of twin primes converge. The number, discovered by and named after the Norwegian mathematician Viggo Brun (1885–1978), is = (1/3 + 1/5) + (1/5 + 1/7) + (1/11 + 1/13) + . . . = about 1.902 160 582 4. . .[109]

b/sr An abbreviation for barn per steradian.

b/sr · erg An abbreviation for barn per steriadian erg.

b/sr · eV An abbreviation for barn per steradian electronvolt.

BT An abbreviation for *basse tension*.

B.Th.U. An informal abbreviation for British thermal unit.

Btu or **BTU** An abbreviation for British thermal unit.

Btu per hour (Btu/h) An obsolete unit of electrical power = 0.293 W.

Btu/h An abbreviation for British thermal unit per hour. See *Btu per hour*.

Btuh or **BTUH** A non-standard symbol used in the U.S. heating and airconditioning industry for British thermal units per hour, a unit of power. 1 Btuh = 0.293 071 W. The proper symbol is Btu/h.

BU An abbreviation for bitterness (or bittering) unit.

Bu A symbol for Bethesda unit.

bu An abbreviation for bushel (U. S.).

bu. An abbreviation for bushel in Britain.

Bubnoff unit (B) A standard measure for describing the rates of geologic and geomorphologic erosional processes[110] = the removal of 1 mm of surface material per thousand years. The unit, defined in 1969 by the German–American geologist Alfred George Fischer (b. 1920), is named after the German-Baltic geologist Serge von Bubnoff (1888–1957).

bucking in To place an instrument so that its line of sight passes through two given points or fulfills two requirements simultaneously.

bulk A term used for the property possessed by a large mass.

Bunit or **bunit** An occasionally used abbreviation for billion units.

buoyancy The power to float or rise in a fluid.

buoyant force A upward force which any fluid exerts on a body placed in it.

Bureau International des Poids et Mesures (BIPM) [English translation: International Bureau of Weights and Measures] International organization created by the Metre Convention signed by seventeen nations in Paris on May 20, 1875, during the last session of the Diplomatic Conference of the Metre.[111]

Burger number (Bu) A dimensionless number for atmospheric or oceanographic flow, expressing the ratio between density stratifycation in the vertical and the earth's rotation in the horizontal. Bu = $(NH)^2/(\Omega L)^2 = (\mathrm{Ro})^2/(\mathrm{Fr})^2 = (\mathrm{R_D})^2/L^2$, in which N is the Brunt–Väisälä frequency, Ω is the angular rotation rate of the earth, H is the scale height of the atmosphere, L is a horizontal length scale of typical motions, Ro is the Rossby number, Fr is the Froude number, and R_D the Rossby deformation radius.[112] It is named after the mathematician and meteorologist Alewyn P. Burger (1927–2003).

bW or **BW** A German abbreviation for *Blindwatt*.

[106] whatsabyte.com

[107] A parody of the method for measuring, e.g., brinell hardness.

[108] [PETE3].

[109] Calculated by Thomas Nicely, a professor of mathematics at Lynchburg College.

[110] [FISC2].

[111] [TERR3] and [CHES].

[112] [CUSH, p. 320].

bya or **Bya** A common abbreviation, in English-speaking countries, for “billion years ago.”

byte (B) [sometimes called **octet**] A unit of information, used in computer engineering, = the amount of storage used for a single character. Typically, this is 8 bits, which means that a byte has $2^8 = 256$ possible states. The unit was named by IBM engineer Werner Buchholz (b. 1922) in 1956, and the 8-bit size was popularized shortly thereafter by the introduction of the IBM/360. Although various machines have used other byte sizes, such as 6 or 9 bits, 8 bits is now well established as the norm.[113] See also *nibble*.

3 C

C [<L: *centum*: “hundred”] A symbol for the Roman numeral 100. Sometimes C is used as a unit of quantity or as a prefix meaning 100, as in Cwt (hundredweight) or CCF (100 cubic feet). See also *cent*.

C An abbreviation for capacitance and coulomb.

C An obsolete abbreviation for curie.

C A unit of relative current for batteries. For a particular battery, a current of 1C is a current in amperes numerically = the rated capacity of the battery in ampere hours.[114]

C A symbol for Euler’s constant.

C See *centigrade*.

°**C** An abbreviation for degree Celsius.

C° A French abbreviation for *Degré Celsius* = degree Celsius.

c [<L: *celeritas* = “swiftness”] A symbol for the speed of light. One of the fundamental principles of physics is that all electromagnetic radiations in a vacuum always travel at the same velocity in a vacuum, exactly 299,792,458 m/s.[115] In calculations involving relativity, speeds are customarily expressed as fractions of the speed of light, such as 0.96 *c*.[116]

c or **C** An abbreviation for centigrade.

c An abbreviation for the prefix centi-.[117]

c An abbreviation for continuum, one form of infinity in mathematics.

c An obsolete informal abbreviation for cubic; used for ccm (cm^3), cdm (dm^3), and cmm (mm^3).

c An obsolete abbreviation for cycle.

c An abbreviation for cup.

c An obsolete abbreviation for curie.

c An obsolete abbreviation for metric carat.

ca An abbreviation for centiare.

caballería In Librilla, in the Spanish province of Murcia, a unit of water entitlement in an irrigation system = enough water to irrigate a caballería of land.[118]

cadastral . . . A prefix = “survey”.

cadil Name used in the early planning of the metric system for the unit subsequently renamed the litre in 1795.

cal, **cal$_{15}$**, **cal$_2$0**, **cal$_{IT}$**, **cal$_{th}$** An abbreviation for calorie, calorie (15°C), calorie (20°C), calorie (I.T.), and calorie (thermochemical).

Cal An obsolete abbreviation for kilocalorie (kcal).

calibre or **calibre**[119] **(cal)** [<Arabic: *quâlib* = “mold”] A unit used to express the diameter of the bore of a gun.[120] Traditionally, the diameter was stated in inches, so that “0.303 caliber” or “three-oh-three” is 0.303 in = about 7.696 2 mm, and “0.22 caliber” or “twenty-two” referred to a pistol having a bore of 0.22 in = about 5.588 mm. This usage is declining, because bore diameters of many guns are now stated directly in millimetres, as in “calibre of eighty-eight millimetres” (88 mm).

caliber (cal) A measure of the relative length of a gun barrel, defined as the length from breech

[113] [RAYM].

[114] [SAND3].

[115] physics.nist.gov/cgi-bin/cuu

[116] Historical references: [MICH] and [NEWC2].

[117] Strictly lower-case.

[118] [RUIZ, pp. 178–179].

[119] “Caliber” is the American spelling; elsewhere the unit is often spelled “calibre.”

[120] The bore is the inside diameter of the gun barrel. In a rifled barrel, the distance is measured between the lands.

to muzzle divided by the diameter of the bore. Thus, a "50-caliber" gun on a warship has a barrel 50 times longer than its bore.

calibrate To determine by measurement or comparison the correct value of each scale reading on a metre or other device being calibrated, or to determine the settings of a control that corresponds to particular values of some characteristic.

calibration A process whereby the magnitude of the output of a measuring instrument is related to the magnitude of the input force actuating that instrument.

calibration of an instrument A process of validating the output of an observing system against known reference observations or standards.

caliper Name of the thickness of a sheet of paper or card stock. Traditionally, it was measured in points (thousandths of an inch), but caliper is now usually measured in microns (micrometres). The word "caliper" is sometimes used in place of the proper unit, as in "0.005 caliper" (5 points) or "80 caliper" (80 microns).[121]

Callier coefficient (Q) A coefficient designated by Callier as the ratio between the density of photographic negatives measured by parallel light and that measured by diffuse light, due to scattering effects. The average value of the coefficient Q is estimated at 1.4 ± 0.2.[122]

calorie (cal), **gram-calorie**, or **small calorie** [<L: *calor* = "heat"] A CGS unit of heat energy = the amount of heat required at a pressure of one atmosphere to raise the temperature of one gram of water by one degree Celsius. As it varies with the temperature of the water, it is necessary to specify at which degree Celsius. A traditional choice for physicists and chemists was the degree from 14.5°C to 15.5°C; raising the temperature of water through this range requires about 4.185 8 J (NBS, 1939) or about 4.185 5 J (CIPM, 1950), a quantity called the 15°C calorie (cal_{15}), or sometimes water calorie 20°C calorie (cal_{20}), = about 4.181 9 J. The mean calorie (cal_{mean}) denotes the mean over the range 0–100°C = about 4.190 02 J.

Calorie (Cal or **kcal)**, **kilogram-calorie**, **kilocalorie**, or **large calorie** [<L: *calor* = "heat"][123] A MKS unit of heat energy = the amount of heat required at a pressure of one atmosphere to raise the temperature of a kilogram of water by 1°C = 1000 small calories = 4.186 8 kJ = about 3.968 3 Btu.

calorie (international-), **international table calorie**, or **IT calorie** (**cal_{IT}**) [<L: *calor* = "heat"] A unit of heat energy. It was defined in 1929, by the International Steam Table Conference in London, as 1/860 of the international watt hour = 4.186 0 J. The adoption of the absolute system of electrical units changed the values to 1/859.858 Wh = about 4.186 74 J. The Fifth International Conference on the Properties of Steam, in July 1956 defined it as exactly 4.186 8 J = about 0.003 968 32 Btu.[124] When the name calorie or symbol cal are used unspecified after July 1956, they refer to the international table calorie.[125]

calorie (thermochemical-) (**cal_{th}**) [<L: *calor* = "heat"] A unit of heat energy, used in some branches of chemistry, defined by the U. S. Bureau of Standards in 1953 as exactly 4.184 0 J.

calorie per centimetre second degree Celsius (cal_{IT}/cm·s °C) A unit of thermal conductivity = 4.186 8 dW/m·K.

calorie per centimetre second kelvin (cal_{IT}/cm·s·K) A unit of thermal conductivity = 4.186 8 dW/m·K.

calorie per degree Celsius (cal_{IT}/°C) A unit of heat capacity = 4.186 8 J/K.

calorie per gram degree Celsius (cal_{IT}/g·°C) A unit of specific heat capacity and specific entropy = 4.186 8 kJ/kg·K.

calorie per gram (cal_{IT}/g) A unit of specific internal energy = 4.186 8 kJ/kg.

[121] www.unc.edu/~rowlett

[122] www.photonics.com

[123] This unit is often distinguished from the small calorie by capitalizing its name and symbol.

[124] This value was suggested by E. J. Le Fevre because it is evenly divisible by 9.

[125] [SCHM].

calorie per gram kelvin (cal_{IT}/g·K) A unit of specific heat capacity and specific entropy = 4.186 8 kJ/kg·K.

calorie per kelvin (cal_{IT}/K) A unit of heat capacity = 4.186 8 J/K.

calorie per second (cal_{IT}/s) A unit of heat flow rate = 4.186 8 W.

calorie per second centimetre degree Celsius (cal_{IT}/s·cm °C) A unit of thermal conductivity = 4.186 8 dW/m·K.

calorie per second centimetre kelvin (cal_{IT}/s·cm·K) A unit of thermal conductivity = 4.186 8 dW/m·K.

calorie per second square centimetre degree Celsius (cal_{IT}/s·cm^{2}· °C) A unit of coefficient of heat transfer = 41.86 8 kW/m^2·K.

calorie per second square centimetre kelvin (cal_{IT}/s·cm^2·K) A unit of coefficient of heat transfer = 41.868 kW/m^2·K.

calorie per square centimetre second degree Celsius (cal_{IT}/cm^2·s·°C) A unit of coefficient of heat transfer = 41.868 kW/m^2·K.

calorie per square centimetre second kelvin (cal_{IT}/cm^2·s·K) A unit of coefficient of heat transfer = 41.868 kW/m^2·K.

candela (cd) [<L: *candela* = "candle"] A fundamental SI unit of luminous intensity. The candela has been defined, since October 1979 (the 16th CGPM, Resolution 3), as being the luminous intensity of a light source producing single-frequency light at a frequency of 540 THz with a power of 1/683 watt per steradian = 18.398 8 mW over a complete sphere centered at the light source. The frequency of 540 THz corresponds to a wave length of approximately 555.17 nm. In order to produce one candela of single-frequency light of wavelength *l*, a lamp would have to radiate 1/(683*V*(*l*)) watts per steradian, in which *V*(*l*) is the relative sensitivity of the eye at wavelength L. Values of *V*(*l*) are defined by the International Commission on Illumination (CIE).

candela per square centimetre (cd/cm^2) An obsolete SI unit of luminance = exactly 10 kcd/m^2. Formerly called a stilb.

candela per square foot (cd/ft^2) An obsolete unit of luminance = 1.076 39 kcd/m^2.

candela per square inch (cd/in^2) An obsolete unit of luminance = 1.550 00 kcd/m^2.

candela per square metre (cd/m^2) It is the SI unit of luminance, = 10^{-4} cd/cm^2 = π ασβ. Formerly called a nit.

candle Name of several obsolete units of luminous intensity. Standardized candles, often made of spermaceti, were replaced by various standardized lamps burning pure chemical compounds, then by blackbody radiators at the temperature of freezing platinum, and finally by the redefined candela in SI. See *British standard candle*, *decimal candle*, *international candle*, *Metropolitan Gas Referees Notification candle*, *Munich candle*, *new candle*, and *Vereinskerze*. See also *bougie nouvelle*, *carcel unit*, *Hefner candle* and *violle*.

candle (cd) or **new candle** Older name of the unit now known officially as the candela, or for the candlepower. See also *bougie nouvelle*, *Hefner candle*, and *international candle*.

candle-foot See *footcandle*.

candlepower or **candle power (cp)** A unit formerly used for measuring the light radiating capacity of a lamp or other light source. One candlepower represents the radiating capacity of a light with the intensity of one "international candle."

cantle Name in Britain for a heap in the normal sense.

cap or **cap strength** Measures the ability of stable air aloft (a layer of relatively warm air) to inhibit low-level parcel ascent. Empirical studies show that a cap greater than 2°C often precludes thunderstorms in the absence of a strong dynamical or forced lift.

Capillary number (*Ca*) A dimensionless number in momentum transfer in general and atomization and 2-phase flow in beds of solids calculations in particular. It is normally defined as (ρ v)/(g_c σ), in which ρ = density, v = velocity, g_c = dimensional constant, and σ = surface tension.

capnometer A instrument incorporating an infrared detector assembly, used to analyze carbon dioxide gases and in medical applications to monitor air exchange in the lungs of patients on ventilators or under anesthesia.

capon unit (CU) or **capon-comb unit** A unit of androgenic activity. One CU is the smallest amount of any substance having androgenic activity that, given on two successive days to a capon (a rooster whose testicles have been removed), causes its comb to enlarge 20%. 1 mg of androsterone has an activity of about 10 CU.[126]

carb, **carbo**, **carb unit**, **choice**, or **exchange** An informal unit used in the treatment of diabetes = 15 g of carbohydrates. The significance of 15 g is that, in a very rough way, that quantity of carbohydrate requires about 1 g of injected insulin for patients with Type I diabetes. The actual ratio between carbohydrate and insulin varies considerably from patient to patient.

carb An informal unit = 1 g of carbohydrate, commonly used in describing low-carbohydrate diets such as the Atkins diet. This newer usage of the term "carb" conflicts with the traditional use by diabetics.[127]

carboy [<Arabic: *qarraba* = "big jug"] Name of a large glass or plastic container, often used in fermenting beverages such as wine, mead, and beer, of no standard size.[128]

carcel or **carcel unit** An obsolete unit of luminous intensity, formerly used in France, defined as the horizontal intensity of a Carcel lamp burning 42 g of colza oil/h, with a flame 40 mm in height = 10 bougie decimal. Its illuminating power was variously stated as being from 8.9 to 9.6 British standard candles. Comparisons[129] were made by Parterson in England in 1904, by Perot and Janet at the Conservatoire National des Arts et Métiers, Jouaust and Laporte at the Laboratoire Central d'Electricité in France and Liebenthal in Germany in 1906, by Hyde in the USA in 1907, and by Rosa and Crittenden in the USA in 1914. These measurements gave the following results: 1 French decimal candle = 1 English candle = 1/0.9 Hefner candle with an uncertainty of 2%. Later, the carcel was stated as being about 9.61 international candles = about 9.6 candle Hefner = about 0.92 international candles (ICP) = about 1.02 candle Violle = 0.974 cd. The unit is named after the French inventor Bernard G. Carcel (1750–1818), who, in 1800, invented an Argand lamp containing a clockwork mechanism that pumps the oil from a reservoir at the bottom up into the wick.[130]

Carmichael number Name of an odd composite number n which satisfies Fermat's little theorem $a^{n-1} - 1 \equiv 0 \pmod{n}$, for *every* choice of α satisfying $(\alpha, n) = 1$ (i.e., α and n are relatively prime) with $1 < \alpha < n$.[131] Ther numbers are named after the American mathematician Robert D. Carmichael (1879–1967). The first Carmichael numbers are 561, 1105, 1729, 2465, 2821, 6601, 8911, 10585, 15841, 29341, 41041, 46657, 52633, 62745, 63973, 75361, 101101, 115921, 126217, 162401, 172081, 188461, 252601, 278545, 294409, 314821, 334153, 340561, 399001, 410041, 449065, 488881, and 512461.[132]

Carnegie unit A unit of academic credit, used in college admissions decisions in the U.S. The unit was introduced by the Carnegie Foundation for the Advancement of Teaching in 1907[133] to provide colleges with a standard measure of students' course work in high schools. A Carnegie unit represents the equivalent of one academic year of study in a subject in a class meeting 4 or 5 times a week for 40–60 min per meeting, a minimum of 120 h of total class time.[134]

cartload An obsolete unit of capacity which generally did not have any standard dimensions, but referred to an arbitrary amount of goods loaded on a 2-wheeled boxcart. Somtimes equal to the fother.

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126 [DIEM, p. 751].

127 See previous entry.

128 Carboys come in various volumes ranging from 1 gal to 15 gal.

129 See cie.kee.hu/symp99/doc/Bastie.doc

130 [WEB13], [NEWM, p. 2] and Sizes.com

131 [CARM].

132 See also: [ALFO].

133 Carnegie Foundation for the Advancement of Teaching, *Annual Report*, 1907.

134 See also: [NATI2].

carton A unit of volume. The size of a carton is usually not standardized, but certain sizes are customary. In the U.S. citrus fruit industry, a standard carton is = ½ box = 0.8 bu = about 28.191 L.

cascade unit, **radiation length**, or **radiation unit** (***X*₀**) A unit of length, used in cosmic ray work, = the mean path length in a given medium to reduce the energy of a charged particle by 50% = 1/ln2 times the shower length = about 1.442 shower length.[135] See also *shower unit*.

castellation A unit of angle measure, used in mechanical engineering, = 1/6 turn = 60°. A castellated nut is a locknut having a raised rim with a number of equally spaced slots, usually 6. A cotter pin fits into one of the slots and into a hole bored in the bolt, holding the nut in place with a precise degree of torque, or "tightness." To turn the nut one castellation, one has to turn it from one slot to the next by 1/6 turn.

catal (cat) A unit, used before 1969, that was recommended by the International Union of Pure and Applied Chemistry and the International Federation for Clinical Chemistry. One catal was said to equal the catalytic amount of a system which catalyses as many cycles per second of a stated reaction scheme as there are atoms in 0.012 kg of the pure nuclide ^{12}C.[136]

Catalan numbers (***C**n*, ***c(n)***, or ***u*n**) or **Segner numbers** Name of a sequence of natural numbers that occur in various counting problems and the solution to Schroeder's first problem. C(n) = binomial (2n,n)/(n + 1) = (2n)!/(n! (n + 1)!) = 1, 1, 2, 5, 14, 42, 132, 429, 1430, 4862, 16,796, 58,786, 208,012, 742,900, 2,674,440, 9,694,845, 35,357,670, 129,644,790, 477,638,700, 1,767,263,190, 6,564,120,420, 24,466,267,020, 91,482,563,640, 343,059,613,650, 1,289,904,147,324, 4,861,946,401,452, ... The numbers are named after the Belgian mathematician Eugène Charles Catalan (1814–1894), who discovered the connection to parenthesized expressions during his exploration of the Towers of Hanoi puzzle.[137]

Cauchy number (***C***) or **Hook number** A dimensionless number in momentum transfer in general and compressible flow calculations in particular. It is normally defined as $(\rho\ v^2)/(g_c\ E_b)$, in which ρ = density, v = velocity, g_c = dimensional constant, and E_b = bulk modulus of fluid.

Cavitation number (**σ_C**) A dimensionless number used in momentum transfer in general and throttling calculations in particular. It is normally defined as $[2\ g_c\ (p - p_v)]/(\rho\ v^2)$, in which g_c = dimensional constant, p = local static pressure, p_v = vapor pressure, ρ = density, and v = velocity.

cavity radiometer A self-calibrating pyrheliometer or device for measuring direct solar radiation. The receiver (cavity) is typically conical in shape, with precision temperature sensors and heaters. Operating at an equilibrium temperature, direct electrical power to the heater is decreased if solar radiation is added to the receiver (or added if solar radiation is removed). The electrical power necessary to maintain equilibrium is equivalent to the change in incident solar radiation.

cb- An abbreviation for "cubic," seen in combinations such as cbm (cubic metre) or cbft (cubic foot).

cbm The German abbreviation for *Kubikmeter* = cubic metre (m³).

cc An alternate symbol for the cubic centimetre (cm³). This symbol is obsolete and should not be used; cm³ should be used in its place.

cc or **^{cc}** A symbol for the centesimal second.

... **^{cc}** An abbreviation for one hundredth of a centigrade (centesimal second).

CCF An abbreviation for 100 cu ft. Local water and sewer utilities often sell water in CCF units, which equal about 748.05 U.S. gallons = about 2831.7 L. When it comes to selling natural gas, the CCF is a unit of energy roughly equivalent to the them.

[135] The mean path length in air at s.t.p. = about 332 m, in water = about 433 mm, and in lead = about 50 mm.

[136] [DYBK. p. 28].

[137] See also: [PÓLY].

ccm An alternate obsolete symbol for the cubic centimetre (cm^3).

CCs A unit of telecommunications traffic = 100 call-seconds. One CCS could represent a single call 100 seconds long, or 10 calls each 10 seconds long, etc. One CCS equals 1/36 erlang.

cd An abbreviation for candela.

cd/m² An abbreviation for candela per square metre.

cd/sf An abbreviation for candela per square foot.

CDU A French abbreviation for *Classement Décimal Universel*.

CE The French abbreviation for *colonne d'eau*, water column, seen in pressure measurements. See *centimetre of water* and *millimetre of water*.

celo A suggested unit of acceleration in the British f.p.s.-system = 1 ft/s^2 = about 0.304 8 m/s^2. See also *leo*.

Celsius See *degree Celsius*.

Celsius heat unit (Chu, c.h.u., or **CHU)**, **centigrade heat unit**, or **pound centigrade unit (Pcu)** During the nineteenth–twentieth centuries, a rarely used unit of heat energy = the energy required to raise the temperature of 1 lb of water by 1°C at standard atmospheric pressure. 1 Chu is = exactly 1.8 Btu = about 453.592 37 IT calories = about 1.899 101 kJ.

CEM An abbreviation for Centro Español de Metrología.

CENAM An abbreviation for Centro Nacional de Metrologia.

CENAM An abbreviation for Centro Nacional de Metrología de Panamá.

cent An obsolete dimensionless unit used in music, especially in the U.S. and in Germany. One cent was said to equal ¹⁄₁200 part of an octave = 1/100 semitone. If two notes differ by 1 cent, the ratio between their frequencies was 2 $^{1/1200}$ = about 1.000 5778. The unit was defined by Alexander John Ellis (1814–1890) in 1884.[138]

[138] Presented in the appendix of his English translation of Hermann von Helmholtz' book *Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik*.

cent In the U.S., a dimensionless unit used in nuclear engineering to describe the "reactivity" of a nuclear reactor = 0.01 dollar.[139] See also *inhour*.

cental (cH or **ctl)**, **new hundredweight**, or **kintal** In Britain and most English-speaking countries, an alternate name for the U.S. hundredweight, which is = exactly 100 lb (the British hundredweight is 112 lb) = 45.359 237 kg. It was officially discounted in 1985. After metrification, sometimes also used for 100 kg.

centare [centi-are] An obsolete alternative name for the metric unit 1 m^2.

centesimal... with divisor/multiplier steps of 100, in contrast with the steps of 10 for decimal.

centesimal degree A temperature scale with steps of 100°, such as the Celsius scale. See *degree Celsius*.

centesimal minute (...$^{\mathbf{c}}$ or ...$^{\mathbf{cg}}$) A unit of plane angle measure, sometimes used in surveying. In the centesimal system, the right angle is divided into 100 grads or gons. Each gon is divided into 100 centesimal minutes (or centigons). Thus, the centesimal minute equals 10^{-2} grade = 1.570 80 · 10^{-4} rad = 0.009° = about 0.54 arcminute = about 32.4 arcseconds.[140]

centesimal second (...$^{\mathbf{cc}}$) or **decimilligrade** A unit of plane angle measure sometimes used in surveying. In the centesimal system, the right angle is divided into 100 grads or gons. Each centesimal minute is devided into 100 centesimal seconds. Thus, the centesimal second equals 10^{-4} grade = about 1.570 809 · 10^{-6} rad = 0.000 09° = about 0.324 arcseconds.[141]

centesimal thermodynamic scale An early name for the Celsius scale, but now more likely to mean the kelvin scale. See *degree Celsius* and *kelvin*.

centisimi See *centisimo*.

centesimo [<Ital. = "hundredth"; *pl.* centisimi] In Naples, Italy, after 1840, a metric

[139] [NATI, p. 27].

[140] The name centesimal minute has sometimes been used for centigrade.

[141] The name centesimal second has sometimes been used for one hundredth of a centigrade.

expression for 1/10 decimo = 10 millesimi = about 2.6 mm as a unit of length, about 0.07 a as a unit of land area, about 7.3 mL for liquids, and 10 trappesi = about 8.9 g as a unit of weight.

centesimo [Ital. = "hundredth"; *pl.* centisimi] In Italy, before 1840, an occasionally used metric expression for 1/100 of any unit.

centi- (c-) [<L: *centum* = "one hundred"] A metric and SI prefix = 0.01. It should be avoided as much as possible and used only where well-established in practice.[142] Examples: centigrade $(\ldots^{cg})$, centigram (cg), centilitre (cl), centimetre (cm), centipoise (cP), and centistokes (sSt). In Chinese, the centi- is li.

centiare (ca) A metric unit of area = 0.01 are = exactly 1 m^2. This unit should be avoided.

centibar (cbar or **cb)** A metric unit of pressure identical to the kPa. One centibar equals 0.01 bar = 7.500 6 torr = 0.145 0 lbf/in^2. The centibar is traditionally used in agriculture as a unit of soil water tension (the water pressure on the roots of plants) as measured by devices called tensiometers.

centigon (cgon) A unit of angle measure = 0.01 gon = 0.01 grad = 0.000 1 right angle = 0.009° = 0.54 arcminute = exactly 32.4 arcseconds.

centigrade $(\ldots^{cg})$ See *centesimal minute*.

centigrade See *degree centigrade*.

centigrade; one hundredth of a ~ $(\ldots^{cc})$ or **centesimal second** A unit of plane angle = 10^{-4} grade = about 1.570 809 · 10^{-6} rad. See also *centesimal second*.

centigrade heat unit See *Celsius heat unit*.

centigrade scale See *degree Celsius*.

centigram or **centigramme (cg)** An undesirable metric and SI unit of weight = 1/100 g = 10 mg.

centigramme See *centigram*.

centihg [pronounced "sentig"] A informal and rarely used unit of pressure = 1 cm of mercury. This is equivalent to 10 mm Hg = about 0.393 7 in Hg = 0.1933 lb/in^2 = 13.332 24 mbar = 1 333 224 Pa.

centiliter or **centilitre** (SI: **cl or cL**; metric: **cl)** A common, but undesirable, metric and SI unit of capacity = 10 cm^3 = about 0.610 24 cubic inch = 0.331 8 US fl oz = 0.351 9 Imp fl oz. In the kitchen, a centiliter is roughly = 2 U.S. teaspoons.

centillion Name of the number 10^{600} in the UK-system.

centiMcClintock (cMC) A unit in a coordinate system for cytogenetic maps, used in the study of the genetics of corn (*Zea mays*). The area from a chromosome's centromere to each of its tips is taken to be divided into 100 centiMcClintocks.[143] The unit is named after the American cytogeneticist Barbara McClintock (1902–1992), winner of a Nobel Prize in 1983.

centimeter or **centimetre (cm)** A metric, CGS and SI unit of length, used as a fundamental unit in the building and textile industries, = 0.01 m = about 0.393 700 787 in.

centimeter (cm) An obsolete name for the statfarad = 1.11 pF, the CGS electrostatic unit of capacitance.

centimeter (cm) An obsolete name for the abhenry, the CGSm unit of inductance. The abhenry is the same as the nanohenry.

centimetre per second squared (cm/s^2) An obsolete CGS unit of linear acceleration = 10^{-2} m/s^2. This unit was also called a galileo or gal.

centimetre second degree Celsius per calorie (cm · s · °C/cal_{IT}) An obsolete unit of thermal resistivity = 2.388 46 · 10^{-3} m · K/W = about 2.777 78 · 10^{-4} m · h · °C/$kcal_{IT}$ = about 4.133 79 · 10^{-3} ft · h · °F/Btu.

centimetre squared per second (cm^2/s) See *stokes*.

centimetre to the fourth power (cm^4) An obsolete CGS unit of second moment of area = 10^{-8} m^4.

centimetre of mercury (cmHg) An obsolete unit of pressure = 10 mmHg = 1.333 22 kPa

centimetre of water (cmH_2O, cm WC, cm CE, cm WS) A unit of pressure, used in respiratory medicine, = the pressure exerted at the

[142] In Britain, a legal prefix only for centimetre and centilitre.

[143] The entire chromosome is 200 centiMcClintocks long.

Earth's surface by a water column (WC) 1 centimetre high. This is about 98.067 Pa = 0.980 67 mbar = about 0.393 7 inch of water = about 2.04 lb/ft^2. The French symbol is cm CE (*colonne d'eau*), and the German symbol is cm WS (*Wassersäule*).

centimillesimi See *centimillesimo*.

centimillesimo [Ital. = "hundred-thousandth"; *pl*. centimillesimi] In Italy, before 1840, an infrequently used name for 1/100,000 of any unit, but usually 1/100 millesimo.

centimillion Word sometimes used incorrectly to mean 100 million (10^8). This is a serious misuse of the metric prefix centi-, which means 1/100. The number 100 million could be called a hectormillion.

centimorgan (cM) A unit of genetic separation used in genetics and biotechnology. If two locations on a chromosome have a 1% probability of being separated during recombination in a single generation, then the distance between those locations is one centimorgan. The morgan is not used, only the centimorgan. Typically, a genetic distance of 1 cM corresponds to a physical distance of roughly one million base pairs = about 0.003 mm. Different mappings of genomes are possible. The most common is that of John Burdon Sanderson Haldane (1892–1964), a purely mathematical function,[144] and that of Damodar Dharmananda Kosambi (1907–1966), which also incorporates an empirical term.[145] Thus, one has to distinguish between "Haldane centimorgan" and "Kosambi centimorgan."[146] The unit is named after the American geneticist Thomas Hunt Morgan (1866–1945). The centimorgan is sometimes called a "*map unit*" or "*local map unit*" (and then abbreviated as mu or LMU).[147]

centinewton (cN) A metric unit of force = 0.01 N. This unit has some popularity in engineering as a substitute for the gram of force (gf), since it equals about 1.019 72 gf. In the textile industry, the breaking strength of fibers is commonly expressed in centinewtons per tex.

centipoise (cP, cPs, cps, or **cPo)** In the CGS system, a unit of dynamic viscosity of water at 20 °C (68 °F) = 0.01 poise = 1 mPa·s. The correct symbol for the unit is cP, but sometimes incorrect abbreviations such as cPs, cPo, and even cps are seen.

centiradian A unit of angle measure = 0.01 radian = about 0.572 958° (34′ 22.65″).

centistokes (cSt) A common metric unit of kinematic viscosity = 0.01 stokes = $1 \cdot 10^{-6}$ m^2/s = 1 mm^2/s. The kinematic viscosity of water is often considered to be about 1.003 8 cSt.[148]

centrad An informal name for the centiradian = 1/100 rad. This unit was used to specify angles of deviation of narrow angle prisms.

century A unit of quantity = 100. In ancient Rome, a "century" was originally a company of about 100 soldiers led by an officer called a centurian.

cfm, CFM, cfs, CFS Abbreviations for cubic feet per minute and cubic feet per second, respectively. 1 cfm = 28.317 L/min and 1 cfs = 28.317 L/s.

CFS-Day A volume of water represented by a flow of 1 cubic foot per second for 24 h = 86,400 cubic feet = 1.983471 acre-feet = 646 317 gal.

CFSM [Cubic Feet per Second per square Mile] An average number of cubic feet of water per second flowing from each square mile of area drained by a stream, assuming that the runoff is distributed uniformly over time and area. 1 ft^3/s = the discharge of a stream of rectangular cross section, 1 f. wide and 1 f. deep, of flowing water at an average velocity of 1 ft/s.

CFU An abbreviation for colony forming units, a count of the number of active bacterial cells in preparations of *Lactobacillus acidophilus* and other "friendly" organisms of the digestive

[144] [HALD].

[145] [KOSA].

[146] See: [WELL2, pp. 6–9].

[147] Sizes.com

[148] According to: [SWIN6]. Later, somewhat different values have been reported, but for many years, this value was used as a standard.

system. Counts as high as one billion CFU per gram are not uncommon.

...^{cg} A abbreviation for centigon.

cg SI and metric abbreviation for centigram.

CG An erroneously used abbreviation for centigram.

CGPM Acronym from the French *Conférence Générale des Poids et Mesures*, the General Conference on Weights and Measures. The CGPM is an assembly of delegates from all the nations that have signed the Metre Convention. The conference elects the 18 members of the CIPM, and also makes major decisions concerning the operation of the BIPM.[149]

CGS-e unit See *CGS-esu*.

CGS-emu or **CGSm unit** A unit of the so-called electromagnetic CGS system.

CGS-esu or CGSe unit A unit of the so-called electrostatic CGS system.

CGSm unit See *CGS-emu*.

CGS systems of units or **centimetre-gram-second systems of units** A systems of units used in scientific work from the late nineteenth–early twentieth centuries. In the U.S., it was abbreviated as cgs, and in the rest of the world, C.G.S.

ch An abbreviation for chain.

cH An abbreviation for cental.

CH50 unit A name of "the amount of complement that will lyse 50% of a standard preparation of sheep red blood cells coated with antisheep erythrocyte antibody."[150]

chad A proposed unit in nuclear physics. The unit is named after the English physicist Sir James Chadwick (1891–1974).[151] There were two suggested definitions: 1 neutron/cm^3 and 10 ^{12} neutrons/(cm^2 · s).[152]

Chaitin's constant (Ω) An example of a definable number which is not computable, given by the Argentine–American mathematician and computer scientist Gregory John Chaitin (b. 1947).

Champernowne's constant (C_{10}) A certain real number,[153] named after the British mathematician David Gawen Champernowne (1912–2000), is the number obtained by concatenating the positive integers and interpreting them as decimal digits to the right of a decimal point, described in base ten as 0.123 456 789 10 11 12 13 14 15...[154]

char An abbreviation, in informatics, for character.

character (char) A unit of information used in computer science and telecommunications. One character is usually = 8 bits or one byte. A new coding system, Unicode, assigns 16 bits or 2 bytes to each character code.

character per inch (CPI) See *pitch*.

charity A generous measure used in selling, as a sweetener to the buyer.

chawmp A unit of information, used in computer science, = 16 or 18 bits.

chen [<Mandarin-WG: = "billionth"], **ch'en** [<Mandarin-PY: = "billionth"], or **chhen** [<Mandarin-mWG: = "billionth"] A prefix used in mandarin as an equivalent to nano, with a following qualified unit for modern measures. Sometimes used without a following unit.

chiliad [pronounced "killiad"] A unit of quantity = 1000 elements or people. Sometimes also as 1000 years: a millenium. The word derives from the ancient Greek numeral 1000, *chilioi*, which is also the origin of the metric prefix kilo-.

chill hour or **chilling hour** A unit of measure for fulfillment of plant dormancy requirements prior to the start of springtime growth, especially tree fruits.

chilo- Italian spelling of the metric prefix kilo- (1000).

chlorinity A measure of the chloride content, by mass, of seawater (grams per kilogram of seawater, or per mille).

[149] See also: bipm.org

[150] enacademic.com

[151] [BROW8].

[152] [NATUR10] and [NATUR11].

[153] [CHAM].

[154] It was shown to be transcendental in 1937. See: [MAHL].

chlorosity Name for the chloride content of one litre of seawater.[155]

chopine [French] In French, and especially in French Canada, a unit taken as the equivalent to the U.S. dry pint, for such purposes as marking the capacity of berry baskets.

choppin or **chopine** In Britain, a widely used name for the half-pint in local context, but thereby usually in excess of a whole American, even BI, pint.[156]

chronaxy Name for the shortest duration of an effective electrical stimulus to nerve or muscle tissue, having a strength = twice the minimum strength required for excitation.[157]

chu, **c.h.u.**, or **CHU** An abbreviation for Centigrade heat unit.

Ci An abbreviation for curie.

CIAME An abbreviation for Commission Interministérielle des Appareils de Mesure.

CID An abbreviation for Cubic Inch Displacement.

cinque An old English word for the number 5, pronounced "sink" and derived from the French number 5, *cinq*. In English history, the original Cinque Ports were Sandwich, Dover, Hythe, Romney and Hastings. The word survives today as the name for a 5-spot showing in dice, or for a 5-card in card games.

CIPM [an acronym for *Comité International des Poids et Mesures*] or **C.I.P.M.** See *International Committee for Weights and Measures*.

circle (cir) A traditional unit of angle measure, divided into 2π radians = 360 degrees.

circular inch and **circular mil (CM)** Informal units of area used in Britain and the U.S.A circular inch [mil] is the area of a circle one inch [mil] in diameter. Since the area of a circle is proportional to the square of the diameter, a circle of diameter X inches [mils] has an area of X^2 circular inches [mils]. The circular inch is = $\pi/4$ in^2 = about 500 710 133 567 198 814 115 747 890.942 11 barns = about 500.711 292 5 mm^2. The circular mil is = $\pi/4$ mil^2 = about 500,710,133,567,198,814,115.747 89 barns = about 0.000 500 711 292 5 mm^2. Sometimes MCM is used for 1000 CM.

circular dispersion (CD) A measure of error of the accuracy with which rockets reach their intended target. CD is defined as the diameter of a circle within which 75% of the events under study occur.

circular mil See *circular inch*.

C/kg An abbreviation for coulomb per kilogram and coulomb par kilogramme.

cl or **cL** An abbreviation for centilitre.

Cl An abbreviation for clausius.

Clark See *degree*.

Clark degree See *degree*.

Classes of numbers A system of classifying numbers, devised by Robert P. Munafo in 1996.[158] According to this system, the numbers 0 through 6 are class-0 (numbers "that are small enough to have an immediate intuitive or perceptual impact"); the numbers 7 through 1,000,000 are class-1 ("quantities that people can comfortably handle or perceive"); the numbers 1,000,001 to $10^{1,000,000}$ are class-2 ("numbers that can be represented in exact form using decimal place-value notation"); the numbers $10^{1,000,000}$ through 10^[10^(10^6)] are class-3 ("numbers that can be represented inexactly using scientific notation"); the numbers 10^[10^(10^6)] through 10^[10^(10^ (10^6))] are class-4 ("numbers that are larger than class-3, and whose logarithm can be represented as a class-3 number"); the numbers 10^[10^(10^(10^6))] through 10^[10^(10^(10^(10^6)))] are class-5 ("numbers that are larger than class-4, and whose logarithm can be represented as a class-4 number"). In a similar way, class-N are those numbers that are larger than class N − 1, and whose logarithm can be represented as a class N − 1 number.[159]

clausius or **claus (Cl)** An obsolete unit of entropy, used by engineers, = 1 $kcal_{IT}/K$ = 4.186 8 kJ/K. Entropy is a measure of the extent to which heat or energy in a physical

[155] It is equal to the chlorinity of the sample times its density at 20°C.

[156] [FENN, p. 93].

[157] [STE4].

[158] home.earthlink.net

[159] Information from: mrob.com/pub/math/largenum.html

system is not available for performing work.[160] The unit is named after the German mathematical physicist Rudolf Julius Emanuel Clausius (1822–1888), who introduced and named the concept of entropy in 1850. The unit was sometimes called a **rank**, for the British physicist and engineer William J. M. Rankine (1820–1872).

clepsydra or water clock A device for measuring time by letting water regularly flow out of a container, usually through a tiny aperture.[161] The water clock was the most accurate and commonly used timekeeping device, until it was replaced by the more accurate pendulum clock in the seventeenth century.

CLF An abbreviation for 100 linear feet.

click, **klick**, or **klik** U.S. military slang for the *kilometre*. Widely used during the Vietnam War (1961–1975), this unit seems to have been invented by U.S. troops in Germany during the 1950s. Occasionally, it was used as a non-metric unit = 1000 yards = 0.914 4 km. It was sometimes used for a speed of 1 km/h.

clinometer An instrument for measuring angles of inclination.

clo or **CLO** A unit of thermal resistance used in describing the insulating value of clothing. Defined in 1941,[162] it was intended to represent the insulation required to keep a sitting-resting person warm in a normally ventilated indoor room (air movement 20 ft/min = 10 cm/s) at 70 °F (21.1°C) with a humidity of the air which is less than 50%. One clo is = 0.155 m^2K/W = 1.550 togs. For practical use, one clo is sometimes expressed as (0.18 · Δ°C)/(cal/(h · m^2)) = (0.88 · Δ°F)/(BTU/(h · m^2)).

clusec [acronym for: centi-lusec] A unit of leak rate used to express the performance or leakage of vacuum pumps = a flow of 10 ml/s at a pressure of 1 µm of mercury = 0.01 lusec = about 1.333 22 µW.

CM An abbreviation for circular mil and for metric carat.

CM An improper representation of centimetre in the context of upper-case-only printing.

[160] For more information, see: [ANGR].

[161] See also [MCNO].

[162] [GAGG].

C.M. An abbreviation for Common meter or Common metre.

cm An abbreviation for centimetre.

cm² An abbreviation for square centimetre.

cm³ An abbreviation for cubic centimetre.

CmA A unit of relative electric current, used especially in connection with nickel metal hydride (NiMH) storage batteries. The symbol designates the current flow per hour, into or out of the battery, as a fraction of the battery's rated capacity.

cMC An abbreviation for centiMcClintock.

CMI An abbreviation for Ceský Metrologický Institut.

CMS-ITRI An abbreviation for Centre for Measurement Standards of the Industrial Technology Research Institute.

CODATA An acronym for Committee on Data for Science and Technology.

coherent system of units (of measurement) or **absolute system of units** A system of units is said to be coherent if all of its units are either base units, or are derived from the base units without using any numerical factors other than 1. The International System of Units (SI) is a coherent system.[163]

Colburn-Chilton j factor (***j_H***) A dimensionless number used in heat transfer in general and free and forced convection calculations in particular. It is normally defined as h $(C_p\ \mu)^{2/3}/[C_p\ \rho\ v\ k^{2/3}]$, in which h = heat transfer coefficient, Cp = heat capacity, µ = viscosity, ρ = density, v = velocity and k = thermal conductivity.

column inch (col in) A unit of relative area used in journalism. A column inch is an area one column wide and one inch deep. The width of a column varies. A standard size in the U.S. is 2-1/16 inch. At this width, a column inch is 2.062 5 sq in = about 13.31 cm^2.

combining weight A name of the proportion (by weight) in which a chemical element combines with other elements to form compounds. Combining weights were usually measured by early chemists on a scale in which hydrogen had a combining weight of 1.

[163] [LEMA3, p. 2] and [COHE2, p. 93].

commercial bundle A unit of quantity used for counting sheets of paper = 2 commercial reams = 40 commercial quires = 1000 sheets.

commercial quire or **printer's quire** A unit of quantity used for counting sheets of paper = 25 sheets.

commercial ream A unit of quantity used for counting sheets of paper = 20 commercial quires = 500 sheets.

Committee on Data for Science and Technology (CODATA) A committee set up by the International Council of Scientific Unions in 1966 to improve the compilation, critical evaluation, storage and retrieval of data of importance to science and technology.[164] The committee consists principally of representatives of the various national standards laboratories, as well as the BIPM. CODATA periodically issues reports identifying the best current values for the principal physical constants, and also for certain conversion factors.[165]

common metre Name of "standard measuring stick, rod or rope of the particular industry or trade good."[166]

Commonwealth Scientific and Industrial Research Organisation (CSIRO) Name of National Institute of Standards and Metrology in Australia.

compass A navigational instrument for determining direction relative to the earth's magnetic poles. The full circle, 360º, is divided into 32 named and numbered points[167] (clockwise, from North) evenly spaced around the compass:

1 = N (north), 2 = NbE, 3 = NNE, 4 = NEbN, 5 = NE, 6 = NEbE, 7 = ENE, 8 = EbN, 9 = E (east), 10 = EbS, 11 = ESE, 12 = SEbE, 13 = SE, 14 = SEbS, 15 = SSE, 16 = SbE, 17 = S (south), 18 = SbW, 19 = SSW, 20 = SWbS, 21 = SW, 22 = SWbW, 23 = WSW, 24 = WbS, 25 = W (west), 26 = WbN, 27 = WNW, 28 = NWbW, 29 = NW, 30 = NWbN, 31 = NNW, and 32 = NbW.

Condensation number (*Co*) A dimensionless number used in heat transfer in general and in condensation calculations in particular = the ratio of the number of molecules condensing on a surface to the total number of molecules striking the surface. It is normally defined in one of the following forms: $Co = (h/k)/(\mu^2/(g\ \rho^2))^{1/3}$, in which h = heat transfer coefficient, k = thermal conductivity, μ = density, g = gravitational acceleration, and ρ = viscosity; or $Co = (g\ \rho^2\ \lambda\ L^3)/(k\ \mu\ \Delta T)$, in which λ = latent heat, L = characteristic length, and ΔT = temperature differens.

conimeter or **konimeter** Instrument for determining the dust content of a sample of air.

constant of gravitation See *gravitational constant*.

cont hpq An abbreviation for <u>cont</u>inental <u>h</u>orse-<u>p</u>ower = metric horsepower.

continuum Name in mathematics of a linearly ordered set of points or numbers that is "densely ordered", i.e., between any two numbers.[168] The number of points or numbers in a continuum is denoted by c.

cooling degree day (CDD) See *degree day*.

COOMET An abbreviation for <u>Coo</u>peration in <u>Met</u>rology among the Central European Countries.

COP An abbreviation for coefficient of performance.

coppo [Ital; *pl*. coppi] Name given to the decilitre, used both for dry and liquid capacity, when the metric system was adopted in Milan in 1803. It was also said to equal 1/10 pinta.

corps Military name of the largest aggregation of men and equipment short of a numbered army. In the U.S., traditionally a grouping of three, four, or more brigades, each a mixture of infantary, artillery and tanks, commanded by a two-star general, of about 75,000 men.

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[164] See also: ptonline.aip.org

[165] codata.org

[166] [FENN, p. 98].

[167] There are languages which do not use compound words to name the points, instead assigning unique words, colors, and/or associations to phenomena of the natural world.

[168] But while there is an infinity of rational numbers in that range, they do not form a continuum, for no matter how finely they are separated, another such can be placed.

cosmological constants or **Dirac's big number** Name, proposed by Paul Adrien Maurice Dirac (1902–1984) in 1937,[169] for the ratio of the largest to the smallest natural units of length, of force and of time. According to Dirac: radius of the universe/radius of an electron = coulomb force between proton and electron/gravitational force between proton and electron = the time required for light to reach the edge of the universe/the time required for light to cover a distance egual to the radius of an electron = about 10^{40}.

coul An informal representation for coulomb.

coulomb (C) A metric and MKS unit of quantity of electricity and electric charge; SI unit of electric charge, electric flux and elementary charge. It was accepted by the CGPM in 1948[170] and adopted in 1952. One coulomb is the amount of charge accumulated in one second by a current of one ampere. One coulomb represents the charge on about $6.241\ 506 \cdot 10^{18}$ electrons. The unit is named after the French physicist Charles-Augustin de Coulomb (1736–1806),[171] who was the first to measure accurately the forces exerted between electric charges.

coulomb or **international coulomb** A unit in the International System of Electrical and Magnetic Units (used between 1893 and January 1, 1948) = the amount of charge transported through any section of an electric circuit in one second, when the current in the circuit is one international ampere. One international coulomb = 0.999 85 C. In the practical system of electrical units, a coulomb was one tenth of an abcoulomb. In the CGS electromagnetic system, an abcoulomb is the quantity of electricity which passes any section of an electric circuit when the current is one abampere. The name coulomb was given to the unit at the first meeting of the IEC in Paris in 1881.[172]

[169] [DIRA].

[170] See 1947: *Journal of Institute of Electrical and Electronics Engineers*. **94**, 342.

[171] [POTI].

[172] See 1881: The Cause of Colliery Explosions. *Nature* **24**, 512.

coulomb metre (C · m) The SI unit of an electric dipole moment = m · s · A.[173]

coulomb metre squared per kilogram (C · m²/kg) The SI unit of a specific gamma ray constant = $m^2 \cdot s \cdot A/kg$.

coulomb metre squared per volt (C · m²/V) The SI unit of polarizability of a molecule = $s^4 \cdot A^2/kg = F \cdot m^2$.

coulomb per cubic metre (C/m³) The SI unit of volume density of a charge = s · A/m^3.

coulomb per kilogram (C/kg) An obsolete SI unit of exposure to radiation = s · A/kg = $A \cdot m^2/(J \cdot s) = T^{-1} \cdot s^{-1}$ = about $3.875\ 97 \cdot 10^3$ R.

coulomb per kilogram second (C/(kg · s)) The SI unit of exposure rate = A/kg = about $3.875\ 97 \cdot 10^3$ R/s.

coulomb per mole (C/mol) The SI unit of a Faraday constant.

coulomb per square metre (C/m²) The SI unit of surface density of a charge, electric flux density and electric polarization = s · A/m^2.

count (ct) A unit of quantity = 1. This unit is used in commerce to specify that the quantity stated represents a reliable count. For example, a carton marked "oranges 24 ct" contains exactly 24 oranges.

count (ct) An obsolete unit measuring the texture of a fabric = the number of threads per inch. A 100 count fabric has 39.37 threads per centimetre.

count (ct) An informal unit of volume in bartending. Bartenders usually fit bottles with pourers designed to restrict the flow to 0.5 fluid ounce per second = about 14.8 mL/s.

county In Britain, name of an area, usually a division within the context of local government, of undefined size.

cP An abbreviation for centipoise.

CP An abbreviation for candle power.

CPI An abbreviation for character per inch.

cpm An abbreviation for counts per minute.

CPS A French abbreviation for *caractéres par seconde*.

cps or **c.p.s.** An abbreviation for characters per second.

[173] [DRAZ].

cps or **c.p.s.** An abbreviation for counts per second.

cps, **c.p.s.**, or **c/s** An abbreviation for cycle (s) per second = hertz = characters per second; cps is also an incorrect symbol for the centipoise.

CQU An abbreviation for Committee on Quantities and Units.

crab During the late twentieth century, a unit of X-ray intensity used in X-ray astronomy, based on the brightness of the Crab nebula (= 1 crab). It was usually encountered as the millicrab, and often spelled milliCrab.

crinal [<Gr: *crinis* = "hair"] A unit of acceleration, in the dm/kg/s-system, = 1 dm/s^2 = 0.1 m/s^2.[174]

crinal [<Gr: *crinis* = "hair"] A unit of force, proposed in 1876, in the dm/kg/s-system, = 0.1 N.

criori or **crore** In India, an obsolete unit of quantity = 10^7 = 10 million, usually written as 10,000,000 = 100 lakh. Large numbers are usually described in India using the crore and the lakh (10^5).

crith [Gr: = "barleycorn" (a small weight)] An obsolete unit of weight, sometimes used in the physics and chemistry of gases. The crith is = the mass of a litre of hydrogen at standard temperature (0.01°C) and pressure (1 atmosphere) = about 89.885 mg.[175]

crocodile [name given because "it bites"] In certain nuclear laboratories in Britain, during the mid-twentieth century, an informal unit of electric potential, sometimes used = 10^6 V = 1 MV.

crown In Britain, a coin-weight. In 1878, as a silver coin, = 28.275 90 g.

crumb, **tayste**, or **tydbit** A unit of information used in computer science = 2 binary digits = 1 quad.

c/s An abbreviation for cycles per second.

cS An obsolete abbreviation for the siemens.

CSIRO An abbreviation for Commonwealth Scientific and Industrial Research Organisation.

cSt An abbreviation for centistokes.

Ct An abbreviation for carat.

[174] [FENN].

[175] [CLAR].

ct An abbreviation for cent.

ctl An abbreviation for cental.

cu or **cu.** A common abbreviation for "cubic," as in cubic feet. This symbol is forbidden by the SI, but it remains in common use in ordinary English texts.

ctr An abbreviation for centner.

cubic centimeter or **cubic centimetre** (**cm^3** or **cc**) A CGS and SI unit of volume = 10^{-6} m^3 = 1 mL = about 0.061 023 7 in^3.

cubic centimetre per gram (**cm^3/g**) A CGS and SI unit of specific volume = 10^{-3} m^3/kg = 1 L/kg.

cubic centimetre per kilogram (**cm^3/kg**) An mSI unit of specific volume = 10^{-6} m^3/kg.

cubic decimetre (**dm^3**) An mSI unit of volume = 10^{-3} m^3 = 1 L.

cubic centimetre per kilogram (**dm^3/kg**) An mSI unit of specific volume = 10^{-3} m^3/kg = 1 L/kg.

cubic foot per pound (**ft^3/lb**) An obsolete FPS unit of specific volume, = 1,728 · 10^3 in^3/lb = 6.242 80 · 10^{-2} m^3/kg.

cubic foot per second (**ft^3/s or cusec**) An obsolete FPS unit of volume flow rate = 2.831 68 · 10^{-2} m^3/s.

cubic foot per ton (UK) (**ft^3/UK ton**) An obsolete unit of specific volume in Britain = 2.786 96 · 10^{-5} m^3/kg.

cubic inch per pound (**in^3/lb**) An obsolete unit of specific volume = 5.787 04 · 10^{-4} ft^3/lb = 3.612 73 · 10^{-5} m^3/kg.

cubic meter or **cubic metre** (**m^3**) An SI and CGS unit of volume = 10^6 cm^3 =1000 L = 3.531 47 · 10 ft^3 = 6.102 37 · 10^4 in^3.

cubic metre per coulomb (**m^3/C**) An SI unit of a Hall coefficient.

cubic metre per hour (**m^3/h**) A unit of volume flow rate = 2.777 78 · 10^4 m^3/s = 9.809 63 · 10^3 ft^3/s.

cubic metre per kilogram (**m^3/kg**) An SI unit of specific volume = 1.0 · 10^3 L/kg = 2.767 99 · 10^4 in^3/lb = 1.601 85 · 10 ft^3/kg.

cubic metre per mole (**m^3/mol**) An SI unit of molar volume.

cubic metre per second (**m^3/s**) An SI unit of volume flow rate, conductance of a duct, intrinsic conductance, molecule conductance and recombination coefficient. One cubic metre per second = $3.6 \cdot 10^3$ m^3/h = $3.531\ 47 \cdot 10$ ft^3/s.

cucchiaiata [<Ital.: *cucchiaio* = "spoon"] In Italy, a unit of capacity used in cooking = a tablespoonful (cucchiaio da tavola).[176]

cucchiaino [<Ital.: *cucchiaio* = "spoon"] In Italy, a unit of capacity used in cooking = a teaspoonful.[177]

cu. ft. An abbreviation for cubic foot and cubic feet.

cu. in. An abbreviation for cubic inch and cubic inches.

cu. m. An abbreviation for cubic metre.

cumec [cubic metre per second] Informal unit of flow rate, particularly from a pump, = 1 m^3/s = about 35.314 7 cu ft/s. See also *cusec*.

cunit A measure of wood volume used in forestry = a volume of timber containing 100 ft^3 = about 2.831 7 m^3 of actual wood (excluding bark and air between the logs). The unit is used mostly for pulpwood and firewood.

cunit In Australia, a measure of wood volume. The unit was developed from experience by APM Pty Ltd with the cord which showed that, on average, 100 ft^3 (=about 2.831 7 m^3) of timber filled the tray of a truck.

curie (Ci) A unit of activity of radionuclide, originally defined as the radioactivity of 1 g of ^{226} radium. In 1953, scientists agreed that the curie would represent exactly $3.7 \cdot 10^{10}$ atomic disintegrations per second = 37 GBq. The unit is named after Pierre Curie (1859–1906) and Marie Curie (1867–1934), the discoverers of radium.

curie MeV (Ci · MeV) An obsolete unit of nuclear power = $5.930 \cdot 10^{-3}$ W.

curie per cubic metre (Ci/m³) A unit of volume activity = $3.7 \cdot 10^{10}$ Bq/m^3.

curie per kilogram (Ci/kg) A unit of specific activity of radio-nuclide = $3.7 \cdot 10^{10}$ Bq/kg.

cusec [cubic foot per second] In the British Commonwealth countries (except Canada), a pre-WWII unit of measurement, used to indicate the flow of one cubic foot per second of water or air = about 0.028 317 m^3/s. The pressure is not specified. See also *CFS*, *CFS-Day*, and *CFSM*.

cut A yarn number system for glass or asbestos yarn, in which the cut number is = the number of 100-yard lengths needed to make up 1 lb av.

cut A unit of length of wet-spun linen yarn = 300 yards. For the cut system, for specifying the fineness of wool yarn, also based on 300 yards.

cut A standard length of woven cloth = 60 yards in its unfinished state.

CV or **CV-rating** The French abbreviation for *cheval vapeur* = metric horsepower, retained in taxing automobiles according to their horsepower. The CV rating is a legal construct, not a physical measurement.

cv An abbreviation for calorific value.

Cwt, **Cwt.**, or **cwt** [<L: centum + weight] Symbol for hundredweight.

cyanometer [<Gr: *kyànos* = "a dark blue substance"] Instrument designed to measure or estimate the blueness of the sky. The instrument was first described by the Swiss physicist and Alpine traveller Professor Horace-Bénédict de Saussure (1740–1799) in the late eighteenth century.

cycle (c) [<Gr: *kúklos* = "circle"] A informal name for "cycles per second".

cycles per second (cps or **c/s)** An obsolete unit of frequency = 1 s^{-1} = 1 Hz. Almost all measurements of frequency are now stated in hertz.

4 D

D- An incorrect symbol for the metric prefix deka- or deca-, seen in combinations such as DL (dekalitre) or DTH (dekatherm). The correct prefix is da-.

D An abbreviation for darcy.

D An abbreviation for debye.

D A Roman symbol for the numeral 500.[178]

[176] [LOVE2, p. 111].

[177] [STOB, p. 525].

[178] Graphically derived from the left half of the letter M, representing 1000.

d An abbreviation for darwin.

d An abbreviation for deci (=0.1).

d factor See *Q-factor*.

D unit An obsolete unit of X-ray dosage, introduced in 1925 by Mallet,[179] = 102 roentgen.

Da A metric abbreviation for Deca + are.[180]

da An SI abbreviation for deca or deka (=10).[181]

da An SI and metric abbreviation for deciare.

daa An SI abbreviation for decare (=deca + are).[182]

dag A symbol for the dekagram or decagram (10 g).[183]

daily value (DV) A unit of nutrition used in the U.S. The federal government establishes recommended daily amounts of various nutrients, based on a hypothetical person, male or female, who requires a diet of 2000 calories/day. Food packages generally carry nutritional labels specifying the amount of each nutrient contained in a standard serving, expressed as a percentage of the daily value (%DV).

dal or **daL** An SI symbol for the dekalitre (10 L), which is a common metric unit of volume.[184]

dalton (Da or **D)** A unit that has been approved by the International Union of Pure and Applied Chemistry (IUPAC) as a special name for the atomic mass unit = 1.660 538 782 (83) $\cdot$ 10^{-27} kg. The dalton may be combined with the SI prefixes to express the masses of large molecules, typically in kilodaltons (kDa) or megadalton s(Mda).[185] The unit is named after the English chemist and physicist John Dalton (1766–1844), who, in 1803, proposed the principles of atomic theory to explain the constitution of matter.

[179] [MALL].

[180] In SI, it should be daa.

[181] Previously represented by D.

[182] Previously represented by Da.

[183] Previously represented by Dg.

[184] Previously represented by Dl.

[185] [COHE2, p. 94].

dam An SI symbol for the dekameter and décamétre (10 m).[186]

Damköhler numbers (Da_I, Da_{II}, Da_{III}, and Da_{IV}) Dimensionless numbers used in chemical engineering to relate chemical reaction timescales to other phenomena occurring in a system. There are several Damköhler numbers, and their definition varies according to the system under consideration. For a general chemical reaction A → B of n-th order, the Damköhler number is defined as $kC_0^{n-1}t$, in which k = kinetics reaction rate constant, C_0 = initial concentration, n = reaction order, and t = time. In continuous or semibatch chemical processes, the general definition of the Damköhler number is defined as: reaction rate/mass transport rate or characteristic time/reaction time. In reacting systems that also include interphase mass transport, the second Damköhler number (DaII) is defined as the ratio of the chemical rate to the mass transfer rate. DaII = $(kC_0^{n-1})/(k_g a)$, in which k_g = the global mass transport coefficient and a = the interfacial area. The numbers are named after the German chemist Gerhard Damköhler (1908–1944).

daN A symbol for the decanewton or dekanewton, which is a common metric unit of force.

daniell A name of a unit of electric potential, used during the 1840s and 1850s, = 1.042 V, which is the voltage of a Daniell cell when no load is attached. The unit is named after the British chemist and physicist John Frederic Daniell (1790–1845), who discovered the Daniell cell in 1836.

Danish Institute of Fundamental Metrology (DFM) The name of the National Institute for Standards and Metrology in Denmark.

daraf (F^{-1}) An obsolete metric unit of electrical elastance (reciprocal farads) in the U.S. that measures the ability of an electric potential to charge a capacitor = one volt of potential per coulomb of charge (V/C). The name of the unit is “farad” spelled backwards, because the elastance in darafs is 1 divided by the capacitance in

[186] Previously represented by Dm.

farads. This unit, proposed by the Irish–American engineer Arthur Edwin Kennelly (1861–1939),[187] is not recognized as part of the SI and not much used.

darcy or **darcey (d** or **D)** The CGS unit of permeability, used by geologists to describe rocks in an oil field. One darcy is the permeability of a solid through which 1 cm^3 of fluid, having a viscosity of 1 cP, will flow in 1 s through a section 1 cm thick and 1 cm^2 in cross section, if the pressure difference between the two sides of the solid is one atmosphere. The SI unit of permeability to fluid flow is defined as the amount of permeability that permits 1 m^2 of fluid of a viscosity of 1 Pa/s to flow through a section 1 m thick with a cross section of 1 m^2 in 1 s at a pressure difference of 1 Pa. The SI unit of permeability = $1.013\ 25 \cdot 10^{12}$ darcy, and one darcy is = $9.869\ 233 \cdot 10^{-13}\ m^2$. The unit is named after the French scientist Henry P. G. Darcy (1803–1858). The unit was first proposed in 1933.[188]

Darcy friction factor (*f*) A dimensionless number used in momentum transfer in general and turbulent flow calculations in particular. It is normally defined as $(2\ g_c\ d\ \Delta p)/(\rho\ v^2\ L)$, in which g_c = dimensional constant, d = diameter, Δp = pressure drop, ρ = density, v = velocity and L = length. The number is named after the French scientist Henry P. G. Darcy (1803–1858).

darenth A jocular unit of weight = 0.000 0176 mg or the amount of margarine capable of covering 100 slices of bread to the depth of one molecule.[189]

darwin (d) A unit proposed for measuring rates of evolutionary change in living species, equalling an e (approximately 2.718)-fold change in a trait over one million years. The unit, proposed by John Burdon Sanderson Haldane (1892–1964) in 1948,[190] is named after the British biologist and developer of evolutionary theory Charles Darwin (1809–1882). If a species increases 1000-fold in 1000 years, or diminishes in a like time to 1/1000 of its former numbers, its rate of change in either case is about one darwin.

dash (ds) An informal unit of volume for liquids in the U.S., mostly used in recipes for mixed drinks. American cookbook editors usually figure 2 dashes to the pinch and 8 pinches to the teaspoon. This makes the dash = roughly 0.01 fluid ounce = 0.3 mL. According to a famous saloonkeeper,[191] a dash is 1/8 teaspoon when applied to bitters in mixed drinks; otherwise (for sugar syrup, orgeat, grenadine, lemon juice, etc.), it is ¼ U.S. fluid ounce = 1½ teaspoons. Some sources[192] say that a U.S. dash = 1/6 barspoon = 1/36 US liq oz = about 0.822 mL.

dash (ds) or **splash** In the U.S., an informal unit of liquid capacity used in bartending and recipes for mixed drinks. The bartender's dash (or splash) is usually taken to be 1/32 fluid ounce = about 0.92 mL. Some sources say 1/8 teaspoon = about 0.61 mL when applied to bitters. Otherwise (for lemon juice, grape juice, grenadine, orgeat, sugar syrup, etc), = ¼ U.S. fluid ounce = 1½ teaspoons = about 7.4 mL.[193]

data mile A unit of distance used in radar technology = exactly 6000 ft = 1828.8 m. U.S. military radar equipment is often calibrated in data miles.

daV An abbreviation for dekavolt.

daW An abbreviation for dekawatt.

daWb An abbreviation for dekaweber.

dB– A symbol indicating that a measurement is made using a logarithmic scale similar to that of the decibel in that a difference of 10 dB- corresponds to a factor of 10. In each case, the actual measurement *a* is compared to a fixed reference level *r* and the "decibel" value is defined to be 10 $\log_{10}(a/r)$. The decibel was first used as a unit of power ratio in telephone

[187] [KENN4].
[188] [WYCO].
[189] [ADAM, p. 37].
[190] [HALD2].
[191] [SARV, p. 27].
[192] [FENN].
[193] According to the famous saloonkeeper Victor Jules Bergeron Jr. (1902–1984). See [SARV] and [LORD, p. 77].

engineering.[194] Renamed the bel, to honor Alexander Graham Bell (1847–1922), it was adopted as an international unit at the First International Acoustical Conference in Paris,[195] July 1937, for scales of energy and pressure levels. A variety of other names have been proposed for the decibel, including logit, decilit, decilog, decomlog and decilu.[196]

dB A unit of sound intensity, with a reference level of 1 pW/m^2.

dB An abbreviation for deciboyle.

dB A, **dB B**, **dB C** or **dB(A)**, **dB(B)**, **dB(C)** A unit of sound intensity, exactly like the decibel, except that before the measurement is made, sounds of high and low frequencies, heard poorly or not at all by the human ear, have been filtered out. The letters A, B, and C refer to different filtering methods.

dB c A unit of signal strength used in electronics, especially in measuring noise levels. The signals are measured relative to the strength of the carrier signal, which is the desired signal. A typical statement might be that a certain noise level is −50 dB c, meaning that the noise is 50 "decibels below carrier" or 10^{-5} times the carrier signal strength.

dB FS An abbreviation for "decibels full scale," a unit of power as measured by a digital device. Full-scale may be defined as the power level of a full-scale sinusoid or alternatively a full-scale square wave. The unit is used in converting a signal between analog and digital formats. A digital measurement has a maximum value M depending on the number of bits used. If the actual power measurement is *p*, the dB FS value displayed is $20 \cdot \log_{10}(p/\mathrm{M})$ dB FS. Since *p* cannot exceed M, this reading is always negative.

dbh or **d.b.h.** An abbreviation for diameter breast high.

dB i A unit measuring the gain of an antenna. The reference level is the strength of the signal that would be transmitted by an isotropic antenna, one radiating equally in all directions. For example, an antenna rated 20 dB i transmits a signal in the desired direction $10^2 = 100$ times stronger than an isotropic antenna.

dbl An abbreviation for double.

dB m (the "m" stands for mW) or **dB W** A logarithmic unit of power used in electronics for electric signals. In audio and telephony, these units measure power in decibels above the reference level of 1 mW across an impedance of 600 W, in the case of dB m, and 1 W across an impedance of 600 W, in the case of dB W. In radio frequency work, dB m is typically referenced relative to a 50 Ω impedance.

dBr A symbol used when a reference level is specified in the immediate context.

dB rn A symbol for "decibels above reference noise," a unit measuring noise levels in telecommunications. The usual reference level is −90 dB m, which is equivalent to a power of 1 pW.

dB spl or **dB SPL** A logarithmic unit of sound intensity as computed from the sound pressure level. The reference level is a pressure of 20 mPa, the level of the faintest sound that can be heard. If sound waves exert a pressure of P pascals, the sound intensity is $100 + 20 \cdot \log_{10}(\mathrm{P}/2)$ dB spl.

dB u (the "u" stands for unterminated) or **dB v** A logarithmic unit of power, similar to dB m but computed from voltage measurements. The reference level is 0.775 V rms, the voltage which generates a power of 1 mW across a circuit having an impedance of 600 Ω. A voltage of V volts corresponds to a power of $20 \cdot \log_{10}(\mathrm{V}/0.775)$ dB u.

dB v See *dB u*.

dB V or **dB $\mathbf{V_{RMS}}$** A logarithmic unit of power, similar to dB m but computed from voltage measurements. The reference level is 1 volt rms across any impedance. A voltage of V volts corresponds to a power of $20 \cdot \log_{10}(\mathrm{V})$ dB V.

dB W See *dB m*.

dB Z A unit of radar reflectivity used in meteorology. The unit measures the amount of energy returned to a weather radar site as a function of the amount transmitted. A difference of 10 dB Z indicating a 10-fold increase in energy returned.

[194] [MART7].

[195] The First International Acoustical Conference. *Nature* **140**, 370 (Aug. 28, 1937).

[196] Sizes.com

For display purposes, dB Z values are grouped as follows:

(Level 1, 18–30 dBZ)—Light precipitation

(Level 2, 30–38 dBZ)—Light to moderate rain

(Level 3, 38–44 dBZ)—Moderate to heavy rain

(Level 4, 44–50 dBZ)—Heavy rain

(Level 5, 50–57 dBZ)—Very heavy rain; hail possible

(Level 6, >57 dBZ)—Very heavy rain and hail; large hail possible

The colorful "radar images" shown on television are actually plots of these levels.

DC An abbreviation for Direct Current.

DE An abbreviation for Dextrose Equivalent.

dead load A constant load on a structure (e.g., a bridge) due to the weight of the supported structure itself.

deadweight ton (dwt) An obsolete unit of weight used in the shipping industry. The deadweight tonnage of a ship is the difference between its weight when completely empty and its weight when fully loaded. This includes the weight of everything portable carried by the ship: the cargo, fuel, supplies, crew, and passengers. The deadweight ton is traditionally equal to the British long ton of 2240 lbs = 1016.047 kg.

deal A traditional unit for rough-sawn lumber in Britain = 12 in × 9 in × 3 in = 324 in^3 = 1/120 London standard.

Dean number (*De*) A dimensionless number in momentum transfer in general and flow in curved channels calculations in particular. It is normally defined as $(L/(2r))^{1/2}$ $(Dv\rho)/\mu$, in which L = length, r = radius of curvature of bend, D = diameter, v = velocity, ρ = density, and μ = viscosity.[197]

Deborah number (De) A dimensionless number used in rheology to characterize how "fluid" a material is.[198] Even some apparent solids "flow" if they are observed long enough. Formally, the Deborah number is defined as the ratio of the relaxation time, characterizing the intrinsic fluidity of a material, and the characteristic time scale of an experiment probing the response of the material. The smaller the Deborah number, the more fluid the material appears. See also *Weissenberg number*.

debye (D) A CGS unit of an electric dipole moment used in chemistry and physics. The debye is defined as an electric dipole moment of 10^{-18} Fr · cm = 3.335 64 · 10^{-30} C · m. The unit has also been defined as electron charge × angstrom = about 16.022 · 10^{-30} C · m, and electron charge × Bohr radius = about 8.478 4 · 10^{-30} C · m. The unit, which received its name in 1934,[199] is named after the Dutch physicist Petrus Josephus Wilhelmus Debye (1884–1966), a pioneer in polar molecules.

debye A unit equal to the product of the electron charge and the radius of the first Bohr orbit of hydrogen, 2.54 · 10^{-18} esu cm.

debye A unit equal to the product of the electron charge and 1 angstrom = 4.803 · 10^{-18} esu cm.

dec. . . See *deca-*.

deca- (da-) A metric prefix meaning 10. The prefix is taken from the Latin word for ten, *decem*. The Greek form deka- is also used (see also *deka-*) in the U.S. and a few other countries, and it has the advantage of avoiding confusion with deci-, one tenth. The International Bureau of Weights and Measures (BIPM) specifies deca- for the prefix and da- for the symbol. In its interpretation of the International System (SI) for U.S. use, the U.S. National Institute of Standards and Technology (NIST) recommends deka- for the spelling of the prefix. The SI allows for national variations in the spelling of units and prefixes, but not in symbols. It should be avoided as much as possible and used only where well established in practice. Examples: dekajoule (daJ) and dekanewton (daN).

decade or **decad** A traditional name of a group of 10 items. In medieval English, this unit was anglicized as the dicker.

[197] See also [DEAN2] and [DEAN3].

[198] The origin of the name is the line "The mountains flowed before the Lord" in a song by the prophetess Deborah recorded in the Bible.

[199] [FAIR2].

decade Another name for the bel or the order of magnitude: a logarithmic unit used to compare the sizes of quantities. Two quantities differ by one decade if one is 10 times the other, by two decades if one is 10·10 = 100 times the other, and so on.

decade A unit sometimes used, in physics, to mean a range spanning a multiplication by 10, notably for a span of frequencies, especially a range between consecutive powers of 10.

decagram, **decagramme** See *dekagram*.

décagramme A nineteenth century metric unit of weight in Belgium and France = 10 g. In the Netherlands, where the metric system was introduced under different names, the expression of décagramme was replaced by that of lood. In the Lombardo-Yénitien kingdom, it was given the name grosso or large grosso.

decalitre A nineteenth century name for the unit *Schepel* in the Netherlands.

decameter, **decametre** See *dekametre*.

decare See *dekare*.

decatherm See *dekatherm*.

decay time A unit of relative time used in physics, equal to the time required for an exponentially decaying process (such as radioactivity) to decrease to 1/e = 36.787 9% of its original value. The fraction of activity remaining at time T, if T is measured in decay time units, is simply e^{-T}. The decay time equals 0.693 147 half life.

decay time A unit of relative time used in various engineering applications. In many cases, it is the time required for a decaying process to decrease to 10% of its original value. However, a variety of definitions are used in different fields.

decay time or **fall time** Term used for the time required for the trailing edge of a pulse to decrease from 90 to 10% of its maximum amplitude.

deci- [<L: *decimus* = "tenth"] **(d-)** A metric and SI prefix denoting one tenth, or 0.1.[200] It should be avoided as much as possible and used only where well-established in practice. Examples: decibel (dB), decigram (dg), decilitre (dL), and decimetre (dm).[201]

deciare (da) A very undesirable metric and SI unit of area = 1/10 are = 10 m^2.

decibar (dbar) A metric unit of pressure = 0.1 bar = 10 kPa. One decibar equals 75.006 torr = 1.450 lbf/in^2 or psi. The decibar is often used to measure the pressure of seawater, because an increase of 1 decibar in pressure corresponds closely to an increase of 1 m in depth.

decibel (dB) A customary logarithmic unit most commonly used for amplitude level difference, power level difference, sound power level, sound pressure level, sound reduction index and sound intensity level.[202] Experiments show that when humans perceive one sound to be twice as loud as another, the louder sound is about ten times as intense as the fainter one. For this reason, sound is measured on logarithmic scales. $N = k \lg(Q_1/Q_2)$, in which N = number of decibels, Q_1 and Q_2 = quantites of the same kind, and k = 10 or 20, depending on the quantities. For power level difference and sound power level k = 10, for amplitude level difference and sound pressure level k = 20. One decibel equals about 0.115 129 Np and *d* decibels equal *d*(ln 10)/20 Np. See also *dB-*.[203]

decigram or **decigramme (dg)** An undesirable metric and SI unit of weight = 100 mg = about 1.543 2 grains.

decigramme See *decigram*.

decile [pronounced with a soft "c": *des-ile*] A statistical unit = 10 percentiles, or 1/10 of a ranked sample.

decilit [decilogarithmic unit] A name suggested by the Bell Telephone Laboratories for the decibel in 1955.[204]

deciliter or **decilitre** (SI: **dl** or **dL**; metric: **dl)** A common, but undesirable, metric and SI unit of

[200] In Chinese, the deci- is fen.

[201] A legal prefix in UK only for decimetre and decilitre.

[202] [RAOVV].

[203] See also: [MORR2].

[204] [RAOVV2].

volume, = 0.1 L = 100 cm^3. A decilitre contains 6.102 37 cu in = 3.38 140 U.S. fl oz = 3.519 Imp fl oz.

decillion Name of a very large number. In the North American system, = 1000 nonillions = 10^{33}, and in the French–British system, = 1,000,000 nonillions = 10^{60}.

decilog Name suggested for the decibel in 1954.[205]

decilu Name suggested for the decibel in 1954.[206]

decimale candle An obsolete unit of luminous intensity, first defined in 1889 at the Second International Electrical Congress in Paris. Its value was set at ⅟₂₀th of a violle, a choice which made it nominally equivalent to the British standard candle. In 1896, the International Electrotechnical Congress in Geneva redefined the decimal candle as being = the output of a standard Hefner lamp. The Conference of Photometricians in Geneva redefined it as being = 1 hefner. In 1906, the Laboratoire Central de l'Electricité in Paris defined the decimal candle by saying the output of a Carcel lamp burning colza oil at a rate of 42 g/h was 9.6 decimal candles. In 1909, the Laboratoire Central de l'Electricité in France, the National Physical Laboratory in Britain, the Bureau of Standards in the U.S. and the Physicalische Technische Reichanstalt in Germany, redefined the unit and renamed it the **international candle**.[207]

decimeter or **decimetre (dm)** A fairly common metric unit of length = 10 cm = 3.937 0 in.

decimilligrade See *centesimal second*.

decimillimetre (dmm) A metric unit of distance = 0.1 mm (10^{-4} m) or about 3.937 mils. The unit is used in civil engineering for stating the results of penetration tests of asphalt concrete, in which a needle is pushed into the concrete under specified conditions. Although this unit is allowed by some standards agencies, the use of compound prefixes such as decimilli- is not permitted in the SI.

decitex (dtex) A common metric unit of yarn density = 0.1 tex = 0.9 denier = 0.1 mg/m. This unit was previously called the drex. See also *drex*.

decitonne (dt or dtn) A metric unit of weight = 100 kg = about 220.462 3 lb. This unit is becoming common in international trade and is the same as the Russian centner, the German Doppelzentner, and the French metric quintal.

deckle or **decle** A unit of information used in computer science = 2 nickles = 10 bits.[208]

decina [Italian; *pl.* decine] A prefix used in Italy = 10 of any unit.

decle See *deckle*.

decomlog Name suggested for the decibel in 1954.[209]

dedoe A fancy unit of private greed or moneygrabbing.[210]

deficient number or **defective number** Name for a number n for which $\sigma(n) < 2n$, in which $\sigma(n)$ = the sum of all positive divisors of n, including n itself. The first deficient numbers are: 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 19, 21, 22, 23 and 25.[211]

deg An abbreviation for degree.

degC An obsolete abbreviation for degree Celsius, when used as a unit of temperature interval.

degF An obsolete abbreviation for degree Fahrenheit, when used as a unit of temperature interval.

degK An obsolete abbreviation for degree Kelvin, when used as a unit of temperature interval.

degR An obsolete abbreviation for degree Rankine, when used as a unit of temperature interval.

[205] [GREE5].

[206] [HORT2].

[207] 1909: *Illuminating Engineering* **2**, 393.

[208] Reported among developers for Mattel's GI 1600 (the Intellivision games processor), a chip with 16-bit-wide RAM but 10-bit-wide ROM. See also [RAYM].

[209] [MOOR].

[210] [KLEI].

[211] [SING2, p. 11] and [DICK2, pp. 3–33].

degree (° or **deg)** A standard unit of plane angle = 1/360 circle = 60 min = 3600 s = π/180 rad (= about 0.017 453 293 rad) = 400/360 grade.

degree (° or **deg**) A unit of length sometimes used at sea = 60 nautical miles = about 111.12 km. This distance is the average length of 1° of latitude.

degree (° or deg) Colloquial expression for any of the various units of temperature in use. In the U.S., the unmodified unit "degree" generally means the degree Fahrenheit; in other countries, it means the degree Celsius or degree Kelvin.

degree (° or **deg**) A unit measuring the hardness of water. Water is called "hard" if it contains a high concentration of mineral salts, especially calcium carbonate. This concentration can be expressed clearly in parts per million (ppm) or in mg/L. See *degree Clark, degree French*, and *Deutsche Härte*.

degree (°, **deg**, or **dg)** Name used for various scientific quantities. Most especially, gravity and viscosity, have been measured in "degrees" based on the readings of particular instruments.

degree (° or **deg**) The percentage of alcohol, by volume, present in a mixture. In winemaking, for example, a 13° wine is 13% alcohol by volume (13% v/v). This unit is also called the **degree Gay-Lussac** (° GL) after the French chemist Joseph-Louis Gay-Lussac (1778–1850).[212]

degree (deg) A unit used in mathematics to describe algebraic expressions. The degree of an expression having a single variable is the highest exponent to which that variable appears. If the expression has more than one variable, then the degree is the highest total exponent of the individual terms, where in each term the exponents of the different variables are added. Thus, $x^2y^4z^3$ is a term of degree 9.

degree absolute An obsolete name for *kelvin*.

degree American A unit of concentration of calcium and magnesium in water (water hardness), one mg of calcium carbonate per litre of water, equivalent to 1 ppm. See also *degree Clark*, *degree French*, and *Deutsche Härte*.

[212] See also: [CROS2].

degree Balling See *degree Plato*.

degree Baumé (°**B** or °**Bé)** or **degree Lunge** A unit of relative density, as read on a type of hydrometer invented by the French chemist Antoine Baumé (1728–1804).[213] The U.S. Bureau of Standards[214] adopted the following definitions for the Baumé scales:

For liquids less dense than water:	d = 140/(G − 130);
For liquids denser than water[215]:	d = 145 − (145/G), in which G = the specific gravity of the liquid at 60°F in relation to water at 60°F.

Today, two scales are used, depending on whether the liquid is lighter than water or heavier than water. For lighter liquids, the relative density d in degrees Baumé is related to specific gravity S by the formula d = (144.3/S) − 144.3; for heavier liquids, the formula is d = 144.3 − (144.3/S). Slightly different conversions were used in specific industries.[216]

degree Brix (°Bx) See *brix*.

degree Celsius (°**C)** or **the centigrade temperature scale** A metric and SI unit of temperature, devised as early as 1710 and used by Linnaeus before 1737. The Celsius temperature scale, a mercury-in-glass scale, is named after the Swedish astronomer Anders Celsius (1701–1744), who, in 1741, introduced a temperature scale with 0 as the temperature at which water boiled and 100 as the temperature at which water froze. Shortly before Celsius's death, the fixed points were reversed in 1743 by J. P. Christen (1683–1755), making 0° the freezing point of water and 100 degrees its boiling point at atmospheric pressure. At first, the scale became

[213] [CHAN].

[214] U.S. National Bureau of Standards. *United States standard Baumé hydrometer scales*. Bureau of Standards Circular No. 59. Washington, D.C.: U. S. Government Printing Office, April 15, 1916.

[215] This definition was adopted for the manufacture of acids and alkalis by the Manufacturing Chemists' Assn. in 1903.

[216] See: [HUST], and [WILS3].

known as the centigrade scale in England.[217] In the SI, the temperature scale has been defined so that the temperature of the triple point of water is exactly 0.01 °C, and the size of the degree is 1/273.16 of the difference between this temperature and absolute zero. For practical purposes, however, there is no difference between this and the original definition. xºC = (x + 273.16) K = (1.8x + 32) ºF = (1.8x + 491.67) ºR; for temperature intervals: 1ºC = 1 K = 1,8 ºF or ºR. See also *degree centigrade*.

degree centigrade (°**C)** An older name for the degree Celsius. Around about 1850, scientists began calling the unit "degree Celsius" in order to honor its presumed inventor.

degree Clark (°**Clark)**, **English degree** (°**E** or °**e)**, or **hydrometre degree (deg-THB** or **deg-e** (e = english)) A unit of concentration of calcium and magnesium in water (water hardness), named after the Scottish scientist Thomas Clark (1801–1867). One deg-THB equals 1 grain of $CaCO_3$ per UK gal of H_2O = 14.3 mg of $CaCO_3$/1000 cm^3 of H_2O. A measure of 5° Clark corresponds to 70 ppm of calcium carbonate in water; and 15° Clark to 210 ppm. See also *Deutsche härte* and *degree French*.

degree curvature (°) A measure of curvature of railroad tracks. When the tracks follow an arc of a circle, the angle of curvature is the angle (measured at the center of the circle) spanned by a chord of a standard length. In the U.S., the chord used is the U.S. chain of 100 feet (30.48 m). In Britain, the traditional chord was the British (Gunter's) chain of 66 feet (20.12 m). In the metric world, a chord of 20 m is used.

degree day (deg da) A unit used in meteorology and engineering to measure the demand for heating or cooling. In the U.S., it is agreed that 65 °F (18.3 °C) is the critical outside temperature; below this tempeature, heating is needed, and above it, cooling is needed. In Great Britain, the heating degree-day is based on 60°F. There is also a definition saying that the English (°F) Heating Degree Days = 65°F − [High temperature (°F) − Low Temperature (°F)]/2; Metric (°C) Heating Degree Days = 18.3°C − [High temperature (°C) − Low Temperature (°C)]/2. This gives us one English Degree Day = 0.555 6 Metric Degree Day, and one Metric Degree Day = 1.8 English Degree Days.[218]

degree Delisle or **degree de Lisle** (°**De)** An obsolete unit of temperature, invented in 1732 by the French astronomer Joseph-Nicolas Delisle (1688–1768). The Delisle scale has the temperature of boiling water as the fixed zero point. In 1738, Josias Weitbrecht (1702–1747) recalibrated the Delisle thermometer with 0 degrees as the boiling point and 150° as the freezing point of water. Absolute zero = 559.725 °De. The scale was in use in Russia during the eighteenth and nineteenth centuries.[219]

degree Dornic (°**D)** A unit used in some parts of Europe to measure the acidity of milk. 1 °D is equivalent to 0.01% lactic acid content. The number of Dornic degrees is the number of millilitres of sodium hydroxide solution used in a standard titration test. Typical values are around 15°D. It is named after the French engineer Pierre Dornic (1864–1933).

degree EBC (°**EBC)** A unit used in Europe to measure the color of beer. EBC is an abbreviation for European Brewing Convention. EBC degrees are related to the Lovibond degrees used in the U.S. by the approximate formula °EBC = (°L * 2.65) − 1.2.

degree English See *degree Clark*.

degree Fahrenheit (°**F)** An obsolete unit of temperature still used customarily in the U. S. The unit was defined by the German physicist Daniel Gabriel Fahrenheit (1686–1736), who also invented (between 1710 and 1714) and manufactured (in Amsterdam from about 1717 until his death in 1736) the mercury thermometer. Fahrenheit set 0° as the coldest temperature he could conveniently achieve, using a bath of ice melting in a solution of common salt. For a consistent, reproducible high point, he chose the temperature of the blood of a

[217] This name was abandoned in favour of Celsius in 1948. See: 1949: Ninth International Conference of Weights and Measures *Nature* **163**, 427–428.

[218] Oliver, John E. Encyclopedia of World Climatology. Dordrecht: Springer, 2005, p. 315.

[219] Celko, Joe. Joe Celko's Data, Measurements and Standards in SQL. Burlington: Elsevier, 2009, p. 214.

healthy person (his wife), which he measured in the armpit and called 96°. Fahrenheit's successors changed the upper fixed point to the boiling point of water, which they set at 212° in order to retain the size of Fahrenheit's degree. Today, the Fahrenheit scale of temperature is defined in terms of the Kelvin scale: x ºF = 5(x + 459.67)/9 K = 5 (x − 32)/9 ºC = (x + 459.67) ºR; for temperature intervals: 1 ºF = 5/9 K = 5/9 ºC = 1 ºR.

degree French (°f)[220] or **degree hydrotimetrique francais (degree THF)** A unit of concentration of calcium and magnesium in water (water hardness), defined as 10 mg of calcium carbonate per litre of water, equivalent to 10 ppm. See also *degree Clark* and *Deutsche Härte*.

degree Gay-Lussac (°GL) See *degree*.

degree German See *Deutsche Härte*.

degree hydrotimetrique francais See *degree French*.

degree Kelvin (°K) A former SI unit of thermodynamic temperature. See *kelvin*.

degree KMW (°KMW) A unit used in Austria to measure the sugar content of must, the unfermented liquour from which wine is made. One degree KMW is roughly equivalent to 1% sugar by weight or 5° Oe. KMW is an abbreviation for Klosterneuburger Mostwaage (must scale). See also *degree Oeschle*.

degree Lovibond (°L) A unit used in the U.S. to measure the darkness of beer and honey. The scale is open-ended, but most readings fall between 1 (a very light gold or yellow) and 25 (a very dark brown).

degree MacMichael (°McM) or **MacMichael degree** A unit used in viscosity measurement in a rotational (Couette) viscometer. The MacMichael-degree readings can be converted into units of the poiseuille (Pl) or the poise (P) through suitable conversion charts. Typically, 1–3 ºMcM is 1 poise = 10^{-1} Pa · s. The unit is usually used to measure the viscosity, or thickness, of chocolate. Typical values range from around 60°McM (very thin chocolates) to around 190°McM (very thick chocolates). The unit is named after the American chemist and rheologist R. F. MacMichael.

degree Newton (°N) A unit of temperature, named after the English physicist, mathematician, astronomer and natural philosopher Sir Isaac Newton (1643–1727). Newton devised a temperature scale around 1700, comprising about twenty reference points ranging from "cold air in winter" to "glowing coals in the kitchen fire". Later, Newton defined the "zeroth degree of heat" as melting snow and "33 degrees of heat" as boiling water; thus, the Newton degree equals 100/33 of a kelvin.

degree Oechsle (°Oe) A unit used in Germany and Switzerland to measure the sugar content of must. One degree Oechsle is roughly equivalent to 0.2% sugar by weight. This unit is related legally to °KMW by the formula °Oe = °KMW * ([0.022 * °KMW] + 4.54), and named after the German inventor Ferdinand Oechsle (1774–1852).

degree per second (°/s) A unit of angular velocity = 1.745 33 · 10^{-2} rad/s = 1.047 20 rad/min.

degree per second squared (°/s²) A unit of angular acceleration = about 1.745 33 · 10^{-2} rad/s^2.

degree Plato (°P) A unit measuring sugar content, especially of wort, the unfermented liquour from which beer is made. It is named after the German chemist Fritz Plato (1858–1938). One degree Plato represents a sugar content equivalent to 1% sucrose by weight. The reading is made with a device called a saccharometer. The **degree Balling**, named after the Austrian chemist Friedrich Balling (1803–1859), is a somewhat older unit (1859) approximately equivalent to the degree Plato.

degree Quevenne (°Q) A unit measuring the density of milk. One °Quevenne represents a difference in specific gravity of 0.001, so, for example, 20 °Q milk has specific density 1.020.

degree Rankine (°R or **°Ra)** A unit of thermodynamic temperature, now replaced by the kelvin, formerly used by engineers in English-speaking countries. The unit is named after the British physicist and engineer William John Macquorn Rankine (1820–1872), who proposed

[220] Letter in lowercase to avoid confusion with degree Fahrenheit, though "degree F" is sometimes used.

it in 1859. X ºR = 5x/9 K = 5(x − 491.67)/9 ºC = (x − 459.67) ºF; for temperature intervals: 1 Rº = 5/9 K = 5/9 ºC = 1 ºF. Temperature intervals are expressed as **deg R**, **degree R** or **Rº**.

degree Réaumur (°**r**, °**Ré**, °**Re**, and sometimes º**R** (not to be confused with Rankine)) or **octogesimal division** An obsolete unit of temperature adopted in several countries, particularly in France, Germany and Russia, prior to the metric system. The Réaumur temperature scale is named after the French scientist René-Antoine Ferchault de Réaumur (1683–1757), who, in 1731, proposed a scale in which 0 was the freezing point of water and 80° the boiling point. Therefore, 1 °r = 1.25 °C = 2.25 °F.

degree Rømer (°**Rø** or °**R** (not preferred)) An obsolete unit of temperature, named after the Danish astronomer Ole Christensen Rømer (1644–1710), who proposed a temperature scale in 1701. Rømer set the zero as the freezing point of brine, the freezing point of water at 7½° and the boiling point of water was defined as 60°; thus, a Rømer degree = 40/21 kelvin.[221]

degree Sikes (°**S**) An obsolete unit expressing the percentage of alcohol in wines and spirits. The unit was introduced in 1794 by the Royal Society. In 1816, Bartholomew Sikes produced his hydrometer, which was universally adopted under the Hydrometer Act of 1818, and remained in standard use until 1980, when Gay Lussac's much simpler ABV method was adopted in Europe. See also *degree*.

degree Soxhlet-Henkel (°**SH**) A unit used in some parts of Europe to measure the acidity of various dairy products, especially milk. One °SH is equivalent to about 0.022 5% lactic acid content. Typical values are around 7° SH. The technique for this measurement was developed by German chemists Franz von Soxhlet (1848–1926) and Theodor Henkel (1855–1934). See also *degree Dornic*.

degree Spendrup (°**Spd**) A unit used in some parts of Northern Europe, mainly in Denmark and Sweden, to measure the percentage of alcohol. 7.25 °Spd is equivalent to about 37.5% alcohol by volume (37.5% v/v). The unit was named after the Danish distiller Peter Mathias Spendrup (1747–1827). See also *degree* and *degree Stoppani*.[222]

degree Stoppani (°**Sto**) A unit of relative density, mainly used in Germany for determining alcoholic strength. The scale was named after the German instrument maker Franz Nicholas Stoppani and his brother, who made a hydrometer using the so-called Vitriol sulfuric heat scale. By 1735, the German chemist Jeremias Benjamin Richter (1762–1807) had already created a hydrometer to determine the alcohol content, and therefore degree Stoppani have the same numerical value as the degree Richter. Two different formulas are used for calculating the Stoppani/Richter degree into relative densities (d). For liquids heavier than water (at 15.625 °C): d = 166/(166 − Sto), and for liquids lighter than water (at 15.625 °C): d = 166/(166 + °Sto). See also *degree Richter*.

degree Thörner (°**Th**) A unit used in some parts of Europe (mainly Germany, Sweden and Russia) to measure the acidity of milk. One degree Thörner is defined as the volume of 0.1 molar sodium hydroxide solution, which is needed for a 100 ml sample, diluted with two parts of distilled water, to make a pink color change of a phenolphthalein pH indicator. Each degree Thörner is equivalent to 0.009% lactic acid in the milk. Typical values are around 17° Th. The unit is named after the German chemist Wilhelm Thörner. See also *degree Soxhlet-Henkel*.

degree Tralles (°**Tr**) A unit of gravity, mostly used in Germany for determining alcoholic strength. The method is based on the use of a hydrometer, at 15.56 °C. The scale is named after the German physicist Johann George Tralles (1763–1822), who, in 1812, invented the scale. The degree Tralles and degree Gay-Lussac (using 15°C as the reference temperature) is nearly identical: 1 °GL = 1.03 °Tr = about 1 v/v (at 20 °C). See also *degree*.

221 See also [FRIE3].

222 [SCHW6].

degree Twaddle, **Twaddle number**, or **twaddle (°Tw)** An obsolete unit for measuring the specific gravity of liquids denser than water. The unit was mostly used in the leather industry to check tanning solutions, and for sulfuric acid and milk. 1 °Twaddle represents a difference in specific gravity of 0.005 = 1/200, so a liquid of specific gravity S is measured at 200(S − 1) °Tw. For milk, 1 °Twaddle equals 5° Quevenne.

deka- (da-) A metric prefix meaning 10, taken directly from the Greek word for ten, *deka*. The Latin spelling deca- is also used.[223]

Dekade In Germany, a premetric unit of count = 10. See also *decker*, *deger*, and *dicker*.

dekagram, **decagram**, **decagramme**, or **dekagramme** (SI: **dag**; metric: **Dg)** Common, but undesirable, metric and SI unit of weight, the dekagram is frequently used in European food recipes. One dekagram is = 10 g = 0.01 kg = 0.352 739 66 oz. The symbol **dkg** sometimes used for this unit is incorrect.

dekaliter, **decaliter**, **decalitre**, or **dekalitre** (SI: **daL** or **dal**; metric: **Dl)** An undesirable unit of volume = 10 L and comparable to the English peck. The dekalitre is = 2.641 72 U.S. liquid gallons, 2.270 21 U.S. dry gallons (1.135 10 U.-S. pecks), or 2.199 69 Imp gal (1.099 85 British pecks). The symbol **dkL** sometimes used for this unit is incorrect.

dekameter, **decameter**, **decametre**, or **dekametre** (SI: **dam**; metric: **Dm)** A common, but undesirable, metric and SI unit of length = 10 m. The symbol **dkm** sometimes used for this unit is incorrect.

dekanewton or **decanewton (daN)** A metric unit of force = 10 N = 1 megadyne = 1.019 716 kgf = 2.248 09 lbf = 72.3301 poundals. In engineering, the dekanewton serves as a convenient replacement for the kilogram of force or kilopond, since it is nearly equal to those units.

dekan A unit of angle measure = 10°=1/36 circle. The ancient Egyptians divided the circle of the Zodiac into 36 divisions, which the Greeks called dekans. The unit is still used occasionally in astrology, for which one dekan equals 1/3 sign.

dekare or **decare** (SI: **daa**; metric: **Da)** An undesirable metric and SI unit of area = 10 ares = 10 000 m^2. In English units, the dekare equals about 10,763.91 sq ft = 1195.99 sq yd = 0.247 105 acres.

dekatherm or **decatherm (DTH)** A unit of energy = 10 therms = one million Btu = about 1.055 057 GJ. This unit is used in the energy industry as a synonym for the *million-Btu* (MM Btu).

Delannoy number A name for numbers that describe the number of paths from the southwest corner of a rectangular grid to the northeast corner, using only single steps north, northeast, or east. The Delannoy numbers are named after the French amateur mathematician Henri Delannoy (1833–1915). The Delannoy numbers can be computed recursively using this formula: $D(a, b) = D(a - 1, b) + D(a, b - 1) + D(a - 1, b - 1)$, in which $D(0, 0) = 1$. The first twentyone Delannoy numbers are: 1, 3, 13, 63, 321, 1683, 8989, 48,639, 265,729, 1,462,563, 8,097,453, 45,046,719, 251,595,969, 1,409,933,619, 7,923, 848,253, 44,642,381,823, 252,055,236,609, 1,425,834,724,419, 8,079,317,057,869, 45,849, 429,914,943 and 260,543,813,797,441.[224] See also *Motzkin numbers*.

de Lisle scale See *degree Delisle*.

demal (D) An obsolete unit of concentration in chemistry. From 1901 to 1964, the litre was officially defined to be exactly 1.000 028 dm^3. During this period, there was a small difference between measuring concentration in moles per litre and in moles per cubic decimetre. Concentration in moles per litre was called molar, while concentration in moles per cubic decimetre was called demal, a name proposed in 1924[225] by H. C. Parker and E. W. Parker. The former conversion was 1 demal = 1.000 028 molar.

demi… A phrase, particular to a French-language context, which means half of any unit,

[223] The symbol dk- for deka- is incorrect, but it is seen fairly often.

[224] Dickau, R. M.: "Delannoy and Motzkin Numbers" at www.prairienet.org

[225] [PARK8].

and which often precedes the names of weights and measures.

demi-heptaméride A unit of interval in music = 1/602 part of an octave. The unit was defined by Joseph Sauveur (1653–1716) in 1696 as one half of an eptaméride.

demijohn [not "a half" of a 'john', the demi is assimilated from Dame] A large bulbous glass bottle, used for transport or storage of liquids, of no specific size.

den An abbreviation for denier.

denary A unit of quantity = 10.

dendrometer [<Gr: *déndron* = "tree"] An instrument used for measuring the hight and diameter of trees.

denier (den) [<L: *denarius*] An obsolete unit of linear density used only for textile filaments. One denier is the density of a thread having a mass of 1 g/9000 m in length. The metric unit of yarn density is the tex; 1 denier equals 1/9 tex = 10/9 decitex.

densitometer An instrument for measuring the optical density (photographic transmission, photographic reflection, visual transmission, and so forth) of a material.

derived units Name for units that are defined by algebraic relations between base units in a system of units.

detachment A military name for a small unit of troops of special composition.

deuce An old English word for two, derived from the old French *deus* (now spelled *deux*). The word survives as the name for a two-spot showing in dice or a two card in card games. In tennis, "deuce" describes a tie situation in which a player must win the next two points in order to win the game.

Deutsche Härte (°dH) A unit of concentration of calcium and magnesium in water, defined as 10 mg of calcium oxide per litre of water. This is equivalent to 17.848 mg of calcium carbonate per litre of water, or 17.848 ppm. See also *degree Clark* and *degree French*.

devil's dozen An alternate name for the baker's dozen, a traditional unit of quantity = 13. This name reflects the long-standing association of the number 13 with bad luck or evil.

dew point A name for a temperature at which the water vapor in the air begins to condense. At this temperature, the relative humidity is 100%.

dex [decimal exponent] An obsolete logarithmic unit currently back in use in astronomy. Originally, dex was a convenient function defined by dex $(x) = 10^x$. But the notation is now being used after the exponent in expressions such as −0.043 dex, meaning $10^{-0.043}$. Thus, 1 dex equals a factor of 10, making the dex identical to the bel. The unit was proposed in 1951 and revived by J. B. S. Haldane (1892–1964) in a letter from 1960.[226]

DFM An abbreviation for Danish Institute of Fundamental Metrology.

DG Usually a representation either of Dg (decagram) or dg (decigram) in the context of upper-case-only printing.

Dg Before 1960, a metric abbreviation for decagram.

Dg An SI abbreviation for dag.

dg A metric and SI abbreviation for decigram.

dg An informal abbreviation for degree.

dhrystone [a play on words; the whetstone being a predecessor] An obsolete unit of computer performance, used in benchmarking, to measure the speed of the computer.[227]

dialog unit (dlu) A unit of relative distance used in computer graphics. Actually, there are two units: the horizontal dialog unit equals ¼ the average width of the font being used, and the vertical dialog unit equals 1/8 the average height of the font. If the font's aspect ratio (the ratio of height to width) is 2:1, these two units will be the same. This is often the case. The unit is particularly used in the design of dialog boxes.

diameter (dia) A unit of magnification, equivalent to power.

diameter breast high (dbh or **d.b.h.)** The diameter of a tree outside of the bark at roughly breast height. Normally measured 4 f. off the ground on the uphill side of the tree.

diamond A marking on many tape measures in the U.S. The diamonds mark a distance

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226 [HALD3].

227 Developed in 1984 by R.P. Wecker.

unit = exactly 8/5 ft = 48.768 cm. This is useful for carpenters if they wish to place five studs, floor joists, etc., at a distance of 8 ft.

didot or **didot point (ptD** or **dd)** A unit of length, used in typography, = 0.375 92 mm.

dieb. alt., **dieb. tert.** Abbreviations for the Latin *diebus alternis*, every other day, and *diebus tertius*, every third day, units of frequency sometimes used in medical prescriptions.

dielectric constant Factor in which the capacitance of a capacitor is increased by using a certain dielectric as opposed to a vacuum. For example, if a capacitor with a vacuum dielectric has a capacitance of 1 farad, but then it uses another dielectric, and the capacitance rises to 5 farads, then the new dielectric that was used has a dielectric constant of 5.[228]

diem [<L: *diem* = "day"] e. g., *per diem* = per day.

differential voltmeter A voltmeter that operates on the potentiometric principle. The unknown voltage is compared to an adjustable calibrated voltage developed within the differential voltmeter.

digit [<L: *digitus* = "finger" or "toe"] A single character in a numbering system. In decimal, digits are 0 through 9, in a hexadecimal system, the letters A, B, . . .F stand as the sequence beyond 9, and in binary, digits are 0 and 1.

digital voltmeter An automatic electronic measuring instrument which displays its measurements directly in the decimal system.

dime In the U.S., a unit of area used to describe small areas in everyday life as "the size of a dime."[229] The dime has had its present size of 0.705 in (=17.91 mm) in diameter since 1828.

dime bag [dime = U.S. 10-cent coin] A vernacular for ten-dollars' worth of marijuana or a similar drug.[230]

dimension (dim) A mathematical unit measuring the number of independent directions in a set or space. Traditionally, a space has as many dimensions as there are mutually perpendicular directions at each point in the space; thus, a line has 1 dimension, a plane has two dimensions, and the ordinary space we live in has three dimensions.

dimensional analysis Process whereby the metrologist separates a quantity into its constituent parts to facilitate the solution to a problem.

dimensional unit The basis for quantification of the entity. For example, length is a dimension, whereas centimetre is a unit of length. A dimension is unique; however, a particular dimension—say, length—may be measured in various units, such as metres, inches, or miles.

dimensional weight See *volumetric weight*.

dimensionless number A quantity which describes a certain physical system and which is a pure number without any physical units.[231] Such a number is typically defined as a product or ratio of quantities which do have units. There are infinitely many dimensionless numbers. Some of those that are used most often have been given names, e.g., *Nusselt number*.

diopter or **dioptre (δ**, **dpt**, or **D)** A metric unit used in optics to measure the refractive power of a lens. Each lens has a focal length, defined as the distance from the center of the lens to the point at which the lens focuses light. The shorter the focal length, the greater the refractive power of the lens. The refractive power of the lens, in diopters, equals 1 divided by the focal length of the lens, in m, so 1 diopter = 1 m^{-1}. The diopter was adopted as a unit at a medical conference in Brussels in 1875.[232] The unit is often spelled *dioptre* outside the U.S.

dirac A jocular unit measuring the prevalence of silence during discourse. Proposed by students at Cambridge University after they had heard the theoretical physicist Paul Adrien Maurice Dirac (1902–1984) as a lecturer. The students were so

[228] Plastics tend to have dielectric constants of around 2 or 3, glass around 5, and water has a dielectric constant of 80.

[229] www.sciencedaily.com

[230] [FENN, p. 131].

[231] See also: [BOUC] or [IPSE].

[232] [THOM6, p. 59].

impressed by his absence of volubility that they coined this unit.

displacement graticule A graduated reticle used in Collimators measuring vertical and horizontal displacement. Generally in terms of linear displacement.

displacement ton In the U.S. and Britain, an obsolete unit of volume = 35 cu ft of salt water = about 0.99 m^3.

Dissolved Organic Carbon (DOC) A unit defined as the amount of organic carbon present in a water sample after filtration through a membrane filter of pore size 0.45 µm.

distance modulus (μ) A way of expressing distances from Earth to an astronomical object, often used by astronomers. $\mu = (m - M)$, in which m = the observed apparent magnitude and M = the computed absolute magnitude. The distance in parsecs is then given as $d = 10^{(0.2\mu + 1)}$.[233]

dito [Ital: = "digit"] A name given to the centimetre in Milan in 1803.

division octogesimale The French name for octogesimal division. See *degree Réaumur*.

dk- An incorrect symbol for the metric prefix deka- (10), sometimes seen in combinations such as dkg for the dekagram or dkm for the dekametre. The correct symbol is *da*-.

dkg An incorrect abbreviation for dekagram. The correct symbol is *dag*.

dkm An incorrect abbreviation for dekametre. The correct symbol is *dam*.

d.k.s. system [decimetre kilogram second], **D. K.S. system**, or **metric-d.k.s.** A metric system, now defunct, that has its derived constants relating coherently to the decimetre, the kilogram and the second.

DL Representation for either Dl, dl, or dL in the context of upper-case-only printing.

Dl A metric abbreviation for decalitre. In SI, this should be *daL* or *dal*.

dl, dL An abbreviation for decilitre.

DM Representation for either Dm or dm in the context of upper-case-only printing.

Dm A metric abbreviation for decametre. In SI, this should now be *dam*.

dm A metric and SI abbreviation for decimeter and décimétre.

DMTU An abbreviation for Dry Metric Ton Unit.

DN A symbol for "nominal diameter," a size measure for piping, valves, fittings, etc. Nominal diameter is essentially the inside diameter of the piping in millimetres. Industrial standards organizations, such as the American National Standards Institute (ANSI), set standards for pipes and fittings based on DN ratings; these standards specify in detail the size, composition, and strength of each component.

Dobson unit (DU) or **Dobson number** A unit used in geophysics to measure the ozone content in the atmosphere over a specific area. One Dobson unit represents the amount of atmospheric ozone that would form a uniform layer 0.01 mm thick at 0 °C and a pressure of 1013.25 mbar = 10^{-5} atmo-metre = about $2.69 \cdot 10^{19}$ ozone molecules in a column with a cross section of 1 cm^2. The unit is named after the British physicist Gordon M. B. Dobson (1889–1976),[234] who, in 1920, invented the Dobson spectrophotometer to measure ozone concentrations from the ground. The Dobson spectrometer measures the intensity of solar UV radiation at four wavelengths, two of which are absorbed by ozone and two of which are not.[235]

DOC An abbreviation for Dissolved Organic Carbon.

dodeca... [<Gr: = "twelve"] e. g., *dodecagon* = having 12 angles and sides.

dol [<L: *dolor* = "pain"] A unit proposed for the measurement of pain. James D. Hardy, Herbert G. Wolff, and Helen Goodell, all of Cornell University, proposed the unit based on their studies of pain during the 1940s and 1950s[236]; they defined 1 dol as equalling 2 "just

[233] Distance moduli uncorrected for interstellar absorption (whose values may overestimate the distance) are called **visual distance moduli**, denoted $(m - M)_v$. Absorption-corrected moduli are called **true distance moduli**, denoted $(m - M)_0$. (en.wikipedia.org)

[234] [DOBS].

[235] See also: [SALB] and Sizes.com

[236] [WOLF] and [WOLF2].

noticeable differences" (jnd's) in pain. Each subject's threshold and maximum tolerance were measured in dols.

Dolezalek qudrant electrometer A quadrant electrometer that uses a quartz fiber suspension. A slight rotation of the electrodes is registered as a motion of a light beam reflected from a small mirror mounted on the suspension fiber. The instrument was invented by the Hungarian scientist Professor Friedrich Dolezalek (1873–1920).

dollar (sometimes indicated by symbol **$**) A dimensionless unit suggested in the 1940s. It was used in nuclear engineering to describe the "reactivity" of a nuclear reactor. For a particular reactor, one dollar is the reactivity at which the chain reaction is just self-sustaining.

donkey power or **donkeypower** A jocular metric unit of power, proposed in 1884,[237] = 250 W = 0.335 3 hp.

door A rarely used unit of effective nuclear cross section = 10^{-26} cm^2.

Doppel... or **Doppelt** ... The German word for "double."

Doppelzentner (Dz) [<G: *doppelzentner* = "double hundred"] A name often used in Germany for the decitonne or metric quintal. Since a Zentner is 50 kg, a Doppelzentner or "double" zentner equals 100 kg.

dots per inch (dpi) A unit of graphic resolution, or sharpness, of a photograph or video image. The unit remains in use even though individual picture elements are now called pixels rather than dots. 1 dpi = 39.370 078 74 point/m.

double A general qualifier distinguishing a doubled size of measure.[238]

Double Magnum A large wine bottle holding about 3 L. See also *jeroboam*.

double-stère In France, a premetric unit of volume used for firewood = 2 m × 1 m × 1 m = 2 stères or metres cubes = 2 m^3.

doublet Another name for a *pair*.

double centner A metric unit of weight = 100 kg.

double-decker bus A measure, used in Britain by newspapers and other media, refering to heights in comparison to the length (8.4 m) or height (4.4 m) of a London Routemaster double-decker bus.

dovap or **DoVAP** [Doppler Velocity And Position] Measurement of the Doppler effect on radio signals transmitted and returned to gauge the speed and position of an approaching or passing object.[239]

doylt of tame pigs or **of tame swine** [<Scot.: *doilt* = "tame to the point of stupidity"] A collective applied only to tame pigs, domesticated to the stage of expecting to be housed and fed at all times.[240] See also *dryft of tame pigs*.

doz An abbreviation for dozen and douzaine.

dpa An abbreviation for "displacements per atom," a measure of the damage to a crystalline material caused by bombarding the material with energetic particles. Each displacement represents an atom dislodged from its place in the crystal by the radiation.

dpi An abbreviation for dots per inch.

D-plus rule (D+ rule) A general rule for thinning of crop trees of various types. In each case, a given number is added to the d. b. h. (= diameter of the tree at breast height) of the crop tree. For example: a "D + 4" rule would mean that a 16 in d.b.h. tree would need 16 + 4 = 20 f. of growing space for optimal growth.[241]

dpm, **dps** Abbreviations for decay per minute and decay per second, units used in the measurement of rates of radioactivity. 1 dps is properly called 1 becquerel (Bq). 1 dpm is = 1/60 Bq = 0.450 45 picocuries.

dpt, **dptr** Abbreviations for diopter.

dr or **dr.** Abbreviations for dram (avoirdupois).

drachm A traditional British spelling of dram.

drag coefficient (***C_d***) A dimensionless number in momentum transfer in general and free settling velocities and resistance to flow

[237] Preece, William Henry. 1884: *The Electrical Review* **15**, 217.

[238] "...though not necessarily a literal precise doubling." [FENN, p. 136].

[239] [NEWE, p. 217].

[240] [ROBE7, p. 241].

[241] [LEWI10, p. 279].

calculations in particular. It is normally defined as $[g (\rho - \rho_f) L]/(\rho v^2)$, in which g = gravitational acceleration, ρ = density of object, ρ_f = density of surrounding fluid, L = characteristic length and v = velocity.

dram In Britain and the U.S., a system for specifying the fineness of thrown silk yarn, such as silk sewing thread. In this system, a yarn's fineness is the weight of 1000 yards expressed in drams, for example, "Number 1 dram silk."

dram (dr) See *fluid dram*.

dram The name given to the gram in Persia, during the country's conversion to the metric system.

dr ap or **dr. ap.** Abbreviations for apothecaries' drachm (or dram).

Drei-gerte Name given in Germany to a piece of land that was 3 Ruthen wide.

drex or **decitex** In the U.S. and Canada, a unit traditionally used in the textile industry to measure the density of a single fiber of yarn. One drex equals a density of 1 g/10 km of length = 1 µg/cm. Since 1 drex equals ⅒ tex, the unit is now called the decitex.[242]

drink In the U.S., a unit measuring the alcoholic content of beverages, used in describing the medical effects of alcohol. U.S. physicians generally consider one drink = 0.5 U.S. fl oz of alcohol; the appropriate metric equivalent would be 15 mL. In U.S. fluid units, one drink corresponds to about 4 oz of wine or 1.25 oz of whiskey.

drink In Australia, a legal unit of capacity for any alcoholic beverage that contains 10 g of ethanol.[243]

Dröbisch angle A unit of interval in music = 1/360 part of an octave.[244] The angle was proposed by the German mathematician Moritz Dröbisch (1802–1896) in the nineteenth century as a cycle of 360° to the octave.

drop (gtt)[245] or **minim** A unit of capacity used in a pharmacy. Traditionally, the drop was another name for a minim, a unit of volume = 1/60 fluid dram or 1/480 fluid ounce (about 0.061 6 ml in the U.S., and 0.059 2 ml in Britain). Now that prescriptions are written in metric units, the pharmacist's drop is = exactly 0.05 mL.

drop An informal unit of capacity used in recipes. According to some older kitchen references, 24 drops = ¼ teaspoon; with U.S. definitions, this makes the drop = 1/576 fluid ounce = about 0.051 mL. In fact, it has no definite volume. The size of a drop depends on the nature of the liquid and the shape of the dropper.

drop An informal unit of capacity = the smallest amount of liquid that can occure naturally in near-spherical form.[246]

drosometer [<Gr.: *drosos* = "dew"] An instrument used to measure the amount of dew deposited.[247]

Druckpunkt or **Schriftgrößenpunkt** In Germany, a unit of length used by the graphic industry = 0.376 mm.

drum During the nineteenth–twentieth centuries, a unit of volume, sometimes used in the oil trade, = 55 U.S. gallons = about 208.198 L.

drurr A unit of length invented and mentioned by Jonathan Swift (1667–1745), Irish writer and novelist, in his novel *Gulliver's Travels* (1726). One drurr was said to equal about 0.18 mm.[248]

dry . . . Indicating a measure being used for dry commodities.

dry goodsbarrel In the U.S, an obsolete commercial unit of dry capacity defined by Congress in 1915[249] for all dry goods except cranberries,

[242] For more information about yarn measures, see*: Yarn counts – A Universal System*. Manchester: the Textile Insitute, 1948, and [YOUN].

[243] A bottle's label must state the number of drinks it contains.

[244] Dr. Andrew Pikler suggested the name "Dröbisch angle" in his article [PIKL].

[245] Originally, **gt** was the symbol for a single drop, with **gtt** being the plural. The abbreviation is from the Latin *gutta* = "drop."

[246] "The smallest 3-dimensional drop or droplet of pure water is of six molecules. hence a volume of about 18 zeptolitres = 18zL = $18 \cdot 10^{-21}$ L." [FENN, p. 139].

[247] [NEGR, p. 101].

[248] See also: [PROJ, p. 608] and [SWAI, p. 54].

[249] March 4, 1915 c 168 § 1, 38 Stat. 1186.

repeating the dimensions given in the definition of the apple barrel, with the addition that the staves were to be no thicker than ¼ inch. The capacity continued at 7056 in^3 = about 115.627 L. Any shape was acceptable, provided the capacity was 7 056 in^3. At the same time, third-barrels, half-barrels, and three-quarter barrels were made illegal in domestic trade.

dryft of tame pigs or **of tame swine** A collective applied only to tame pigs, domesticated to the stage of expecting to be housed and fed at all times.[250] See also *doylt of tame pigs*.

dsp An abbreviation for the dessertspoon (=2 teaspoons).

dspn An abbreviation for the dessertspoon (=2 teaspoons).

dssp An abbreviation for the dessertspoon (=2 teaspoons).

dt The German abbreviation for *Dezitonne*.

du... e. g., *dual* = two-fold, double.

duad = a pair.

duet or **duo** A traditional unit of quantity = 2. The word *duet* is a French version of the Italian *duo*, two. See also *duo*.

duffieux A name suggested for an SI unit of angular spatial frequency in 1973.[251] The unit is named after the French spectroscopist Pierre-Michel Duffieux (1891–1976).

dula [<Arabic: *daula* = "turn"] In Elche and Gandia, Spain, a unit of entitlement to irrigation water.[252]

dula [<Arabic: *daula* = "turn"] In San Antonio, Texas, a unit of entitlement to irrigation water.[253]

duo [<L: *duo* = "two"] = two or a pair.

duodecim See *dozen*.

duodecal Describing something with 12 parts, specifically the number of pins on a valve base or electron tube.

duodecimal [<L: *duo* = "two"] A base-12 number system composed of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B. Such a system has been advocated by no less than Herbert Spencer, John Quincy Adams, and George Bernard Shaw.[254]

duodecimo (12mo) One-twelfth of a sheet of paper, or a sheet folded to make 12 leaves.

Dutchweight A Scots troy scale for general imported goods, derived from the Troye scale of the Netherlands. See *pound* (Scots troy pound).

duty During the early nineteenth century, a unit of work introduced by James Watt (1736–1819) = the work done in lifting a pound weight through a distance of one foot, = about 1.356 J.

duty (m) During the eighteenth century, a unit devised by the British engineer John Smeaton (1724–1792) to describe the efficiency of steam engines used for pumping water. It is the number of millions of pounds of water raised 1 foot by burning 1 bushel of coal.[255]

dvt An abbreviation for dödviktston, the Swedish name for *deadweight ton*.

dw An occasionally used abbreviation for deadweight ton.

DWT or **dwt** An abbreviation for deadweight ton.

dwt or **dwt.** A traditional symbol for pennyweight.

dwt t An abbreviation for deadweight ton.

dyad A unit of quantity = 2. This unit is frequently used in cell biology and biotechnology, for a double chromosome arising from the halving of a tetrad during the first meiotic division.[256]

dyn The CGS abbreviation for dyne.

dyname A unit of power, proposed by the French mathematician Pierre Charles François Dupin (1784–1873) in 1826, defined as the power needed to lift 1000 French tons of distilled water, reduced to its greatest density, to a metre of height, during an astronomical day.[257] See also *dynamode*.

[250] [BARR3, p. 290].
[251] [HAWK2].
[252] [GLIC].
[253] [WATE4].
[254] [GARD2, pp. 104–105].
[255] Typical duties in the era of Newcomen engines were around 4–6 m.
[256] [MORR, p. 696].
[257] [DAUB, p. 317] and [GRAT, p. 1082].

dynameter [<Gr: *dúnamis* = "power"] An instrument for determining the magnifying power of telescopes.

dynamode A unit of work, proposed by the French mathematician Gaspard Gustave de Coriolis (1792–1843) in 1830, defined as the work done in raising 1000 kg through 1 m.[258] This unit was also given name as a **dynamie**, proposed by the French physicist Nicolas Clément (1779–1841), and a **grande unité dynamique**, proposed by the French mathematician Jean Nicolas Pierre Hachette (1769–1834).[259] See also *dyname*.

dynamometer [<Gr: *dúnamis* = "power"] Any of various instruments for measuring force or power, in the mechanical sense.

dyne (dyn) [<Gr: *dúnamis* = "power"] The CGS unit of force = the force which imparts an acceleration of 1 cm/s^2 to a body having a mass of 1 g = 10^{-5} N.[260] The name was first proposed by the British Association for the Advancement of Science's Committee for the Selection and Nomenclature of Dynamical and Electrical Units in its Report of 1873.[261]

dyne centimetre (dyn · cm) The CGS unit of moment of force = 1 erg = 10^{-7} Nm.

dyne centimetre per biot (dyn · cm/Bi) The CGS unit of magnetic flux = 10^{-8} Wb.

dyne centimetre per second (dyn · cm/s) The CGS unit of moment of momentum = 1 erg second = 10^{-7} kg · m^2/s.

dyne per biot centimetre (dyn/(Bi · cm)) The CGSb unit of magnetic flux density and magnetic polarization. For magnetic flux density =10^{-4} T; for magnetic polarization = about 1.256 64 · 10^{-3} T.

dyne per biot squared (dyn/Bi^2) The CGSb unit of permeability = about 1.256 64 · 10^{-6} H/m.

dyne per centimetre (dyn/cm) The CGS unit of surface tension = 1 erg/cm^2 = 10^{-3} N/m.

dyne per cubic centimetre (dyn/cm^3) The CGS unit of specific weight = about 10 N/m^3.

dyne per franklin (dyn/Fr) The CGSf unit of electric field strength = about 2.997 92 · 10^4 V/m.

dyne per squared centimetre (dyn/cm^2) The CGS unit of pressure = 1 μbar = 10^{-1} Pa.

dyne second (dyn · s) The CGS unit of momentum = 10^{-5} kg · m/s.

dyne second per centimetre (dyn · s/cm) The CGS unit of mechanical impedance = 10^{-3} N · s/m.

dyne second per centimetre cubed (dyn · s/cm^3) The CGS unit of specific acoustic impedance = 10 Pa · s/m.

dyne second per centimetre to the fifth power (dyn · s/cm^5) The CGS unit of acoustic impedance = 10 Pa · s/m^3.

dyne second per square centimetre (dyn · s/cm^2) The CGS unit of (dynamic) viscosity = 1 poise. See *poise*.

dynner A unit of information used in computer science = 32 binary digits.[262]

dz The German abbreviation for *Doppelzentner* (=quintal).

5 E

E An abbreviation for SI-prefix exa- (=1,000,000,000,000,000,000).

E A symbol for the 5th digit after 9 in the hexadecimal notation, so the equivalent of 14.

E An abbreviation for exponent, e.g., 10E−2 = 10^{-2}.

E A symbol for Ekman number.

E An abbreviation for erlang.

E See *E-unit*.

E An abbreviation for eötvös.

E The name of the said note in the octave below middle C. With the normal modern setting for the diapason, this E has a frequency of about 165 Hz.

[258] [GRAT, p. 1082].

[259] [KRET2, p. 4].

[260] Hence also: dyn s cm^{-2} = poise (for dynamic viscosity); dyn cm = erg (for energy, work, quantity of heat); dyn cm^{-2} = barad (for pressure); dyn s cm^{-3} = rayl (for specific acoustic impedance); and dyn^{-1} cm s^{-1} = mohm (for mechanical mobility).

[261] 1873: *Rep. Brit. Ass.*, 224.

[262] [RAYM].

e The symbol for the electric charge of one electron. Since the charges on other particles in atomic physics are whole-number multiples of this charge, the symbol e is often used as a unit of measure.[263] 1 e is = 160.217 764 62 · 10^{-21} C.

e, **Euler's number**, or **Napier's constant** A mathematical unit used as the base of "natural" logarithms and exponentials.[264] The real number *e* is irrational, which means that its decimal expansion is infinite and non-repeating, given by the series: 1 + 1/1! + 1/2! + 1/3! + ... = 2.7182...

e The name of the said note in the octave above middle C. With the normal modern setting for the diapason, this e has a frequency of about 329 Hz.

°**E** An abbreviation for degree English.

°**e** An abbreviation for degree English.

E-unit or **E unit** An obsolete unit of X-ray intensity, used by the American physicist William Duane (1872–1935)[265] in 1914,[266] = 1 roentgen/s.

e-unit or **e unit** An obsolete unit of X-ray dosage, used by the American physicist Walter Friedrich in 1916,[267] = 6–8 roentgens.

earth mass (***M_E*** or ***$M_\oplus$***) The mass of Earth, used as a reference mass for comparative indication of planetary masses. Some sources[268] say about 5.973 7 · 10^{24} kg and some[269] say about 5.972 2 · 10^{24} kg.

earth-rate unit (eru) The unit of angular velocity = 15° per hour = 0.072 8 millirad/s, the rate at which the earth rotates on its axis.[270] This unit is used to measure the drift rates of gyroscopes and various pointing devices in aerospace engineering.

EBC An abbreviation for European Brewing Commission, frequently used for a Formazin Turbidity unit according to European Brewing Convention, = 4.08 EPH 90° White NTU = 4 absorption JTU = 4 absorption TE/F according to German standard = 69 90° White Formazin ASBC (American Society of Brewing Chemicals) = 10 Kieselguhr unit ppm SiO_2 = 4 APHA mod. corresponding to ppm SiO2 = 25 matrix units corresponding to ppm.[271]

Ebq The SI abbreviation for exabecquerel.

ebulliometer [<L: *ebullire* = "to boil away"] An instrument for measuring and displaying the boiling points of liquids, especially solutions.[272]

ebullioscopy A method of finding the relative molecular mass of a substance by measuring the extent to which it raises the boiling point of a solution, using an ebulliometer.[273]

EC The SI abbreviation for exacoulomb.

ECd The SI abbreviation for exacandela.

echolocation A technique for measuring the range and bearing of an object by detecting echoes of high-frequency sounds reflected by it.[274]

Eckert number (***E*** or ***Ec***) A dimensionless number in momentum and heat transfer in general and compressible flow calculations in particular. It is normally defined as $v_\infty{}^2/(C_p\ \Delta T)$, in which v_∞ = velocity of fluid far from body, C_p = heat capacity and ΔT = temperature difference.[275]

ecm A unit of an electric dipole moment, used in physics, = 1.602 178 · 10^{-21} C·m. The moment of an electric dipole is the product of an electric charge and the distance by which the charge is displaced from the center of charge. The ecm is defined as the product of the charge *e* on an electron and a distance of 1 cm.

263 [TIPL, p. 653].

264 The e number is often said to be among the most important numbers in mathematics. "In 1864 Benjamin Peirce had his picture taken standing in front of a blackboard on which he had written the formula $i^{-i} = \sqrt{(e^\pi)}$. In his lectures he would say to his students: *Gentlemen, we have not the slightest idea what this equation means, but we may be sure that it means something very important*." (www.history.mcs.st-andrews.ac.uk).

265 See also [BRID2, pp. 23–41].

266 [GLAS3].

267 [GLAS3].

268 [ALLE2, p. 240].

269 The Astronomical Almanac Online (asa.usno.navy.mil).

270 [ASME, p. 5].

271 [MCMI, p. 6.61]. See also:[EURO].

272 www.wisegeek.com

273 [ROSS2, pp. 263–266].

274 [PERR, p. 348].

275 [OERT, p. 430] and [HUGH, p. 125].

Eddington limit (*L*) The theoretical maximum luminosity of a star or other stellar object, which can keep electrons from being blown out of the sphere. $L = (4\pi G c m_p M)/\sigma_e$ erg/s, in which M = mass and σ_e = the Thomson cross section.

Eddington number (N) The name of the ratio of the mass of the universe to the mass of an average particle of matter[276] = 31 495448272550005155211307922363110936089435829054233418732462850152371262062592 ~= 3.149 544...×10^79^. The number is named after the British astronomer Sir Arthur Eddington (1882–1944), who predicted (apparently on a transatlantic boat crossing) the number of protons and electrons in the observable universe.[277]

edison A twentieth century unit of electric current = 100 A. It is named after the American inventor and businessman Thomas Alva Edison (1847–1931).

EER An abbreviation for energy efficiency rating.

effective dose (ED) A measure used in pharmacology to express the percentage of a population which receives the desired benefit from a dose of the substance being studied. The measurement is often given as a subscript. For example, the ED_{50} dose is the amount of the substance which benefits 50% of the test population.[278]

effective mass The mass of a body which is being acted upon by the buoyant forces of air. The effective mass of a weight is its true mass minus the buoyant force of air displaced by the weight.

effusiometer An apparatus for comparing the relative molecular masses of gases by measuring the time they take to effuse through a small aperture.[279]

EHP An abbreviation for Effective Horse Power.

eighteen inches Imperial measure of a length with many practical applications.[280]

eighth The name of the span of 8 note letters, from a first to an eighth in sequence.

eighth A name used in North America, particularly in racing parlance, for a furlong.

eighth-mile A name used in North America, particularly in racing parlance, for a furlong.

einstein or **Einstein unit** A mid-twentieth century metre-gram-wink-unit of light energy concentration, sometimes used in photochemistry. One einstein equals the energy per mole of photons carried by a beam of monochromatic light, while its value varies with the frequency of the light in the reaction being studied. If a beam of light in a vacuum has the frequency *v* (in hertz) and the wavelength *l* (in m), then one einstein = $(3.990\ 313 \cdot 10^{-10})v$ or $(0.119\ 627)/l$ J/mol. The unit is named after the physicist Albert Einstein (1879–1955), who first explained how light carries energy in 1905. See also *samson*, *simson*, and *wink*.

Einstein's constant A proposed name for the speed of light in a vacuum (=299,792,458 m/s), to help alleviate confusion that can be produced when talking about the speed of light, as light travels, in mediums such as water, much slower than Einstein's Constant. The name was proposed by Professor Kenneth Brecher of Boston University.

eka- Prefix, being the Sanskrit numeral one, meaning 'one immediately after' or 'the next one to,' and once applied to hypothetical chemical elements additional to those in the known Periodical Table of Elements.[281]

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276 According to [EDDI].

277 The mean free path of a proton in the universe is roughly = the radius of the observable universe. This was noticed by Scrödinger in an investigation in 1938. See also: [BERT, p. 75] and [HARD2, p. 15 and p. 49].

278 [DOWE, p. 28].

279 See also:[MULL4, p. 290].

280 Cf. [GILP, p. 166] and [MCIN, p. 121]. 18 in = 1 ½ ft = ¼ fathom = ½ yard = about 1 cubit = 2 spans.

281 In 1871, the Russian chemist Dmitri I. Mendeleyev (1834–1907) highlighted the gaps below boron, aluminium, and silicon. His knowledge of the variation of properties of adjacent elements and their compounds enabled him to make predictions about the yet-to-be-discovered elements. These predictions were confirmed upon discovery of "eka-boron" (scandium) in 1879 by Lars Fredrik Nilson (1840–1899), "eka-aluminium" (gallium) in 1875 by Paul-Émile Lecoq de Boisbaudran (1838–1912), and "eka-silicon" (germanium) in 1866 by Clemens Winkler (1838–1904). See also: [VANS, p. 139].

Ekman number (Ek, E, or N_E**)** A dimensionless number used when measuring the ratio of viscous to Coriolis forces. $Ek \equiv F_{viscous}/F_{Coriolis} \equiv |\upsilon \nabla^2 u| / (2|\Omega \times u|) \equiv \nu/(2\ \Omega L^2 \sin\theta)$, in which ν = kinematic viscosity, u = fluid speed, Ω = angular frequency vector, L = length, and θ = angle between Ω and u. The number, = the Rossby number divided by the square root of the Reynolds number, was proposed by the Swedish oceanographer Vagn Walfrid Ekman (1874–1954), best known for his studies on ocean currents.[282]

ekW An abbreviation for equivalent kilowatt.

El An abbreviation for Elasticity number.

elasticity The physical property of a material when it deforms under stress, but returns to its original shape when the stress is removed.

Elasticity number (*El*) A dimensionless number in momentum transfer in general and viscoelastic flow calculations in particular. It is normally defined as $(\theta\ \mu)/(\sigma\ r^2)$, in which θ = relaxation time, μ = viscosity, σ = density and r = pipe/conduit radius.[283]

elastic limit A maximum unit stress which can be obtained in a structural material without causing permanent deformation.

electric field intensity The magnitude of the intensity of an electric field at a particular point = the force which would be exerted upon a unit positive charge placed in the field at that point. The direction of the electric field is the direction of this force.

electrin A name proposed in 1874, by Professor George Johnstone Stoney (1826–1911), for the unit of charge on a hydrogen ion. In 1891, Stoney himself changed the name to "electron."

electromagnetic centimetre See *centimetre*.

electromagnetic spectrum A spectrum representing the range of all possible electromagnetic radiation.

electromagnetic unit (E.M. unit of . . . or e.m. unit of . . .) Units of the e.m.u. system are sometimes refered to as the "e.m. unit of . . .".

e.m. unit of capacitance	= abfarad
e.m. unit of electric charge	= abcoulomb
e.m. unit of conductance	= abmho
e.m. unit of current strength	= abampere
e.m. unit of electric potential	= abvolt
e.m. unit of electric resistance	= abohm
e.m. unit of inductance	= abhenry
e.m. unit of magnetic field strength	= oersted
e.m. unit of magnetic flux	= maxwell
e.m. unit of magnetomotive force	= gilbert

electrometer An instrument for measuring electric charge or electrical potential difference.[284]

electron charge or electric charge A name of the electric charge carried by a single electron, and a fundamental physical constant with a value of $1.602\ 176\ 620\ 8(98) \cdot 10^{-19}$ C, according to CODATA 2014.

electron (m_e) A unit of weight used in particle physics = the mass of the electron. This is about $9.109\ 383 \cdot 10^{-31}$ kg = $9.109\ 383 \cdot 10^{-28}$ g = 0.510 9989 MeV.

electron rest mass The theoretical mass of the electron, evaluated as $9.109\ 383\ 56(11) \cdot 10^{-31}$ kg according to CODATA 2014.

electronvolt, **electron volt (eV)**, or **equivalent volt** A unit of work or kinetic energy used in atomic physics. The unit was introduced in 1912[285] as the "equivalent volt." One electron volt is the work required to move an electron through a potential difference of one volt. The size of the electronvolt must be determined experimentally; the currently accepted value is $1.602\ 176\ 565(35) \cdot 10^{-19}$ J. It is a very small amount of energy and the more commonly used multiples are MeV (million eV), GeV (billion eV or giga-electronvolt) and TeV (trillion eV). The prefix B (for billion in the American style) has also been used, but is deprecated by the IUPAP. The unit is accepted for use with SI units. The official spelling is electronvolt (one word).

electronvolt (eV) A unit of weight used in particle physics. Mass and energy are related by Einstein's famous equation, $E = mc^2$, in which

282 [DYKE, p. 34].

283 [PARK2, p. 116].

284 See also [THOM2].

285 [RICH4].

c is the speed of light, 299,792,458 m/s. An energy of one electronvolt = a mass of about $1.782\ 662 \cdot 10^{-33}$ g = about $1.073\ 544 \cdot 10^{-9}$ atomic mass unit.

electronvolt per metre (eV/m) A unit of linear stopping power and linear energy transfer = about $1.602\ 19 \cdot 10^{-19}$ J/m.

electronvolt per square metre (eV/m²) A unit of energy fluence = about $1.602\ 19 \cdot 10^{-19}$ J/m^2.

electronvolt per square metre second (eV/(m²s)) A unit of energy fluence rate = about $1.602\ 19 \cdot 10^{-19}$ W/m^2.

electronvolt square metre (eVm²) A unit of atomic stopping power = about $1.602\ 19 \cdot 10^{-19}$ Jm^2.

electronvolt square metre per kilogram (eVm²/kg) A unit of weight stopping power = about $1.602\ 19 \cdot 10^{-19}$ Jm^2/kg.

electroscope An instrument for detecting the presence of electric charge, usually by means of a pair of thin gold leaves that diverge as they become charged.

elite type A typewriter type, actually the most common size in typing, that runs 12 characters per inch.

em A printer's unit of relative distance. One em is the height of the type size (in points) being used. If 12 point type is being set, then 1 em is 12 points, and so on.

eman [<L: *emantio* = outflow, discharge] An obsolete unit used in balneology to express the activity concentration of water containing the radon isotope ^{222}Rn. It has also been used to express the radioactivity concentration of the atmosphere. One eman is = 10^{-13} Ci/cm^3 = $3.7 \cdot 10^{-3}$ Bq/cm^3. At the meeting of the International Radium Standards Committtee in 1930,[286] it was said that the eman had been in use since 1921, but without giving references to any publications containing the eman.

emE A German abbreviation for *elektromagnetische Einheit* (=electromagnetic unit).

emf An abbreviation for electromotive force.

EMT The French abbreviation for *Equivalent Méga Tonnique*.

emu or **e.m.u.** An abbreviation for "electromagnetic unit." See *ab-*.

emu The CGS unit of magnetic dipole moment = 4πμOe. In SI units, one emu equals 0.001 A·m².

emu/cm³ or **emu/cc** The CGS unit of magnetization. In SI units, one emu/cm³ can be interpreted either as 4π/10 mT as a unit of magnetic polarization or excess magnetic induction, or as 1000 A/m as a unit of a magnetic dipole moment per unit volume.

E.N. [European Norm] A general term adverting to official standards of the European Union.

en A printer's unit of relative distance = the width of the capital letter N (traditionally half that of the widest letter, M) = ½ em. If 12 point type is being set, then one en is 6 points (= about 2.108 7 mm), and so on.[287]

energid A biological 'unit' of life consisting of the nucleus and the body of cytoplasm with which it interacts.[288]

energy efficiency rating (EER) A measure of the efficiency of an air conditioner. The EER is computed as the cooling capacity of the unit (in Btu per hour) divided by the electric power consumed (in watts) at a temperature of 30 °C and under specified test conditions. Typical values are in the range 8–12. Technically, 1 EER is a number (the ratio between two measurements of power) = 0.293 071. See also *COP* and *energy factor*.

energy factor (EF) A measure of the energy efficiency of an appliance. In the U.S., the Department of Energy has defined energy factors for a variety of appliances: for dishwashers, the energy factor is the number of cycles per kilowatt hour of power input; for clothes washers, it is the capacity of the washer in cubic feet divided by the number of kilowatt hours of power input per washing cycle; and for clothes dryers, it is the

[286] [RMP2].

[287] See also: www.chicagomanualofstyle.org, www.apastyle.org and www.mla.org

[288] www.wordwebonline.com

number of pounds of clothes dried per kilowatt hour of power consumed.

Engineer's chain or **Ramden's chain** During the seventeenth–twentieth centuries, a unit of length used by American surveyors and civil engineers = 100 Ramden's links = 100 ft = about 30.48 m.[289]

Engler degree A unit of kinematic viscosity, used mostly in Great Britain, given by readings on a standardized Engler viscometer. Viscosity in Engler degrees is the ratio of the time of flow of 200 cm^3 of oil to the time of flow of cm^3 of water at the same temperature (usually 20°C but sometimes 50°C or 100°C). The conversion of Engler degrees to absolute units requires an appropriate table, but for liquids having a viscosity of 100 centistokes or more, the Engler degree is = 7.58 cSt. The unit is named after the German chemist Carl Oswald Viktor Engler (1842–1925).[290]

English degree See *degree Clark*.

enne- [<Gr: *ennea* = "nine"] A prefix meaning nine, e.g., *enneagon* = polygon or plane figure with nine sides and nine angles = a nonagon.

ennead [<Gr: *ennea* = "nine"] A unit of quantity, mostly used when speaking of the nine gods of Heliopolis (Atum, Shu, Tefnut, Geb, (Newet) Nut, (Wesir) Osiris, (Aset) Isis, (Nebt-Het) Nephthys, and Seth), = 9.[291] The title is also given to the works of the philosopher Plotinus, published by his pupil Porphyry. The name "ennead," which Porphyry gave to his edition of Plotinus' writings, indicates that each of the six books contains nine chapters.[292]

enzyme activity unit (**U** or **EU**), **enzyme unit**, or **the International Union of Biochemistry unit** A unit used by biochemists to measure the activity of enzymes, which are proteins produced by living cells to cause or facilitate necessary chemical reactions within the cell. One enzyme unit is the quantity of enzyme needed to cause a reaction to process 1 micromole of substance per minute under specified conditions of temperature, substrate concentration and pH number. The unit was adopted, with no name, in 1964[293] by the International Union of Biochemistry, having been defined by its Enzyme Commission in 1961.[294] In 1978, the unit was replaced by the katal. The enzyme unit equals 1/60 microkatal (μkt) = 16.667 nanokatals. 14.28 enzyme units = 1 Sumner unit.

Eötvös number (***Eo***) A dimensionless number in momentum transfer and atomization in general, and calculation of the motion of bubbles and droplets in particular. It is normally defined as $[L^2 (\rho - \rho_f)]/\sigma$, in which L = characteristic length, ρ = density of bubblet/droplet, ρ_f = density of surrounding fluid and σ = surface tension.[295] The number is named after the Hungarian geophysicist Baron Roland von Eötvös (1848–1919).

Eötvös unit, **Eoetvoes-unit**, **Eotvos**, or **Eoetvoes (E)** A unit used in geophysical prospecting to measure the change in the acceleration of gravity with horizontal distance. One Eötvös unit equals 10^{-9} Gal/cm= 10^{-4} Gal/km. In proper SI terms, the Eotvos unit equals 10^{-9} s^{-2}; hence, the E unit equals a change of 10^{-9} m/s^2 in acceleration, resulting from a shift of 1 m in horizontal direction on the Earth's surface. The unit is named after the Hungarian geophysicist Baron Roland von Eötvös (1848–1919), who made the first successful torsion balance.[296]

Ep An abbreviation for pulse energy and energie par impulsion.

equilibrium A condition in which all forces, processes or tendencies present are exactly counterbalanced by equal and opposite forces, processes, or tendencies.

equivalent or **equivalent weight** (**Eq** or **EW**) A unit of relative amount of substance used in chemistry. One equivalent weight of an element,

[289] [SCHW, p. 1048].
[290] See also:[JACO2, p. 15].
[291] [ARMO, p. 4].
[292] [SHIE, p. 307].
[293] [IUB2].
[294] [IUB2].
[295] [CAUG, p. 407].
[296] [EÖTV].

compound, or ion is the weight in grams of that substance which would react with or replace 1 gram of hydrogen.[297]

equi-viscous temperature (EVT) A unit for viscosity, used in the tar industry, = the particular temperature in degree Celsius at which tar has a viscosity of 50 s when meaured in a standard tar efflux viscometer. The unit, now recognized by the British Standards Institution,[298] was proposed by G. H. Fuidge of the South Metropolitan Gas Company in the late 1930s.[299]

erf, **erve**, or **erwe** [="land"] Used by Dutch people in New York, during the seventeenth–eighteenth centuries, a unit of land area, usually containing about half an acre.[300] After the Dutch withdrawal, the unit was spelled *erve* or *erwe*.[301]

erg [<Gr: *ergon* = "work"] The CGS unit of work or energy = the work (energy) done by a force of 1 dyne acting through a distance of 1 cm. Equivalently, 1 erg is the kinetic energy of a mass of 1 g moving at a velocity of 1 cm/s = 1 dyn · cm = 0.1 μJ. The unit was first proposed by a committee of the British Association for the Advancement of Science in the first Report of the B. A. Committee for the Selection and Nomenclature of Dynamical and Electrical Units in 1873[302]. A million ergs was sometimes termed a megalerg. See also *megalerg*.

erg/Bi An abbreviation for erg per biot.

erg/Bi^2 An abbreviation for erg per square biot.

erg/cm An abbreviation for erg per centimetre.

erg/cm^3 An abbreviation for erg per cubic centimetre.

erg per biot (erg/Bi) The CGSB unit of magnetic flux = 10 nWb = 1 Mx.

erg per square biot (erg/Bi^2) The CGSB unit of self inductance and mutual inductance = 10^{-9} H.

erg per centimetre (erg/cm) The CGS unit of linear stopping power and linear energy transfer = 10^{-5} J/m.

erg per cubic centimetre (erg/cm^3) The CGS unit of energy density and calorific value on a volume basis = 10^{-1} J/m^3.

erg per cubic centimetre degree Celsius (erg/(cm^3°C)) The CGS unit of heat capacity per unit volume = 10^{-1} J/(m^3 K).

erg per cubic centimetre second (erg/(cm^3 s)) The CGS unit of heat release rate = 10^{-1} W/m^3.

erg per centimetre second degree Celsius (erg/(cm s °C)) The CGS unit of thermal conductivity = 10^{-5} W/(m K).

erg per degree Celsius (erg/°C) The CGS unit of heat capacity = 1 erg/K.

erg per franklin (erg/Fr) The CGSF unit of electric potential = 2.997 92 · 10^2 V.

erg per gram (erg/g) The CGS unit of specific heat capacity and kerma = 10^{-4} J/kg.

erg per gram degree Celsius (erg/(g °C)) The CGS unit of specific heat capacity = 10^{-4} J/(kg K).

erg per gram second (erg/(g s)) The CGS unit of absorbed dose rate and kerma rate = 10^{-4} W/kg.

erg per kelvin (erg/K) The CGS unit of heat capacity and entropy = 10^{-7} J/K.

erg per mole degree Celsius (erg/(mol °C)) The CGS unit of molar gas constant = 10^{-7} J/(mol K).

erg per second (erg/s) The CGS unit of electrical power and sound energy flux = 10^{-7} W.

erg per second steradian (erg/(s sr)) The CGS unit of radiant intensity = 10^{-7} W/sr.

erg per second steradian square centimetre (erg/(s sr cm^2)) The CGS unit of radiance = 10^{-3} W/(sr m^2).

erg per square centimetre (erg/cm^2) See *dyne per centimetre*.

erg per square centimetre second (erg/(cm^2 s)) The CGS unit of energy fluence rate = 10^{-3} W/m^2.

[297] [MACK, p. 65] and [NEBE, p. 136].

[298] [BSI].

[299] [FUID] and [FUID2].

[300] [LLEW, p. 213] and [LEDE].

[301] See also: [HOMA, p. 173].

[302] First Report of the B. A. *Committee for the Selection and Nomenclature of Dynamical and Electrical Units*. London, 1873.

erg per square centimetre second degree Celsius (erg/(cm² s °C)) The CGS unit of coefficient of heat transfer = 10^{-3} W/(m² s K).

erg per square centimetre second kelvin to the fourth power (erg/(cm² s K⁴)) The CGS unit of Stefan-Boltzmann constant = 10^{-3} W/(m² K⁴).

erg/s An abbreviation for erg per second.

erg second (erg s) The CGS unit of Planck constant =10^{-7} J s.

erg square centimetre (erg cm²) The CGS unit of atomic stopping power =10^{-11} J m².

erg square centimetre per gram (erg cm²/g) The CGS unit of weight stopping power = 10^{-8} J m²/kg.

erg square centimetre per second (erg cm²/s) The CGS unit of first radiation constant =10^{-11} W m².

ergon [<Gr: = "work"] A unit proposed in 1913 by Partington,[303] = $h \cdot f$, in which h = Planck's constant and f = frequency of the electromagnetic radiation.

eriometer An optical instrument, invented in 1824 by Dr. Thomas Young (1773–1829), for determining the diameters of fibres, minute globules and wool particles.[304]

erlang (E) or **traffic unit** An international unit of average traffic on a facility during a period of time. The number of erlangs is the ratio of the time the facility is occupied (continuously or cumulatively) to the time the facility is available.[305] One Erlang is = 3600 Calling Seconds = 36 CCS. The unit, adopted in 1946, is also described as the average number of simultaneous connections observed during a measurement period.[306] The unit is named after the Danish mathematician Agner Krarup Erlang (1878–1929),[307] who was the first person to study the mathematics of telephone networks.[308]

error The difference between an observed value, or calculated value, and the true or actual value.

'erub' The Jewish name for a quantity of food, enough for two meals.

erve See *erf*.

e.S. unit or **e.s. unit** An abbreviation for electrostatic unit.

esE The German abbreviation for *electrostatische Einheit* (=electrostatic unit).

ESM French abbreviation for *Ecole Supérieure de Métrologie*.

ester value The amount of potassium hydroxide (KOH) needed to saponify 1 g of a fat. It equals the difference between the saponification value and the acid value.

ESU, **esu**, or **e.s.u.** An abbreviation used for CGSe units ("electrostatic unit.") See *stat-*.

etalon [<F: *étalon* = "standard"] An optical instrument, invented by the French physicists Charles Fabry (1867–1945) and Alfred Pérot (1863–1925), with two semi-silvered plane and strictly parallel reflecting surfaces, used for the precise measurement of distance or the wavelength of light. [309]

ett- or **etto- (h-)** An Italian spelling for the metric prefix hecto- (100). The hectare, for example, is ettaro in Italian. The International System allows for national variations in the spelling of the names of units, but not in the symbols used for them; thus, the symbol for etto- is h-.

etti See *etto*.

etto (hg) [*pl.* etti] or **ettogrammo** An informal twentieth century Italian name for the *hectogram* = 100 g.[310]

Eu An abbreviation for Euler number.

[303] [PART, p. 521].

[304] [BREW, p. 101], [EMMO], and [EMMO2].

[305] In planning, 42 erlangs is often taken to equal one full circuit. The underlying 70% (60 × 0.70 = 42) factor being regarded as providing a fair likelihood of a caller finding the circuit free.

[306] ANSI/IEEE Standard 312-1977. *Standard Definitions of Terms for Communication Switching*.

[307] [BROC2].

[308] IEEE Standard 599-1983 *Standard Glossary of Power Systems Data Transmission and Related Channel Terminology and* ANSI/IEEE Standard 312-1977 *Standard Definitions of Terms for Communication Switching*.

[309] [DUNN, pp. 379–380].

[310] It was used to describe the weight of items like cheese and sliced meat when sold at retail. [STOB, p. 525]. See also: [SINC3, p. 192] and [EVAN2, p. 151].

EU An abbreviation sometimes used for the enzyme unit.

eudiometer An apparatus for measuring the change in volume when a mixture of gases react together.

eudiometer An instrument, invented by Marsilio Landriani (1751–1815) in 1775, used to measure the purity of air, and especially the volume of oxygen in it.[311]

Euler's constant or **Euler-Mascheroni constant (γ)**

$$\gamma = -\int_0^\infty \exp(-x)\ln(x)\,dx = 0.577\ 215\ 664$$

901532 860 606 512 090 082 402 431 042 . . .

The Greek letter γ was first used by the German mathematician Leonard Euler (1707–1783), who denoted this value in 1781 by 16 digits.

Euler number (*Eu*) A dimensionless number used in momentum transfer in general and the calculation of fluid friction in conduits in particular. It is normally defined as $(g_c \cdot \Delta P)/(\rho \cdot v^2)$, in which g_c = dimensional constant, ΔP = pressure drop, ρ = density, and v = velocity. The number is named after the German mathematician Leonard Euler (1707–1783).

Euler's number See *e*.

EUV An abbreviation for extreme ultraviolet.

eV An abbreviation for electronvolt.

evaporimeter See *atmometer*.

evaporometer See *atmometer*.

eV/m An abbreviation for electronvolt per metre.

eV/m^2 An abbreviation for electronvolt per square metre.

E.V.T. An abbreviation for equi-viscous temperature.

EW An abbreviation for equivalent weight.

exa- (E-) An SI and metric prefix denoting 10^{18} (1 quintillion). The Latin and Greek prefix ex- means "out of," and is often used to indicate "a long way," as in the words "expanse" or "extreme." In addition, the prefix suggests the Greek *hexa*, meaning 6, this being the sixth prefix (n = 6 in 10^{3n}) in the SI system of metric prefixes. The 15th CGPM[312] added it to the SI (Resolution 10).

exabyte Term used in the world of computing to describe data storage space and system memory. When referring to an exabyte for disk storage, hard drive manufacturers usually use the standard that an exabyte is 1000 petabytes = 10^{18} bytes. When exabyte is used for real and virtual storage, then 1024 petabytes is the appropriate notation.[313]

exagram (Eg) A metric unit of weight = 10^{18} g.[314]

exajoule (EJ) A metric unit of energy. One exajoule equals 947.817 (U.S.) trillion Btu = 277.777 8 petawatt hours = about 9480 megatherms. The unit is often used in discussing global energy production, which is measured in hundreds of exajoules per year.

exameter or **exametre (Em)** A metric unit of length = 10^{15} km = about 621.371 trillion miles = 105.7 ly = 32.408 parsecs. One exameter is approximately the distance from the earth to the Hyades star cluster in Taurus.

exbi- (Ei-) [contraction of "exabinary"] A binary prefix meaning 2^{60} = 1 152 921 504 606 846 976. This prefix, adopted by the International Electrotechnical Commission in 1998, replaces exa- for binary applications in computer science.[315]

excelsior A unit of type length = 3 points = about 1.054 381 5 mm.[316]

exposure value (EV) A unit used in photography to describe relative exposure. The EV system originated in Germany in the 1950s and was intended as an easily mastered substitute for the shutter speed/aperture combination. EV = [(1/log 2) log (N^2/t)], in which N = lens aperture and

[311] brunelleschi.imss.fi.it. See also: [MARC].

[312] *Comptes Rendus des Séances de la Conférence Generale des Poids et Mesures*, 106. *Metrologia* 1975: **11**, 180–181.

[313] www.whatsabyte.com

[314] Used, for example, when describing the amount of methane carbon in oceanic sediments. See: [CHUN, p. 463].

[315] [COHE2, p. 91].

[316] See also: [ALUM].

t = shutter speed. EV 0 is assigned to a specific combination of exposure time and lens aperture, such as 1 second at f/1. An increment of 1 EV increases or decreases the light by a factor of two, so an increase of one EV doubles the exposure, and a decrease of one EV cuts it in half.[317]

extensometer An instrument, invented by Dr. Charles Huston in 1879,[318] that detects and displays the minute changes in length or shape in a material that result from an increase or decrease in temperature.

extremely low frequency (ELF) An imprecise term for radio frequencies. According to generally accepted usage in Europe, the region from 30 to 300 Hz is designated as extremely low frequency; the region below this ELF band is unnamed. In the U. S., the ELF region is sometimes designated as 0–100 Hz.[319]

extremum A name for the maximum or the minimum value of a function.

6 F

F An MKSA and SI abbreviation for farad.

F See *fermi*.

F A hexadecimal notation for the sixth digit after 9, so the equivalent of 15.

f An abbreviation for SI prefix femto- (=0.000 000 000 000 001).

f An abbreviation for foot in such constructions as fps-system.

°**F** An abbreviation for degree Fahrenheit.

°**f** An abbreviation for degree French.

fafillion See *zillion*.

faggot The name of a bundle of twigs, logs or log-like pieces of accepted size.

Fahrenheit See *degree Fahrenheit*.

fanning friction factor or **fanning friction number** (*f*) A dimensionless number used in momentum transfer in general and turbulent isothermal flow in pipes in particular = ¼ Darcy friction factor. It is normally defined as $(g_c\ d\ \Delta P)/(2\rho v^2 L)$, in which g_c = dimensional constant, d = diameter, ΔP = pressure drop, ρ = density, v = velocity, and L = length.[320] If the Reynolds number is given, the von Karman equation predicts f as:

$$f^{-1/2} = [4\ log_{10}(Re\, f^{1/2}) - 0.4]$$

The number is named after the American rheologist J. T. Fanning (1837–1911).

farad (F) An SI unit of electric capacitance. 1 F = 1 $A^2 s^4/(kg \cdot m^2)$ = 1 C/V = 1 A · s/V = 1 s/Ω. The name farad was coined in 1861[321] by Latimer Clarke to honor the British chemist and physicist Michael Faraday (1791–1867), but for a unit of quantity of charge.

farad per metre (F/m) An SI unit of permittivity = $s^4\ A^2/(m^3\ kg)$ = C/(V m).

farad square metre (F m²) See *coulomb metre squared per volt*.

faraday (Fd or **F)** A unit of electric charge. Originally, it was defined as the quantity of electricity which would deposit 1 kg equivalent of silver from a conducting solution. The British electrochemist and physicist Michael Faraday (1791–1867) determined that the same amount of charge is needed to deposit one mole of any element or ion of valence one. This amount of charge, = 96,485.3 C = 26.801 5 Ah, became known as Faraday's constant. Later, it was adopted as a convenient unit for measuring the charges used in electrolysis. One faraday is = the product of Avogadro's number and the charge on a single electron.

fathom In the U.S., an obsolete unit of count, used for counting the number of pearls in a string of pearls. It varied with localty.

FAU An abbreviation for formazin attenuation unit, a unit of water turbidity. This unit is used to express turbidity measured by a nephelometer that directly measures the fraction of light transmitted through a water sample as compared to the fraction transmitted through a standard preparation of formazin.[322]

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[317] [JACO3, p. 318].

[318] [HUST].

[319] [POLK, pp. 21–48].

[320] For more information, see: [GEAN].

[321] 1861: *Electrician* **1**, 3.

[322] The procedure is specified by standard ISO 7027.

fbm, **f.b.m.**, or **F.B.M.** An abbreviation sometimes used for the board foot in North America. The "bm" stands for "board measure." This measure often occurs with the multiplicative prefixes m (for thousand) and mm (for million).

fc, **f˙c**, or **f.c.** An abbreviation for foot˙candle.

FCC unit A U.S. measure of purity and effectiveness for chemical substances added to foods. FCC stands for Food Chemical Codex, a code of standards prepared by the U.S. Institute of Medicine for the U.S. Food and Drug Administration.

Feb An abbreviation for February.

fem A French abbreviation for *force électromotrice*.

femta (F) A deprecated metric prefix denoting 10^{15}.

femto- (f-) An SI and metric prefix standing for 10^{-15} (one quadrillionth). The prefix was coined from *femten*, which means 15 in Danish and Norwegian. It was first officially recognized by physicists when the general assembly of the International Union for Pure and Applied Physics approved a proposal of its Commission on Symbols, Units and Nomenclature in 1960. Use of the femto- with SI units was authorized by Resolution 8 of the 12th CGPM in 1964.[323]

FEQ An abbreviation for forty-foot equivalent unit.

fer... Icelandic for "square".

fermi (fm or **f)** During the twentieth century, a metric and SI-deprecated unit of length used in subatomic measure.[324] One fermi equals 10^{-15} m = 0.01 X-unit = 0.000 01 Å = 1 fm (femtometre). Some persons used "fermi" as a synonym for the barn, a unit of area.[325] The unit, proposed by Robert Hofstadter (1915–1990) in 1956,[326] is named after Enrico Fermi (1901–1954), the Italian–American physicist who built the first nuclear reactor.

fermi See *barn*.

[323] *Comptes Rendus des Séances de la Conférence Generale des Poids et Mesures*, 94.

[324] There was a need for this unit before the metric prefixes for very small quantities were defined.

[325] [HAVE].

[326] [HOFS3].

FEU An abbreviation for forty-foot equivalent unit.

Fg An abbreviation for French gauge.

fg An abbreviation for frigorie.

fg/h An abbreviation for frigorie per hour.

FICOM An abbreviation for Forum for Inter-organizational Cooperation in Metrology.

field box In the U.S. citrus fruit industry, a unit of dry capacity, used = 10 boxes = 16 bu = about 0.563 8 m^3.

fifth In the U.S., as a traditional version of the bottle, a unit of liquid capacity = 1/5 gallon. It contains exactly 46.2 cu in = about 757.1 mL.

fineness (fine) A unit of proportion = 1/1000. This unit is used to express the purity of alloys of gold or other precious metals. A statement that a gold bar is "999 fine" means that the bar contains at most 0.1% other metals. See also *per mill*.

finger tip unit (FTU) In medicine, a unit defined as the amount of ointment, cream or other semi-solid dosage form expressed from a tube with a 5 mm diameter nozzle, applied from the distal skin-crease to the tip of the index finger of an adult.[327]

Finsen unit (FU), **Finxen unit**, or **finsen** During the nineteenth century, a unit of erythemal flux density. "Erythemal" means "skin reddening," and the unit was used in medicine to measure the intensity of ultraviolet radiation in terms of its capacity to cause reddening of the skin.[328] Ultraviolet radiation (UV) of the standard wavelength 296.7 nm has intensity 1 FU if its energy density is 10^5 W/m^2. UV light of 2 FU causes sunburn in 15 min. The unit is named after the Danish physician Niels Ryberg Finsen (1860–1904), who received the Nobel prize for medicine in 1903 for his research on the use of light in the treatment of various diseases.

Finxen unit See *Finsen unit*.

fiscal year A unit of 1 year, used for budgeting or accounting. A fiscal year has the same length as an ordinary year, but its starting date may be different.

[327] [LONG2].

[328] See also: [AIEE2].

fist An informal unit of length equal approximately to the hand (10 cm). The unit represents the width of a clenched fist.

fist An informal unit of angle measure = 10°, which is the approximate angle subtended by a clenched fist held at arm's length. This unit is used by amateur astronomers to estimate angular distances in the sky.

fistmele or **brace height** An obsolete unit of distance, used in archery to measure the brace height of a bow and also in kayaking to measure various critical dimensions of the boat, = the width of a clenched fist with the thumb extended.[329] This is about 6.5 in = 16.51 cm. The intention is that if the fist of the actual archer or kayaker is used in establishing the unit, then the bow or the boat will fit that person precisely.

FIT A acronym for "Failure In Time" or "Failure unIT," a unit used to express the expected failure rates of semiconductors or other electronic components. One FIT is = a rate of one failure per U.S. billion (10^9) h, that is, 1 FIT = 10^{-9}/h.

FL An abbreviation for foot lambert.

flag A common construction term indicating a 5.0-square-foot section of a concrete sidewalk.

flask, **flasce**, **flaske**, **flasque**, or **flaxe** [<Old High German: *flaska*, and L: *flascon*] During the nineteenth century, a name for a bottle, now specialized to mean a narrow, flattened container for alcoholic beverages. Such flasks come in various sizes, often holding around 6 U.S. fl oz = about 180 mL in North America; in Britain = 3 Imp pt = about 1.42 L.

flask [A bottle-shaped iron container[330]] In Britain, western Europe, and the U.S., during the sixteenth–twentieth centuries, a commercial unit of weight used to measure and transport liquid mercury (then known as quicksilver). In May 31, 1579, Don Philip II (1527–1598) decreed that all quicksilver sent overseas from Spain should be packed in iron containers, containing a quintal each and no more.[331]

Britain	= 76 ½ av lb = about 34.70 kg;
Mexico	= 75 lb = about 34.05 kg;
Spain and the U.S.	= 76 lb = about 34.50 kg.

flat An informal unit of angle measure = 1/6 turn = 60°.

flat In North America, during the twentieth century, a unit of quantity, in concept = the amount stacked on a flat pallet used with fork-lift trucks.

flaxe See *flask*.

fl dr A British abbreviation for fluid drachm.

fl dr A U.S. abbreviation for fluid dram.

floor Another name for a story as a unit of height for buildings. In Britain, the floor above the ground floor is usually called the first floor. In the U.S., the numbering of floors is most often the same as the numbering of stories.

flops [floating point operation per second] A unit of computing power = one floating point operation per second. In computer science, there is a distinction between fixed point numbers (which have a fixed number of decimal places) and floating point numbers (which are stored with as many digits as the computer's design allows).

fluorer A black light[332] flux unit = 1 mW of radiant energy in the wavelength range 320–380 nm.[333]

fluorometer A device used to measure the concentration of chlorophyll in sea water.

fl oz or **fl. oz.** An abbreviation for fluid ounce.

fluviometer [<L: *fluvuis* = "river"] A device for automatically measuring and recording the rise and fall of a river or stream. This type of

[329] Hansard, George Hagar. 1841: Of The Shaft, Ancient and Modern, Chap. 10, *The Book of Archery*, The Archery Library. www.archerylibrary.com

[330] [LAKE, p. 270].

[331] [ZUPK5], *The Mineral industry*. Scientific Publishing Company, 1902, p. 579 and [GOLD3, p. 41].

[332] The term "Black-light" has, by popular usage, come to mean the radiation flux in the wavelength range 320–380 nm. Light with these wavelengths is used to make objects fluorescent.

[333] [HOFS4, p. 199] and [SUMM, pp. 10–128, footnote c].

apparatus was known and used in ancient Rome.[334]

fluxmeter An instrument for measuring magnetic flux.[335]

flux unit See *jansky*.

fm A deprecated abbreviation for fathom.

fm An abbreviation for femtometre.

Fm An abbreviation in Germany for Festmeter.

FNU An abbreviation for formazin nephelometric unit, a unit of water turbidity equivalent to the NTU (nephelometric turbidity unit) used in the U.S. The symbol FNU is widely used outside the U.S.

fo A French abbreviation for *fréquence de test* = test frequency.

Fo An abbreviation for Fourier number.

Fo* An abbreviation for Fourier number.

foaminess unit (**Σ** or $\boldsymbol{\varepsilon_f}$) A CGS unit, suggested in 1938,[336] to indicate foaminess. It is defined as (v_f t)/V, in which v_f = volume of foam, t = time in seconds, and V = volume in cm^3 of air passed through the liquid, e.g., Σ for 1% n-butanol = about 4.7 s.[337]

foe [ten to the fifty-one ergs] An informal unit of energy, used by astrophysicists to express the energy released by supernovas, = 10^{51} ergs = 10^{44} J.[338]

folio [<L: *folium* = "leaf"] A unit of quantity for the words in a legal document. In the U.S., a folio is 100 words; in Britain, it is 72 or 90 words, depending on the type of document. In the days before mechanical copying, clerks were paid by the folio to copy legal documents.

fonzie A jocular unit of coolness, invented by the owner of the Planet Express Delivery Company, Professor Hubert J. Farnsworth (b. 2841), in the *Futurama* episode, *Bender Should Not Be Allowed On TV*, = the amount of coolness inherent in the character Fonzie (played by Henry Winkler) from the American television sitcom *Happy Days* (broadcast between 1974 and 1984 on ABC).

food calorie Another name for the *large* or *kilogram Calorie*.

football field A common informal unit of area, used by the American public media when talking about the size of parks or other areas. Including the end zones, an American football field represents an area of 1.322 3 acre = about 0.535 ha.

foot-grain-second system of units A system briefly considered for advocation by the British Association's Committee on Electrical Standards in their first report in 1866, but soon dropped for the metre-gram-second system.

foot hour degree Fahrenheit per British thermal unit (ft h °F/Btu) An obsolete unit of thermal resistivity = $5.777\,89 \cdot 10^{-1}$ m K/W.[339]

footcandle (fc, ft-c, Ftc, or **ftc)**, **foot-candle**, or **foot candle** A unit of illumination, still sometimes used to set lighting levels in architecture, stage lighting, and photography. Originally, it was defined as the illuminance at 1 foot from a standard candle, then as the illumination received by a surface at a distance of 1 foot from a source of intensity 1 international candle. This definition was later redefined as the illuminance produced by 1 lumen of "luminous flux" evenly distributed over a square foot = about 10.763 91 lux.

footlambert (fL, **fl, ft-l**, or **ftL)**, **foot lambert**, or **foot-lambert** A unit of luminance. The footlambert describes the luminance of a surface that emits or reflects one lumen per square foot. One footlambert equals the average luminance of a surface producing 1 footcandle = 1 lm/ft^2 = $1/\pi\ cd/ft^2$ = 3.426 259 cd/m^2. In Britain, this is also called the equivalent foot-candle. The one-word spelling and symbol fL have been endorsed by the Illuminating Engineering Society of North America (IES), as well as by the Institute of Electrical and Electronics Engineers (IEEE).

foot of head (ft hd or **ft-head)** An obsolete unit of water pressure used in plumbing and

[334] [RICH6].

[335] [WINC, p. 542].

[336] [BICK4].

[337] See also:[KROT].

[338] This is comparable to the amount of energy released by a normal star over its entire lifetime, but in a supernova, a foe of energy can be released in a matter of seconds.

[339] [DRAZ].

hydraulics. One foot of head is equivalent to a pressure of about 0.433 lb/in^2 = about 2.989 07 kPa = 29.890 7 mb = about 0.882 in Hg.

foot of water (ftH_2O) An obsolete unit of water pressure = 1 f. hd = about 2.989 07 kPa.

foot per minute (ft/min or **fpm)** An obsolete unit of velocity or flow rate = 1/5 in/s = 60 feet per hour = exactly 30.48 cm/min = 1 m every 3 min 16.85 s = 18.288 m/h = 5.08 mm/s.

foot per pound (ft/lb) A FPS unit of specific length = 6.719 69 · 10^{-1} m/s.

foot per second (ft/s, **ft/sec**, **or fps)** A FPS unit of velocity = 60 feet per minute = 20 yards per minute = 1200 yards per hour = 15/22 mile per hour = exactly 18.29 m/min = 1.097 28 km/h.

foot per second squared (ft/s^2) A FPS unit of acceleration = 0.304 8 m/s^2.

foot pound (ft-lb) A unit and abbreviation incorrectly used for *foot pound-force*.

foot poundal or **poundal foot (ft pdl)** A ft-lbf-s unit of work in the non-gravitational form of the system, being the work done by a force of one poundal acting through a distance of one foot. One foot poundal is equivalent to about 0.031 080 950 2 foot pound-force = 0.042 140 173 7 J.

foot poundal per second (ft pdl/s) A FPS unit of power = 4.214 01 · 10^{-2} W.

foot pound-force (ft lbf) or **footpound** A ft-lbf-s unit of work in the gravitational form of the system, being the work done by a force of one pound acting through a distance of one foot = about 1.355 817 95 J = about 32.174 048 9 ft·pdl = 1.285 07 · 10^{-3} Btu = 3.766 16 · 10^{-7} kWh = 0.323 832 (small) calorie. The corresponding unit in the non-gravitational form is the *foot-poundal*.

foot pound-force per pound (ft lbf/lb) A unit of specific internal energy and specific latent heat = 2.989 07 J/kg = 1.285 07 · 10^{-3} Btu/lb = 7.139 26 · 10^{-4} kcal^{IT}/kg = 3.048 · 10^{-1} kgf m/kg.

foot pound-force per pound degree Fahrenheit (ft lbf/(lb ºF)) A unit of specific heat capacity = 5.380 32 J/(kg K) = 1.285 07 · 10^{-3} Btu/(lb ºF) = 5.486 4 · 10^{-1} kgf m/(kg ºC).

foot pound-force per minute or **foot pound-force per minute (ft-lbf/min)** An obsolete unit of power = 1/60 ft-lb/s = about 0.022 596 9 W.

foot pound-force per second or **foot pound-force per second (ft-lbf/s)** An obsolete unit of power = 60 ft-lb/min = about 1.355 818 W.

foot squared per hour (ft^2/h) A unit of kinematic viscosity = 2.580 64 · 10^{-5} m^2/s = 25.806 4 cSt = 2.777 78 · 10^{-4} ft^2/s.

foot squared per second (ft^2/s) A unit of kinematic viscosity = 9.290 30 · 10^{-2} m^2/s = 9.290 30 · 10^4 cSt = 3.6 · 10^3 ft^2/h.

foot to the fourth power (ft^4) A FPS unit of second moment of area = 8.630 97 · 10^{-3} m^4.

foot ton or **foot ton-force (ft-tn)** An obsolete unit of work = the work done by a force of one ton acting through a distance of one foot. In the U.S. system, a foot ton equals 2000 f. lbf = about 2.711 6 kJ; in the British Imperial system, a foot ton equals 2.240 f. lbf = about 3.037 0 kJ.

force de cheval In France, a premetric unit of power used to express the power of engines = 0.986 3 British horsepower.

formazin turbidity unit or **Formazin Nephelometric Units (FNU)** A unit used to measure the clarity of water.[340] See also *nephalometric unit*.

fors (f) [derived from *force*] A name suggested in 1956[341] by the International Committee for the Correlation of Scientific Symbols, Units and Nomenclature. It was said to equal the force represented by 1 gram = 1 g dynes, in which g = the acceleration due to gravity in CGS units.

fortin barometer A type of cistern barometer, in which the level of mercury in the cistern is adjusted to the zero point of the scale before each reading. It was invented by R. Fuess in 1935.

forty-foot equivalent unit or **Forty Foot Equivalent Unit (FEQ** or **FEU)** A unit of cargo capacity, especially for container ships. The cargo of such ships is packed in large modular steel containers which are stowed and

[340] See ISO 7027:1999. Water Quality—Determination of turbidity.

[341] 1957: *Physics Today* **10**, 34.

removed unopened to trains or trucks. One FEQ represents the cargo capacity of a standard container 40 feet long, 8 feet wide, and usually a little over 8 feet high, and equals roughly 25 register tons = about 72 m^3. See also *Twenty Foot Equivalent Unit*.

fourier A unit of thermal resistance = the "thermal ohm." One fourier corresponds to an entropy flow of 1 W/K in response to a temperature difference of 1 K. The unit, proposed both in 1928[342] and 1931,[343] is named after the French thermodynamicist and mathematician Jean Baptiste Joseph Fourier (1768–1830).

fourier (Fr) A name, proposed in 1974 by the International Commission on Radiation Units and Measurements, for a unit with a special name in SI for the reciprocal second.

Fourier number (*Fo*) A dimensionless number, used in heat transmission, = $(k\ t)/(c\ \rho\ l^2)$, in which k = thermal cunductivity, t = time, c = specific heat, ρ = density, and l = characteristic length. The Fourier number (*Fo**) used in mass transfer problems is given by $\alpha t/l^2$, in which α = thermal diffusivity. The number is named after the French thermodynamicist and mathematician Jean Baptiste Joseph Fourier (1768–1830).

fpm abbreviation for foot per minute (ft/min).

fps An abbreviation for foot per second (ft/s or ft/sec).

Fr An abbreviation for fourier.

Fr An abbreviation for franklin.

Fr An abbreviation for Froude number.

fr An abbreviation for frigorie.

francoeur degree An obsolete unit, introduced in 1842, of percentage of alcohol in wines and spirits.

franklin (Fr) The CGSF (centimetre-gram-second-franklin) unit of electric charge and electric flux, first proposed in 1941[344] as a special name for the unit of electric charge in the CGS electrostatic system. In 1961, the International Union for Pure and Applied Physics' Symbols, Units and Nomenclature Committee adopted it for use within the centimetre-gram-second-franklin system, and defined it as that charge which exerts a force of 1 dyne on an equal charge at a distance of 1 cm in a vacuum = $^{10/c}$ C, in which *c* is the velocity of light in a vacuum in cm/s. For electric charge = $3.335\ 641 \cdot 10^{-10}$ C = 1 statcoulomb. For electric flux = $2.654\ 42 \cdot 10^{-11}$ C. The unit is named after Benjamin Franklin (1706–1790), who was an early investigator of electricity.[345]

franklin centimetre (Fr cm) The CGSF unit of an electric dipole moment = $3.335\ 64 \cdot 10^{-12}$ C m.

franklin per second (Fr/s) The CGSF unit of electric current = $3.335\ 64 \cdot 10^{-10}$ A.

franklin per square centimetre (Fr/cm²) The CGSF unit of electric polarization and electric flux density. For polarization = about $3.335\ 64 \cdot 10^{-6}$ C/m^2. For electric flux density = about $2.654\ 42 \cdot 10^{-7}$ C/m^2.

franklin squared per erg (Fr²/erg) The CGSF unit of capacitance = $1.112\ 65 \cdot 10^{-12}$ F.

franklin squared per erg centimetre (Fr²/(erg cm)) The CGSF unit of permittivity = $8.854\ 19 \cdot 10^{-12}$ F/m.

frant A jocular measure of length, defined as the "legal minimum distance between two trains on the District and Circle lines of the London Underground."[346]

fraunhofer An obsolete unit used to express the wavelength resolution for spectral lines in atomic and molecular spectroscopy. When the width of a spectrum line corresponds to a bandwidth just 10^{-6} of the wavelength of the center of that line, then that line has a one fraunhofer width. The unit is named after the German physicist Joseph von Fraunhofer (1787–1826).

freight ton, shipping ton, **United States shipping ton**, or **measurement ton (MTON** or **MT)** Originally, a unit of ship truck, train, or other freight carrier = exactly 40 ft^3 = about 1.132 674 m^3.

See also *shipping ton*.

freight ton Another name for the *revenue ton*.

[342] [HARP].

[343] [VERN].

[344] [GUGG].

[345] Sizes.com

[346] [ADAM, p. 54].

Freiman's constant (*F*) A constant representing the end of the last "gap" in the Lagrange spectrum. Therefore, all real numbers greater than *F* are part of the Markov spectrum.

$F = \left(2,221,564,096 + \left(283,748^{*}\ 462^{1/2}\right)\right)/(491,993,569) = 4.527\,829\,566\,160\,879\,140\,882\,695\,988\,070\,47\ldots$

French frequency See *French vibration*.

French Roentgen An obsolete unit of radiation intensity, proposed in 1926,[347] = 4/9 German units of x-radiation.[348]

French vibration or **French frequency** A notation used in music for vibrational frequency, defined in terms of time, mass and inertia, effectively twice the usual expression of frequency.

frequency meter An instrument for measuring the frequency of an AC signal.

fresnel During the nineteenth century, a unit of optical frequency used in spectroscopy = 10^{12} Hz. The unit is named after the French optical scientist Augustin Jean Fresnel (1788–1827).

Fri An abbreviation for Friday.

frigorie (fg) [The name was coined from the calorie by replacing the Latin *calor*, for heat, with *frigor*, for cold] In Europe, during the twentieth century, a unit of heat (for refrigeration). It was defined by CIPM in 1950 as = a rate of extraction of heat = 1 $kcal_{15}$ = about 4.185 5 kJ.[349] Sometimes its negative value was used.

frigorie per hour (fg/h) During the twentieth century, a unit of refrigerating capacity = a removal of 1 $kcal_{15}$/h = about 0.000 297 British commercial ton of refrigeration = about 0.000 331 U.S. commercial ton of refrigeration = about 1.162 64 W.

Froude number (*Fr*), **Reech-Froud number**, or **Reech number** A dimensionless number in momentum transfer in general and calculation of open channel flow and wave and surface behavior in particular. It is normally defined as $v^2/(a\ L)$, in which v = velocity, a = acceleration and L = characteristic length. The number is named after the British engineer, hydrodynamicist and naval architect William Froud (1810–1879), who was the first to formulate reliable laws for the resistance that water offers to ships and for predicting their stability.

fsw A symbol for "feet of seawater," a conventional unit of pressure. 1 fsw = 0.304 8 m of seawater (msw).

ft or **ft.** An abbreviation for foot and feet.

ft An abbreviation for *fréquence de transition* = transition frequency.

ft^2 A symbol for square foot.

ft^3 A symbol for cubic foot.

FTE An abbreviation for "full time equivalent," a unit of the rate of work equivalent to that performed by an employee who holds a regular appointment. In the U.S., the FTE is generally = 40 h per week. The symbol FTE is also used for the amount of work performed at this rate over a set period of time, such as a month (170 h) or a year (2080 h).

ftH$_2$O An abbreviation for foot of water.

ftL or **ft L** An abbreviation for foot lambert.

ft La An abbreviation for foot lambert.

ft-lb An abbreviation for foot-pound.

ft/s An abbreviation for foot per second and feet per second.

FTU An abbreviation for finger tip unit.

FU An abbreviation for fibrin unit.

fu or **f.u.** An abbreviation for flux unit.

fudge factor A value or parameter that is varied in an ad hoc way to produce the desired result. See also *Riggs constant* and *Stradivarius' constant*.

funal [L: = "rope"] The MTS unit of force = 1000 N. The unit was proposed in 1876[350] by James Thomson (1822–1892), physicist and brother of the famous Lord Kelvin. See also *sthène*.

fundamental physical constants The name of 26 fundamental constants:

- the mass of the up quark
- the mass of the down quark
- the mass of the charmed quark
- the mass of the strange quark

347 [SOLO2].

348 See also: [BECL].

349 A very small unit for most purposes.

350 *Rep. Brit. Ass.*, 1876, p. 33.

- the mass of the top quark
- the mass of the bottom quark
- four numbers for the Kobayashi-Maskawa matrix
- the mass of the electron
- the mass of the electron neutrino
- the mass of the muon
- the mass of the mu neutrino
- the mass of the tau
- the mass of the tau neutrino
- four numbers for the Maki-Nakagawa-Sakata matrix
- the mass of the Higgs boson
- the expectation value of the Higgs field
- the U(1) coupling constant
- the SU(2) coupling constant
- the strong coupling constant
- the cosmological constant.

fundo legal In Mexico and Spain, a premetric unit of land used in setting up towns = a square 1200 varas on a side.[351]

furlongs/fortnights A jocular American unit = 0.000 166 309 524 m/s. The unit is used to describe, for example, the growing of a tree.

7 G

G An abbreviation for gauss.

G An abbreviation for the prefix giga (1,000,000,000).

G or **Gb** An informal abbreviation in computer science for 2^{30} = 1 073 741 824 bytes = 1 048 576 KB = 1024 MB. See also *gigabyte*.

$\boldsymbol{G_0}$ Symbol for conductance quantum.

...$^{\mathbf{g}}$ An abbreviation for gon and grad.

...$^{\mathbf{g}}$ An abbreviation in France for grade.

g A metric and SI abbreviation for gram.

g or **G** A symbol for the average acceleration produced by gravity at the Earth's surface (sea level). The actual acceleration of gravity varies from place to place, depending on latitude, altitude, and local geology. By agreement among physicists, 1 g is defined to be exactly 9.806 65 m/s^2 = about 32.174 05 ft/s^2, a value known as standard gravity. At latitude p, a conventional value of the acceleration of gravity at sea level is given by the International Gravity Formula, g = 978.049 5 [1 + 0.005 289 2 sin^2(p) − 0.000 007 3 sin^2 (2p)] cm/s^2.

g* An abbreviation for gram-weight.

Ga A symbol for one billion (10^9) years, which applies to age. The *a* stands for the Latin *annus*, year.[352] See also *Gy*.

gadzillion See *zillion*.

gagallion A fictitious large number without a well-defined value, used in colloquial contexts,[353] as well as a large indefinite number that happen to have mathematical validity. It is the name of the number $10^{3\times10^{(3,000,000,000)}+3}$.

gajillion See *zillion*.

gal or **Gal** An abbreviation for galileo.

gal An abbreviation for gallon.

galactocentric distance ($\boldsymbol{R_0}$) The radial distance of the Sun from the center of the Milky Way = about 8.5 kpc = about 28 kly = about 250 · 10^{15} km.

galileo or **galilei** (**Gal** or **gal**) The CGS unit of linear acceleration = 1 cm/s^2. One Gal is about 0.001 019 7 g. The unit is named after the Italian astronomer and natural philosopher Galileo Galilei (1564–1642), who proved that all objects at the Earth's surface experience the same gravitational acceleration. To avoid confusion with the symbol for the gallon, and to conform to the usual metric style, the symbol for this unit should be Gal rather than gal.[354]

Galileo number (***Ga***) A dimensionless number used in momentum and heat transfer in general and calculation of viscous flow and thermal expansion in particular. It is normally defined as (g D^3 ρ^2)/μ^2, in which g = gravitational acceleration, D = diameter, ρ = density and μ = density.

351 [HONE, p. 17], [TAYL8, p. 69] and [MARI, pp. 79 and 80].

352 [ALBA, p. 52].

353 [LAWR, p. 114]: "The brochures basically told the same story Stan had given me: Pacific Properties owned a gagillion places that generated a gagillion dollars."

354 In 1978, the CIPM decided to accept the use of Gal with the SI.

gallon (UK) per hour (UKgal/h) In Britain, a unit of volume flow rate = 1.262 80 · 10^{-6} m^3/s.

gallon (US) per hour (USgal/h) In the U.S., a unit of volume flow rate = 1.051 50 · 10^{-6} m^3/s.

gallon (UK) per mile (UKgal/mile) In Britain, a unit of fuel consumption = 2.824 81 L/km.

gallon (US) per mile (USgal/mile) In the U. S., a unit of fuel consumption = 2.352 15 L/km.

gallon (UK) per minute (UKgal/min) In Britain, a unit of volume flow rate = 7.576 82 · 10^{-5} m^3/s.

gallon (US) per minute (USgal/min) In the U.S., a unit of volume flow rate = 6.309 02 · 10^{-5} m^3/s.

gallon (UK) per pound (UKgal/lb) In Britain, a unit of specific volume = 1.002 24 · 10^{-2} m^3/s.

gallon (US) per pound (USgal/lb) In the U.S., a unit of specific volume = 8.345 40 · 10^{-3} m^3/s.

gallon (UK) per second (UKgal/s) In Britain, a unit of volume flow rate = 4.546 09 · 10^{-3} m^3/s.

gallon (US) per second (USgal/s) In the U.S., a unit of volume flow rate = 3.785 41 · 10^{-3} m^3/s.

galopin The French name for a small glass of beer, typically 200 mL.

galumph A jocular unit of waste motion.[355]

galvat A unit of electric current = 1 ampere. The unit is named after the Italian natural scientist Luigi Galvani (1737–1798).[356]

gamma (γ) An obsolete unit (used about 1896 to present) of magnetic flux density = 10^{-9} tesla = 1 nT = 10 μOe. In geophysics, small changes in the Earth's magnetic field were traditionally stated in gammas.[357] The nanotesla (nT) is now recommended for these measurements.

gamma (γ) A deprecated and obsolete metric unit of weight = 10^{-9} kg = 1 μg.

gamma (γ) An informal and seldom used abbreviation for the Newtonian constant of gravitation.

gammil A unit of concentration, used in microchemistry, = 1 μg/mL. The name of the unit was suggested by the Professor of Mathematical Physics at the University of Dublin, Arthur W. Conway (1875–1950) in 1946. See also *microgammil* and *micril*.

garn An informal scale unit used by NASA to measure reactions caused by space adaptation syndrome. A score of one garn means the sufferer is completely incapacitated, and therefore unable to do anything. It is named after Senator Jake Garn (b. 1932), who was constantly sick when he flew aboard the Space Shuttle *Discovery* in April 1985.[358]

gauss (G or Gs) The CGS unit of magnetic flux density. A field of one gauss exerts, on a current-carrying conductor placed in the field, a force of 0.1 dyne per ampere of current per centimetre of conductor. In 1900, the Fifth International Electrical Congress adopted the name gauss for the CGS unit of magnetic field, and in 1930, the Advisory Committee on Nomenclature of the International Electrotechnical Commission adopted the gauss for the unit of magnetic flux density and the oersted for the unit of magnetic field strength.[359] The term oersted had previously been used for the unit of magnetic circuit reluctance.[360] One gauss represents a magnetic flux of one maxwell per square centimetre of cross section perpendicular to the field. In SI units, one gauss corresponds to 10^{-4} tesla, although the two units actually cannot be compared. The unit is named after the German mathematician and astronomer Karl Friedrich Gauss (1777–1855).[361]

gauss (G or Gs) The former name for the CGS unit of magnetic field strength, officially renamed the *oersted* in 1930.

gauss (G or Gs) The CGS unit of a magnetic dipole moment per unit volume, more commonly written emu/cm^3 or emu/cc. In this use, the gauss equals 1000 A/m in SI units.

Gay-Lussac See *degree*.

355 ourworld.compuserve.com

356 [ZÜLL].

357 1903: *Nature*, **69**, 6.

358 www.jsc.nasa.gov/history/oral_histories

359 [IEC64, p. 27].

360 The name was suggested by the Committee of Units and Standards of the American Institute of Electrical Engineers in May 1900.

361 See also: [BIER].

gazillion See *zillion*.

Gb An abbreviation for gilbert.

GB An abbreviation for gigabyte.

Gbps An abbreviation for gigabits per second.

GBq An abbreviation for gigabecquerel.

GCV An abbreviation for Gross Calorific Value.

GDU An abbreviation for gelatin digesting unit.

$\mathbf{g_e}$ A symbol for *Lorentz splitting constant*.

gee pound or **geepound** An informal name for a slug. See *slug*.

gelatin digesting unit (GDU or **gdu)** A unit used for measuring dosages of the pain- and inflammation-reducing supplement bromelain. Bromelain is a substance obtained from the stem of the pineapple plant (*Ananas comosus*). It contains a mixture of sulfur-containing proteolytic enzymes. This unit cannot be converted into a weight unit, because different preparations of the enzyme differ in activity. Bromelain is also measured in milk clotting units (MCU); 1 GDU equals about 1.5 MCU.

gematria A Jewish name for the numerical value of letters used as a basis of homiletical interpretation.

gemmho A name sometimes used for the reciprocal megaohm = 10^{-6} mho.[362]

geobyte or **orgobyte** Term used in the world of computing to describe data storage space and system memory. When referring to a geobyte or orgobyte for disk storage, hard drive manufacturers usually define it as 1000 brontobytes = 10^{30} bytes. When geobyte or orgobyte is used for real and virtual storage, then 1024 brontobytes is the appropriate notation.[363]

German candle See *Vereinskerze*.

German r unit See *R units*.

Gesamtmusikspitzenleistung The German name for *PMPO*.

GeV (giga electron-volt) A symbol for 10^9 eV. An older term, more frequently used in the U. S., for the giga-electron-volt is a billion electron-volts = BeV.[364] Thanks to Einstein's equation $E = mc^2$ equating mass with energy, the GeV can be regarded either as a unit of energy, = 160.217 646 2 picojoules, or as a unit of weight, = 1.782 662 · 10^{-24} g = 1.073 544 amu.

gf An abbreviation for gram-force.

Gflops An abbreviation for gigaflops.

Gg An abbreviation for gigagrams.

gg An abbreviation for gauge.

g/g A symbol for "gram per gram," a unit of weight concentration. For example, a concentration of 0.02 g/g, or 2% g/g means that the substance being measured comprises 2% of the mass of the mixture in which it is found. This symbol is equivalent to the traditional symbol w/w.

G.H.A. An abbreviation for Greenwich Hour Angle.

GHz An abbreviation for gigahertz.

gi An abbreviation for gill (US).

gibbs A unit of surface tension = 1 erg/cm^2 = 10^{-3} J/m^2 = 10^{-3} N/m. The unit was proposed by Hans M. Cassel (b. 1891) to be named in honor of the American thermodynamicist Josiah Willard Gibbs (1839–1903).[365]

gibbs A unit of adsorption, proposed in 1951 by the American chemist Robert B. Dean (1913–2007), = the concentrating of 10^{-10} mole of any substance per square centimetre of the adsorbing surface = 10^{-6} mole/m^2 of the adsorbing surface. The unit was proposed to be named in honor of the American thermodynamicist Josiah Willard Gibbs (1839–1903).

gibi- (Gi-) A binary prefix meaning 2^{30} = 1,073,741,824. This prefix, adopted by the International Electrotechnical Commission in 1998, replaces giga- for binary applications in computer science. The prefix is a contraction of "gigabinary."

gig . . . An informal contraction of the *gigabyte* (GB) common in computer science, especially as a unit of storage capacity.

giga- (G-) [Gr: *gigas* = "giant"] The SI and metric prefix denoting 10^9 or one billion (in the American meaning of the word billion). In 1940,

[362] See also [MCGL].

[363] www.whatsabyte.com

[364] [TAYL7, p. 113].

[365] [KLEI, p. 695].

the Technical Committee ISA-9 d 2 of the International Federation of National Standardizing Associations made a proposal about this prefix. In 1948, the General Assembly of the International Union for Pure and Applied Physics approved it, on the recommendation of its Commission on Symbols, Units and Nomenclature. The prefix was widely used, but not actually approved until the adoption of SI by the 11th CGPM in 1960.

giga- A prefix used in IT as the value 1,073,741,824 = 2^{30}, the binary power close to 10^9; particulary as GB (gigabyte).

gigabecquerel (GBq) A unit of radioactivity = one billion atomic disintegrations per second = 27.027 millicuries.[366]

gigabyte (GB) Term used in the world of computing to describe data storage space and system memory. When referring to a gigabyte for disk storage, hard drive manufacturers usually use the standard that a gigabyte is 1000 megabytes = 10^9 bytes. When gigabyte is used for real and virtual storage, then 1024 megabytes = 1,073,741,824 bytes is the appropriate notation.[367]

gigaflops (Gflops) A unit of computing power = 10^9 floating point operations per second. It is used as a measure of computer processing capability. See also *flops*.

gigahertz (GHz) A unit of frequency = 10^9 per second = 1 per nanosecond. Cellular phones and microwave ovens operate with radio waves having frequencies in the gigahertz range.

gigajoule (GJ) A metric unit of energy commonly used in the energy industry. One gigajoule equals 947,817 Btu = 277.777 8 kWh = about 9.48 therms.

gigameter or **gigametre (Gm)** A metric unit of length = one million kilometres = about 621 371.2 miles. Seldom used, this unit would be a good yardstick for the inner Solar System: the distance from the earth to the sun is about 149.60 Gm.

gigaparsec (Gpc) A non-metric unit of length = one billion parsecs = 3.261 6 billion light years = 30.856 78 zettametres (30.856 78 × 10^{21} km). The unit is used in astronomy.

gigapascal (GPa) A metric unit of pressure. One gigapascal equals 10 kilobars = about 145 038 lb (72.519 short tons) per square inch.

gigatonne (Gt) A metric unit of weight or weight = one billion tonnes = about 2.204 6 trillion pounds. This very large unit is used, for example, in discussing the amounts of carbon added to the atmosphere by human activities.

gigawatt (GW) A metric unit of power = 10^9 W = about 1.341 million horsepower.

gigawatt hour (GW·h) A metric unit of energy = one billion kWh = 3.6 TJ.

gillette An obsolete (early 1960s) and informal unit of laser power. It was determined by how many stacked double-edged razor blades a laser's beam would burn through.[368]

gillion An informal alternate name for the number 10^9, called "billion" in America, but often called "milliard" in France and "thousand million" in Britain.[369]

giorgi (G) A unit of magnetic permeance proposed in June 1938[370] by the Swedish delegation at the International Electrotechnical Commission (IEC) plenary meeting in Torquay. The unit was named after the Italian physicist Giovanni Giorgi (1870–1950), who, in October 1901, described the construction of what eventually became the SI.

giorgi A unit of magnetic flux density proposed by the German–American electrical engineer Reinhold Rüdenberg (1883–1961) at a 1950[371] meeting of the IEC's committee on units. Eventually, the CIPM recommended the name tesla.

Giuga number The name of a composite number n such that each of its distinct prime factors p_i is a divisor of $[(n/p_i) - 1]$. The Giuga

[366] [DERE, p. 1368].

[367] www.whatsabyte.com

[368] [KLEI].

[369] [NESH, p. 21].

[370] IEC Technical Committee 24-Electric and magnetic magnitudes and units. Minutes of first meeting, in Torquay, *June* 23–24, 1938.

[371] IEC Technical Committee 24-Electric and magnetic magnitudes and units. Minutes of meeting in Paris, *July 17–18, 1950*.

numbers are named after the mathematician Giuseppe Giuga.[372]

GJ An abbreviation for gigajoule.

g/kg A symbol for "gram per kilogram," a unit of weight concentration = 1 per mill (1 part per thousand). 1 g/kg also equals 0.1% g/g = 0.1% w/w.

glass Another name for the U.S. cup = about 236.6 mL.

glug A unit of weight, proposed in 1957, = a mass which is accelerated by 1 cm/s^2 by a force of 1 g weight = 0.980 665 kg. The glug would play the same role in a CGS system that the slug does in the foot pound second system.[373]

glumgluff A unit of length invented and mentioned by Jonathan Swift (1667–1745), Irish writer and novelist, in his novel *Gulliver's Travels* (1726).[374] One glumgluff was said to equal about 10.76 cm.[375]

gm A common but incorrect symbol for the gram. The correct symbol is g.

gnat's eye An idiomatic "unit" of distance. It is common to hear that something is "as small as a gnat's eye." In fact, the eyes of typical gnats tend to have diameters similar in size to a hair's breadth = roughly 0.10−0.15 mm.

GO An abbreviation for gigaoctet.

goad Name sometimes used for the *perch*.

godzillion See *zillion*.

golden ratio (*Φ*) Name used in mathematics and the arts for the ratio between two quantities, when the ratio between the sum of those quantities and the larger one is the same as the ratio between the larger one and the smaller.[376] $\Phi = (1 + \sqrt{5})/2$ = about 1.618 033 988 749 894 848 204 586 834 365 638 117 720.[377]

gon (^{g}) [<Gr: *gonia* = "angle"] or **grade** A unit of plane angle = 400 gon = 360° = about 0.0157 079 6 radian. The symbol is a superscript "g," for example, 35^g.

gōng- In the Pinyin system for transliterating Chinese, the word 'gong' represents a character whose basic meaning is "public" or "official." This meaning has been extended in recent years to include "metric," as a prefix applied to traditional names to denote fully metric versions.

googillion See *zillion*.

googol A unit of quantity = 10^{100} (1 followed by 100 zeroes). The googol was invented by the American mathematician Edward Kasner (1878–1955) in 1938. According to the story, Kasner asked his nephew Milton Sirotta (1929–1980), who was then 8 years old, what name he would give to a really large number, and "googol" was Milton's response. Kasner also defined the googolplex, = 10^{googol}, that is, 1 followed by a googol of zeroes. These inventions caught the public's fancy and are often mentioned in discussions of very large numbers. In the traditional American system for naming large numbers, the googol is = 10 dotrigintillion.

googolplex See *googol*.

gouy An electrokinetic unit defined as $\xi D/(4\pi\eta)$, in which ζ = electrokinetic potential, D = electric displacement, and η = electrolytic polarization. The unit, suggested in 1956, is named after the French magnetic physicist Louis-Georges Gouy (1854–1926).

Gp A French abbreviation for *gain de puissance* = power gain.

gpg, GPG, or **Clark degree** A customary symbol for grains per gallon (gr/gal), a traditional unit in the U.S. for measuring the hardness of water, = about 17.118 1 mg/L.

gpm, **GPM**, **gps**, **GPS** Customary symbols for gallons per minute (gal/min) and gallons per second (gal/s), traditional units for measuring the flow of liquids. 1 gpm equals about 3.785 41 L/min if U.S. gallons are meant, and exactly 4.546 09 L/min if British imperial gallons are meant.

Gr A symbol for Grashof number.

gR An abbreviation for gram-röntgen.

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[372] See [GIUG], [TAKA] and [BORW].

[373] [PRIC] and [MILL6].

[374] [GULL3].

[375] See also: 1953: *Studies in Philology*, p. 608, Philological Club, Project Muse. University of North Carolina Press and [SWAI, p.54].

[376] See also [LIVI], [MARK2], and [HOFS].

[377] See also: www.matematicas.unal.edu.co

gr An ambiguous symbol, traditionally used in English both for the grain and the gross. It has also been used, very improperly, for the gram (g).

g · rad An abbreviation for gram-rad.

g-rad An abbreviation for gram-rad.

grad or **grade** (...^{g}) A unit of plane angle = π/200 rad = 1/400 circle = 0.01 ∟ (right angle) = 0.9° (degree) = 54′ (minute) = 3 240″ (second).

grade A measure of the steepness of a slope, such as the slope of a road or a ramp. Usually stated as a percentage, the grade is the same quantity known as the slope in mathematics: the amount of (vertical) change in elevation per unit distance horizontally.

grade A measure of quality for ball bearings. A bearing of grade *g* is required to be spherical to an accuracy of *g* parts per million ($g\ 10^{-6}$). Thus, lower grade numbers represent better bearings; a 25 grade bearing is spherical to within 25 ppm, but a 1000 grade bearing is only spherical to within 1000 ppm.

grade per second (**^{g}/s**) A unit of angular velocity = π/200 rad/s.

grade per second squared (**^{g}/s^{2}**) A unit of angular acceleration = π/200 rad/s^{2}.

Graetz number or **Grätz number (Gz)** A dimensionless number used in heat transfer in general and calculation of convection in laminar flow in particular, defined as $(L/d)(k/(dv\rho C_p))$, in which L = length of the pipe, d = diameter of the pipe, k = thermal conductivity, v = velocity, ρ = density, and C_p = heat capacity. The number, named after the German physicist Leo P. Grätz (1856–1941), was recognized by the American Standards Association in 1941.[378]

Grahams number (**3^^^...^^^3** etc) An upper bound, derived by R. L. Graham, from a problem in a part of combinatorics called Ramsey theory.[379]

"Grahams number cannot be expressed using the conventional notation of powers, and powers of powers. If all the material in the universe were turned into pen and ink it would not be enough to write the number down. Consequently, this special notation, devised by Donald Knuth, is necessary.

3^3 means '3 cubed', as it often does in computer printouts.

3^^3 means 3^(3^3), or 3^27, which is already quite large: 3^27 = 7,625,597,484,987, but is still easily written, especially as a tower of 3 numbers: 3^(3^3).

3^^^3 = 3^^(3^^3), however, is 3^^7,625, 597,484,987 = 3^3^3^3 ... 7,625,597,484,987 times.

3^^^^3 = 3^^^(3^^^3), of course. Even the tower of exponents is now unimaginably large in our usual notation, but Graham's number only starts here.

Consider the number 3^^^...^^^3 in which there are 3^^^^3 arrows. A largish number! Next construct the number 3^^^...^^^3 where the number of arrows is the previous 3^^^...^^^3 number. An incredible, ungraspable number! Yet we are only two steps away from the original ginormous 3^^^^3. Now continue this process, making the number of in 3^^^...^^^3 = the number at the previous step, until you are 63 steps, yes, 63, steps from 3^^^^3. That is Graham's number.[380]

grain per cubic foot (**gr/ft^{3}**) A unit of weight density and concentration, = 0.228 835 mg/L.

grain per UK gallon (gr/gal or **gr/UKgal)** A unit of weight density and concentration in Britain, = 1.425 38 mg/L.

grain per US gallon (gr/gal, **gr/USgal**, or **gpg)** See *gpg*.

grains per gallon See *gpg*.

gram (g) [<L: *granum* = "grain"] An SI and CGS unit of weight = 15.432 4 grains = 0.035 273 966 oz. The gram was originally defined to

[378] American Standards Association Sub-Committee Z 10 C, Mar.1941.

[379] See also: *Scientific American* **5**, 237, Nov. 1977.

[380] Quoted from: [WELL, pp. 209–210].

be the mass of one cubic centimetre of pure water. One gram is now defined to be 1/1000 of the mass of the standard kilogram, a platinum-iridium bar carefully guarded by the International Bureau of Weights and Measures in Paris. The original French spelling *gramme* was formerly used.

gram atom, gram atomic weight An obsolete name for the *atomic mass unit*.

gram calorie The CGS unit of heat energy. See *calorie*.

gram centimetre per second (g · cm/s) The CGS unit of heat energy, $= 10^{-5}$ kg · m/s = 1 dyn · s. See *momentum*.

gram centimetre per second squared (g · cm/s^2) The CGS unit of force = dyne. See *dyne*.

gram centimetre squared (g · cm^2) The CGS unit of moment of inertia, $= 10^{-7}$ kg · m^2.

gram centimetre squared per second (g · cm^2/s) The CGS unit of moment of momentum, $= 10^{-7}$ kg · m^2/s = 1 dyn · cm/s.

gram equivalent (gEq), **gram equivalent mass (GEM)**, **gram equivalent weight (GEW)** Various names for the mass in grams of a substance that would react with or replace 1 g of hydrogen. See *equivalent*, the shorter name now used in many contexts for this unit.

gram mole, **gram molecule**, **gram molecular weight (gmol** or **gmole)** Obsolete names for the *mole*.

grammolekyl The Swedish name for *gram mole*.

gram per cubic centimetre (g/cm^3) The CGS unit of weight density = 10^3 kg/m^3.

gram per litre (g/l or **g/L)** A unit of weight density = 1 kg/m^3.

gram per millilitre (g/ml or g/mL) A unit of weight density = 10^3 kg/m^3.

gram per squared metre (g/m^2) The mSI unit of surface density and grammage of paper or paperboard = 10^{-3} kg/m^2.

gram per squared metre day (g/(m^2 · d)) The oSI unit of water vapour transmission rate.

gram rad or **gram-rad (g · rad** or **g-rad)** The CGS unit of absorbed dose, ratified at the meeting of the International Commission of Radiology in Copenhagen in 1953,[381] = 100 erg/g = 100 J/kg. The unit was sometimes called an **integral absorbed dose**.

gram weight or **gram force (gf)** An informal unit of weight = the force exerted on a mass of 1 g by gravity at the Earth's surface = about 980.665 dynes = 9.806 65 mN = about 0.002 2045 pounds of force.

gram-atom An obsolete unit of weight of an element = ξ g, in which ξ = relative atomic mass of that element.

gram-calorie An obsolete name for *calorie*.

gram-force (gf) The m-kgf-s unit of force = 9.806 65 · 10^{-3} N.

Gramm The German name for the metric unit *gram*.

grammage See *gsm*.

gramme The French name for the metric unit *gram*.

gram-molecule (gmol) An obsolete unit of weight of a compound = κ g, in which κ = relative molecular mass of that compound.

gram-rad (g · rad) A unit of integral absorbed dose = 10^{-5} J = 100 erg = 1000 rad = 10 Gy.

gram-roentgen A unit of absorbed energy = the amount absorbed by 1 g of air when receiving 1 roentgen of radiation = about 8.38 μJ.

gram-weight (g*, g(wt)) An obsolete name for gram-force. See *gram-force*.

grand ... Qualifier distinguishing a larger form of some ambiguous measure, e.g., grand calorie.

grand U.S. slang for 1000, especially the sum of $1000.

grande ... In France, qualifier distinguishing a larger form of some ambiguous measure.

grande unité dynamique See *dynamode*.

grano Name given to the *decigram* in Milan in 1803.

381 1954: Recommendations oft he International Commission on Radiological Units. *British Journal of Radiology* **27**, 316, 243–245.

granule Particle size, used in geology, typically between 2 and 4 mm.

graphometer An instrument whose use is to observe any angle whose vertex is at the center of the instrument in any plane, and to find how many degrees it contains.

Grashof number (*Gr*) A dimensionless number used in heat transfer in general and free convection calculations in particular. It is normally defined as $(L^3\ \rho^3\ g\ \beta\ \Delta T)/\mu^2$, in which L = characteristic length, ρ = density, g = gravitational acceleration, β = coefficient of expansion, ΔT = temperature difference and μ = viscosity. A Grashof number greater than one indicates that the wave field will decay very slowly, and if *Gr* is less than one, viscous dissipation damps the waves as fast as they are formed.[382] The number is named after the German engineer Professor Franz Grashof (1826–1893), who was the founder and editor of Verbandes Deutscher Ingenieure (VDI), an association of German engineers. The Grashof number was first defined by H. Groeber in 1921.[383]

Grätz number See *Graetz number*.

grav (g) Another name for the unit of acceleration usually called the g. See *g* and *G*. Renamed the gram in 1795.

grave A unit of weight, proposed by the French Temporary Commission on Weights and Measures in 1793, = 1/1000 bar = 1000 gravet = 1 kg. Rebaned the kilogram in 1795.

gravel In geology, a particle size, typically between 2 and 64 mm.

gravet A unit of weight, proposed by the French Temporary Commission on Weights and Measures in 1793. It was defined as the weight of one cubic centimetre of water at the freezing temperature = 1/1000 grave = about 1 g. In 1799, it was based on a cubic centimetre of water at its temperature of maximum density (about 4°C).

gravimetrical system [gravitational metric system] See *gravitational systems of units*.

gravitational constant, **constant of gravitation**, or **Newtonian constant of gravitation** The constant of proportionality in Newton's equation describing the force of attraction between two bodies. According to 2014 CODATA: $6.674\ 08\ (31) \cdot 10^{-11}\ m^3/(kg^{-1}\ s^{-2})$.

gravitational systems of units or **technical systems of units** A system of units is said to be gravitational if its units for length, time, and force are base units. Gravitational systems are mainly used by engineers and are contrasted with absolute systems.

gray (Gy) The SI unit of absorbed radiation dose, specific energy impartes and kerma, used in studying and regulating ionizing radiation, = 1 J/kg = 100 rad. In 1976, the CIPM approved the use of the gray, by approving a report of the Consultative Committee for Units, which had adopted a recommendation of the ICRU. The unit is named after the English physician Louis Harold Gray (1905–1965), who developed the Bragg-Gray Principle.[384]

gray per second (Gy/s) The SI unit of absorbed dose rate and kerma rate = 1 W/kg = 100 rad/s.

grd A German abbreviation for the unit *Grad* = degree.

great... General qualifier distinguishing a larger form of some ambiguous measure, e.g., great gross = 12 × 144 = 1728.

great gross In Britain, an obsolete unit of quantity = a dozen gross, or 1728.

great hundred In Britain, an obsolete unit of quantity = 120 instead of 100. The great hundred equals 6 score or 2 shocks.

Greenwich Hour Angle (G.H.A.) Indicates the position past the plane of the Greenwich meridian measured in degrees. Equivalent to *longitude* on earth.

grex An obsolete yarn numbering system, used during the nineteenth–twentieth centuries.

[382] [JAKO2].
[383] [GROE].
[384] [TAYL6].

The yarn's fineness was described by the mass in grams of a 1000 m length.[385]

grillion See *zillion*.

gry [<Gr: = "a trifling amount"] Proposed unit of length in the traditional English system. The name was first used in June 1679 by the English philosopher John Locke (1632–1704) as a unit = 0.001 foot = 0.1 line = 1/120 inch = 0.211 667 mm.

Gs An abbreviation for gauss.

gsm A common but non-standard symbol for grams per square metre (g/m^2), the metric unit of density for paper and for fabric. In Japan, the weight is expressed as the weight of 1000 sheets. Paper density measured in this unit is often called **grammage**.

gt, **gtt** A traditional pharmicist's abbreviations for a drop. Originally, gt was the singular (1 gt) and gtt the plural.

Gt An abbreviation for gigaton.

g/t A symbol for grams per tonne (metric ton), a unit of proportion = 0.001 g/kg = 1 part per million by mass.

gtt An abbreviation for gutta.

Gunter's chain During the seventeenth–nineteenth centuries, a unit of length used by American engineers = 100 Gunter's links = 66 feet = 20.116 8 m. The unit was introduced in 1620 by the English clergyman Edmund Gunter (1581–1626).[386]

Gurley unit A unit of porosity = one square inch seconds per deciliters ($s \cdot in^2/dl$) = 6.451 6 seconds per metre column of air (s/m). In the paper industry, "porosity" is generally measured by the time (in seconds) required for 100 cm^3 of air to pass through one square inch of the paper at a standard pressure difference.

gutenberg A unit of length, used in typography, = 1/7200 inch = 3.5278 μm. The unit is named after Johannes Gutenberg (*c*.1390–1468), the German inventor of printing from movable type.

gutt or **gutta (gtt)** [<L: *gutta* = "drop"] In Britain, during the eighteenth century, a unit of pharmaceutical use = a drop.[387]

G-number A value defined as the number of molecules that is produced or disappears for every 100 eV energy that is absorbed.

GW An abbreviation for gigawatt.

GWh An abbreviation for gigawatt hour.

Gy An abbreviation for gray.

8 H

H An abbreviation for *henry*.

H An abbreviation for *Hounsfield unit*.

H The metric abbreviation for hector-[388], e.g., HL = hectolitre, and the archaic decimal metric prefix hebdo-, e.g., Hm = hebdometre.

h SI abbreviation for hecto.

h Planck's constant, according to CODATA 2014 = $6.626\,070\,040(81) \cdot 10^{-34}$ J · s, a fundamental constant of physics also used as a unit of "action" or of angular momentum in particle physics. The unit was defined by the German theoretical physicist Max Planck (1858–1947), who showed, in 1900, that at atomic and subatomic scales, energy occurs in discrete packets called quanta. Each quantum has energy $h \cdot f$, for which f is the frequency of the radiation in hertz.

HA An improper abbreviation, used in a context of upper-case-only printing, for hectare.

Ha The metric abbreviation for *hectare*.[389]

ha The SI abbreviation for hectare.

Hagen number (Hg) A dimensionless number used in forced flow calculations. It is the forced flow equivalent of the Grashof number, and defined as $-[dp/dx(L^3\rho^{-1}\upsilon^{-2})]$, in which dp/dx = the pressure gradient, L = a characteristic length, ρ = the fluid density, and υ = the kinematic viscosity.

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[385] *ASTM Standard D-123-03. Standard Terminology Relating to Textiles*. Edition approved 10 February 2003.

[386] [RUSS2, p.167].

[387] [LIND3].

[388] Used until 1960.

[389] Used until 1960.

hair's-breadth or **hairbreadth** A common informal[390] unit of length = the width of a human hair. Traditionally, it was about 0.529 158 2 mm. A hair's-breadth is nowadays said to be about 0.1 mm.

half A unit of proportion = ½. The English word "half," like the German prefix "halb-," is often placed before the name of a unit to create a combination which functions as a new unit = half the old one. Half dozen, half hour, and half gallon are typical and common examples.

half Plane angel, in nautical context, = a half of a compass point = 1/64 revolution = π/32 rad.

half life A unit of relative time measuring the rate of decrease for any process that decreases exponentially. In the case of radioactivity, the half life is the time required for the activity to be reduced by half. To reduce the activity to 0.1% of the original amount requires about 9.966 half lives. For exponential decay, the half-life $t_{1/2} = \ln(2)/\lambda$, in which λ = the decay constant. If a quantity decays by two processes simultaneously, the total hal-life $T_{1/2}$ may be expressed in terms of the two half-lives t_1 and t_2 as $T_{1/2} = (t_1 t_2)/(t_1 + t_2)$.

Hampson unit A unit of x-ray exposure = ¼ of the erythema dose.[391]

handful, **manipulus**, or **fasciculus** A quantity of a powder or a similar substance that can be picked up in the cupped hand.

hands [alwalys plural] A unit of capacity used in trading with the Indians, for example, for gunpowder and wampum, in seventeenth–eighteenth centuries colonial America as the quantity contained by two hands held together as a scoop. Said to have been influenced by the Dutch *geest*.

hank or **hanke** [<Swe: *hank* = "hanger"] In English-speaking countries, a premetric unit of length for yarn. The length of yarn in a hank varies with the market and the material. For cotton yarn and spun silk = 840 yd = about 768.096 m of yarn, for wool yarn (in Britain and worsted = 7 wraps or leas = 12 cuts = 560 yd = about 512.1 m, for woolens and linens (in Britain) = 300 yd = about 274.32 m; for wool yarn (in the U.S.) = 1600 yd = about 1463 m, for linen = 3600 yd = 12 cuts or leas = about 3291.84 m. For both cotton and wool, the hank is = 7 leas or 12 cuts. In retail trade, a hank is often = 6 or 7 skeins of varying size.

hào [<Mandarin and Vietnamese: = "thousand"] A prefix used equivalent to milli..., but often, like "kilos", without a unit following it.

happy A jocular unit of happiness = how much happier you feel if someone gives you a pound coin. It was coined by the British documentary comedian and humourist Dave James Gorman (b. 1971) in the television series Dave Gorman's Important Astrology Experiment on BBC Two. See also *puppy*.

hartley (Hart) A unit of information content used in information and communications theory. The hartley is similar to the shannon. If the probability of receiving a particular message is p, then the information content of the message is $-\log_{10} p$ hartleys. One hartley equals $\log_2 10$ = 3.321 928 shannons = about 3.321 928 095 bits or $\log_e 10$ = 2.302 585 nats. The unit is named after the American electrical engineer Ralph Vinton Lyon Hartley (1888–1970), who presented the unit in 1928.[392] See also *ban*.

Hartmann number (*Ha*) A dimensionless number expressing the relative magnetic force that opposes viscous action for an incompressible fluid that flows between parallel planes with a magnetic field. *Ha* is indicated as the ratio of the magnetic viscosity and the ordinary viscosity = $BL^2\sqrt{\sigma/\mu}$, in which B = the magnetic field, L = the characteristic length scale, σ = the electrical conductivity, and μ = the dynamic viscosity. The number was named[393] after the danish physicist Julius Hartmann (1881–1951).

hartree (E_h) A unit of energy used in atomic and molecular physics. According to CODATA 2014 = 4.359 744 650(54) · 10^{-18} J = about

[390] Human hairs vary in width, depending on age, color, genetics, and other factors.

[391] enacademic.com

[392] [HART4].

[393] According to [STAN2].

27.211 396 02(17) eV. In its rationalized form, it is defined as $4\pi^3me^4/[h^2(4\pi\varepsilon_0)^2]$, in which m = the rest mass of the electron, e = the electron charge, h = the Planck constant, and ε_0 = the rationalized permittivity of free space. The unit, proposed in 1926 and named in 1959,[394] is named after the British physicist and mathematician Douglas R. Hartree (1897–1958), who proposed an atomic system of units in 1928.[395]

hat trick An informal unit of quantity = 3. The unit is used in sports in counting goals, especially goals scored by the same player.

haze factor The ratio between the luminescence of an object and the luminescence of the scattering medium (fog or mist) through which it is being viewed.

He An abbreviation for Hedström number.

head (hd) An informal unit of length = the approximate length of a horse's head, used in expressing the results of a horse race. It usually equals about 60 cm.

heat flux unit (HFU) An obsolete unit of thermal flux used in Earth science, especially in geophysics, = $41.855 \cdot 10^{-3}$ W/m^2.

heating degree day (HDD) See *degree day*.

heat transfer factor (j_H) A dimensionless number used in free and forced convection calculations. It is normally defined as $h\,(C_p \cdot \mu)^{2/3} /[(C_p \cdot \rho \cdot v)\,k^{2/3}]$, in which Cp = heat capacity, μ = viscosity, ρ = density, v = velocity, and k = thermal conductivity. It is also equivalent to $St \times Pr^{2/3}$, in which *St* = Stanton number for heat transport and *Pr* = Prandtl number.

heat unit An alternate name, coined by Americans, for the British thermal unit (Btu).

Heaviside, **Heaviside-Lorentz system of electromagnetic units**, **Rational Electrical Units**, or **Rationalized Gaussian CGS** Alternative system[396] of electrical units devised in such a manner that the same constants appear in the magnetic and electric laws. The units is the same as in the Gaussian system, except that the units of charge and current are smaller by a factor of $1/\sqrt{(4\pi)}$, and those of electric and magnetic field are larger by a factor by $\sqrt{(4\pi)}$.[397]

hebdo- [<Gr: *hebdomos* = "seventh"] **(H)** An obsolete decimal metric prefix denoting 10^7. The prefix was proposed in the 1880s by the German physicist Rudolf Clausius (1822–1888), for use in the Quadrant–Eleventh gram–Second System, an absolute electrodynamic system of units based on the metre as 1/10,000,000 of the distance between the North Pole and the Equator.

hebdomadal An obsolete name for an entity that has a weekly (7-day) pattern of occurrence. See also *hebdo-*.

hect- or **hecto- (h-)** A metric prefix denoting 100, coined from the Greek word *hekaton* for one hundred.

hectare (ha) A customary metric unit of land area = 100 ares = about 107,639.1 sq ft = 11 959.9 sq yd = 2.471 054 acres. The are, hectare, and their symbols were adopted by the CIPM in 1879. In 1978, the CIPM decided it would be better to express all areas in square metres, and, while the are and hectare could continue to be used for the time being, they should not be introduced where not presently used. In the U. S., the hectare is still legally considered a unit within SI.[398]

hectare-metre (ha · m) A rarely[399] used unit of volume = the volume of 1 m × 1 ha = 10,000 m^3.

hectare-millimetre (ha · mm) A rarely used unit of volume = 10 m^3.

[394] [SHUL].
"Since the energy unit in this system is the one most generally needed, it seems appropriate that its name be simplified to the 'Hartree' and denoted by H. Thus, we define: $H = \frac{me^4}{h^2}$.
The conversion factor from Hartrees to cm.$^{-1}$ is then precisely twice as large as the infinite Rydberg, R_∞."

[395] [HART5].

[396] Primarily used in theoretical writings, not for experimental measurements, prior to World War II.

[397] "Generally, systems in which the 4π factors appear in the force equations rather than the field equations are called 'rationalized'." [AITC].

[398] Most official English-speaking national publications use the hectare as the SI unit of area.

[399] Mainly used in the measurement of irrigation water.

hecto- (h- in SI, prior to 1960 **H-)** A metric and SI prefix denoting 10^2. This prefix should be avoided as much as possible.[400]

hectogram or **hectogramme (hg** in SI, **Hg** in metric) A common metric unit of weight, widely used in Europe for cheese, chocolate, sweets, and similar goods, = 100 g. Also = 56.438 339 av. drams = about 98,066.5 dynes = about 1543.235 8 gr = about 3.215 073 7 troy oz. = about 3.527 396 3 av. oz.

hectoliter or **hectolitre (hl or hL** in SI, **Hl** in metric) A common metric unit of volume, often used in the brewing industry, = 100 L = 0.1 m^3.

hectometer or **hectometre (hm** in SI, **Hm** in metric) A rarely used (despite appearing in various scientific contexts) metric unit of length = 100 m.

hectopascal (hPa) A metric unit of pressure = 0.1 kPa. The hectopascal is identical to the millibar (mb). The proper SI unit for air pressure is the kilopascal.[401]

hectopièze (hpz) In France, during the twentieth century, a unit of pressure = 10^5 Pa = 1 bar.

hectowatts (hW) A metric unit of power and heat flow rate = 100 W.

Hedström number (*He*) A dimensionless number used in non-Newtonian fluids. It is defined as $(TD^2\rho)/\mu^2$, in which T = yield stress, D = diffusion coefficient, ρ = density, and μ = Bingham plastic viscosity of the fluid. [402] The number is named after the Swedish Professor of chemical engineering Bengt Olof Arvid Hedström (1926–1999).

Hefner candle (HC), **Hefner unit**, or **Hefner-Kerze (HK)** In Germany, during the late nineteenth–early twentieth centuries (mainly used before 1942), a unit of luminous intensity. The unit is named after the German electrical engineer Friedrich Franz von Hefner-Altenack (1845–1904), who, in 1884, invented a laboratory light standard, the Hefner lamp, which burned[403] isopentyl acetate ($C_5H_{11}C_2H_3O_2$) to provide light of intensity 1 HK. The chief source of lack of reproducibility was humidity, the lamp being about 10% brighter in dry air than at high humidities, which was corrected for by standard tables.[404] In Germany, the hefner unit superseded the vereinkerze for scientific work, and was replaced by the candela. One Hefner candle is equivalent to about 0.90 bouigie decimales = about 0.86 English candles = about 0.85 German candles = about 0.90 international candles = about 0.094 carcel units = about 0.902 cd = about 0.090 10-cp. pentane candles.[405]

Hefner unit See *Hefner candle*.

Hefner-Kerze or **Hefnerkerze** See *Hefner candle*.

Hefner number See *Hehner number*.

Hegerhufe See *Hägerhufe*.

Hehner number, **Hefner number**, or **Hehner value** A dimensionless number that was introduced in 1909 as the percentage of the nonvolatile fatty acids yielded by 5 g of a saponified fat or oil; now usually defined as the weight percent of water-insoluble fatty acids in fats and oils. It is named after British analytical chemist Otto Hehner (1853–1924).

heiho... [<Japanese: = "square"] In Japan, a prefix, e.g., heiho-ri.

helen A jocular unit of beauty. One millihelen is described as the amount of beauty needed to launch a single ship. It is named after Helen of Troy, the daughter of Zeus and Leda and the wife of Menelaus in Greek mythology. The unit was humorously coined by the Russian-born American author and Professor of biochemistry Issac Asimov (1920–1992), inspired by the line by Faustus *"Was this the face that launch'd a thousand ships, and burnt the topless towers of Ilium? Sweet Helen, make me immortal with a kiss."* from the play *Doctor Faustus*, by the English

[400] A legal prefix in the UK used solely for hectogram, hectare and hectolitre.

[401] On January 1, 1986, the ninth congress of the World Meteorological Organisations recommended that the preferred unit for measurement of pressure for meteorological purposes should be the hectopascal.

[402] [HEDS].

[403] Burning with a flame 40 mm high.

[404] Sizes.com.

[405] [HEFN].

dramatist and poet Christopher "Kit" Marlowe (1564–1593).[406]

helmholtz A unit of the moment of an electrically charged double layer or dipole, proposed by E. A. Guggenheim. The unit is named after the German physicist, physiologist and physician Hermann Ludwig Ferdinand von Helmholtz (1821–1894). One helmholtz equals 1 debye per square Ångström = about 3.335 64 C/m.

hemi… [Gr: = "half"] Prefix in Greece, e.g., hemikotyle = ½ kotyle.

hemisphere A traditional unit of solid angle = ½ sphere = 2π steradians = 4 right angles = about 6.283 185 3 steradians = about 20,626.48 square degrees.

hemorrhagin unit Name of "the amount of snake venom necessary to produce hemorrhages in the vascular network of a 3-day-old chick embryo." [407]

henry (H) [*pl.* henries, sometimes spelled henrys] The SI unit of self inductance, mutual inductance and permeance = 1 $m^2 \cdot kg/(s^2 \cdot A^2)$ = 1 V · s/A = 1 Wb/A = 1 Ω · s = 1 J/A^2 = 10^9 abhenries = about 1.112 646 · 10^{-12} stathenries = about 0.999 505 international henries.[408] The henry is a large unit, so inductances in practical circuits are measured in millihenrys (mH) or microhenrys (μH). The unit is named after the American physicist Joseph Henry (1797–1878), and was adopted in 1893 by the International Electrical Congress, held that year in Chicago. See also *international henry* and *quadrant*.

henry per metre (H/m) The SI unit of permeability = 1 N/A^2 = about 795,774.72 CGS units of permeability = about 795 774.72 gausses/oersted.

hepta… A prefix, e.g., heptagon = having seven angles/sides.

heptad A unit of quantity = 7.

herd A large group of animals. The term is usually applied to mammals, particularly ungulates, and is typically considered to range from about 30 to several thousand individuals.

herschel A unit of luminance, proposed[409] in 1942 by the American electrical engineer Parry H. Moon (1898–1988), corresponding to the blondel, but for radiometric measurements. It is doubtful that it was ever used. It is named after the German-born British astronomer and composer Sir Frederick William Herschel (1738–1822).

hertz (Hz) [same in plural] The SI unit of frequency = 1 c/s (cycle per second). The hertz[410] is used to measure the rates of events that happen periodically in a fixed and definite cycle; the becquerel, also = one "event" per second, is used to measure the rates of things which happen randomly or unpredictably. The unit is named after the German physicist Heinrich Rudolf Hertz (1857–1894), and was adopted by the 11th CGPM in 1960 (Resolution 12). It replaced cycles per second (c.p.s.), which was usually just referred to as "cycles".

hexa… [Gr: = "six"] A prefix, e.g., hexagon = having six angles.

hexad A unit of quantity = 6.

hexadecimal Numeral system with a radix or base of 16, usually written using the symbols 0–9 and A–F or a–f. The hexadecimal system was first introduced to the computing world[411] in

406 According to en.wikipedia.org: "*Negative values have also been observed—these, of course, are measured by the number of ships sunk or the number of clocks stopped. An alternative interpretation of 1 negative Helen is the amount of negative beauty (i.e. ugliness) that can launch one thousand ships the other way*".

407 enacademic.com

408 National Institute of Standards and Technology provides guidance for American users of SI to write the plural as henries.

409 [MOON].

410 Multiples of the hertz are common: the frequencies of radio and television waves are measured in kilohertz (kHz), megahertz (MHz), or gigahertz (GHz), and the frequencies of light waves in terahertz (THz).

411 It is a useful system in computers because there is an easy mapping from four bits to a single hex digit. A byte can be represented as two consecutive hexadecimal digits.

1963 by IBM.[412] For example, the decimal numeral 79 whose binary representation is 01001111 can be written as 4F in hexadecimal (4 = 0100, F = 1111).

hexit A unit of information = 4 bits = ½ byte. A string of 4 bits has 16 possible states (0–15) and is usually represented as a single base-16, or **hex**adecimal, dig**it** (in the hexadecimal system, the letters A through F are used to represent the numbers 10 through 15, respectively). A hexit of data is also known as a **nibble** or a **quadbit**.

HG Improper representation of Hg or hg for hectogram, in a context of upper-case-only printing.

Hg An abbreviation for Hagen number.

hhd An abbreviation for hogshead.

Hitler (Ht) Unconventional fictional unit of persons killed = 100 million kills (roughly the number of deaths in the Holocaust), named after the German Head of State Adolf Hitler (1889–1945). The unit was invented by the webcomic Goats in August 8, 2006.[413]

HK A German abbreviation for the unit *Hefner-Kerze* = Hefner candle.

Hl or **HL** A metric abbreviation, strictly upper-case initial, for hectoliter and hectolitre, used until 1960.

hl or **hL** The SI abbreviation for hectoliter and hectolitre.

HLS An abbreviation for Hue, Lightness, Saturation (popular model for color conceptualizing). See also *HSV*.

Hm A metric abbreviation, strictly upper-case initial, for hectometre and hectomètre, used until 1960.

hm The SI abbreviation for hectometre and hectomètre.

Hodgson number (*H*) A dimensionless number used in momentum transfer in general and unsteady pulsating gas flow calculations in particular. It is normally defined as $(f_r\ V\ \Delta p)/(q\ p)$, in which f_r = frequency, V = system volume, Δp = pressure drop, q = average volumetric flowrate and p = average static pressure.[414]

hojillion See *zillion*.

Hook number See *Cauchy number*.

hoppus foot and **hoppus board foot** In British forestry, two obsolete units of volume.[415] In a 1736 manual of practical calculation,[416] the English surveyor Edward Hoppus (d. 1739) advised foresters to estimate the volume of wood in a log of length L and girth (circumference) G as $L \cdot (G/4)^2$. Since the correct formula is $L \cdot G^2/(4 \cdot \pi)$, the resulting figure is a fairly reasonable estimate of the usable volume of wood in the log. Volume measurements made using the hoppus formula are stated in hoppus feet. In effect, this makes the hoppus foot a unit of volume = $4/\pi$ = 1.273 ft^3 = 0.036 054 m^3. Similarly, the hoppus board foot is = 1/12 hoppus foot or 1.273 board feet, which is almost exactly 3 L = 0.00300 m^3.

hoppus ton (HT) In British forestry, an obsolete unit of volume, named after the English surveyor Edward Hoppus (d. 1739). One hoppus ton = 50 hoppus feet = about 1.802 7 m^3. Shipments of tropical hardwoods from Southeast Asia, especially shipments of teak veneer logs from Myanmar, still use the hoppus ton. In Trinidad and Tobago, it is used in issuing licenses for felling trees in state forests.

horse An occasionally used abbreviation for horsepower.

horsepower or **British horsepower (hp** or **B. H.P.)** In Britain and the U.S., a unit of power, in concept = the power exerted by a horse when dragging a boom to power machinery. The

[412] It was IBM that decided on the prefix of "hexa" rather than the proper Latin but more politically incorrect prefix of "sexa". The word "hexadecimal" is strange in that *hexa* is derived from the Greek ἑξι (hexi) for "six" and *decimal* is derived from the Latin for "ten". An older term was the pure Latin "sexidecimal", but that was changed because some people thought it too risqué, and it also had an alternative meaning of "base 60".

[413] www.goats.com

[414] See also: [BAKE, p. 33].

[415] The British forestry industry changed its unit of timber measurement from hoppus feet to cubic metre in 1971.

[416] See also [HOPP].

horsepower was defined by James Watt (1736–1819).[417] Watt determined after careful measurements that a horse[418] is typically capable of a power rate of 550 foot-pounds per second[419] = 33,000 foot-pounds per minute = about 745.699 9 W. This means that a horse can lift 550 lb at the rate of 1 ft/s. The SI unit of power is named for *Watt*.

horsepower (metric) (in French: **ch** (for *cheval-vapeur*); in German: **PS** (for *Pferdestärke*)) An obsolete unit of power = 75 kp · m/s = about (75 · 9.806 65) W = about 735.498 75 W.

horsepower In Germany, a premetric unit of power.[420]

Austria = 430 fuβ pfund/s = about 746.472 W;
Hanover = 516 fuβ pfund/s = about 739.039 W;
Prussia = 480 fuβ pfund/s = about 738.686 W;
Saxony = 530 fuβ pfund/s = about 735.940 W;
Würtemberg = 525 fuβ pfund/s = about 737.852 W.

(A.L.A.M.) horsepower or **S.A.E. horsepower** A unit of power used for automobiles. Adopted in 1908 by the Association of Licensed Automobile Manufacturers and later by the Society of Automotive Engineers. A.L.A.M. horsepower rating = $(5 \cdot D^2 \cdot N)/2$, in which D = the diameter of the cylinders in inches and N = the number of cylinders. The constant 5/2 was a judgment call by the Association's Mechanical Branch, based on a piston speed of 1000 ft/min.[421]

(engine) horsepower (number) A unit of power used for engines. Prior to 1971, the figures American automobile manufacturers gave for engine horsepower were taken from tests of engines running on test stands without mufflers or other impedimentia. Today, the engine horsepower numbers are for the engine as installed in the car, which is roughly a third lower than the test stand figure.

horsepower (RAC) During the twentieth century, a unit used to tax cars. It was based on the cylinder diameter, not the swept volume or power, which seems to have inspired the English engineer Walter Owen Bentley (1888–1971) to design long-stroke engines to get them into a lower taxation class. See also *CV*.

horsepower See *boiler horsepower*.

horsepower or **electric horsepower** A unit of power = 746 W.

horsepower or **water horsepower** A unit of power = 746.043 W.

horsepower hour (Hp-hr, **hp hr**, or **hp h)** In Britain and the U.S., a unit of energy = the work done at the rate of 1 horsepower/h = 1,980,000 foot pounds = about 2.685 MJ = about 2545 Btu = about 641.1 (large) Calories = about 745.7 Wh.

horsepower hour (metric) A unit of work = 735.499 Wh = about $2.647\,80 \cdot 10^6$ J.

horsepower hour per pound (Hp-hr/lb) A unit of specific energy, specific enthalpy, specific exergy, and specific anergy = 2546.14 Btu/lb = about 1413.60 Cal_{IT}/g = about 935.632 cu ft-atm/lb = about 1.643 99 Wh/g = about 13,750 cu ft-(lb/in^2)/lb = about 1,980,000 foot-pounds/lb.

[417] "The horsepower was first defined in print in the *Edinburgh Review* (January 1809), in an article that suggests that the value of the unit was set through experiments Watt conducted with dray horses. In *James Watt and the Steam Engine* (Oxford, 1927), H. W. Dickinson and Rhys Jenkins point out that this is probably not so. Among Watt's surviving papers are his 'Blotting and Calculation Book 1782 & 1783.' In an entry made in August 1782 he calculates how large an engine would be needed to power a paper mill currently powered by 12 horses. 'Mr. Wriggley, [the owner's] millwright, says a mill-horse walks in 24 feet diar and makes 2½ turns per minute. . .say at the rate of 180 lb p. horse.' The 180 pounds is an estimate of the force exerted by the horse. From these figures, using a value of pi = 3, Watt calculated the power of 1 horse at $24 \times 3 \times 2^1/_2 \times 180 = 32{,}400$ foot-pounds per minute. Watt used the same value later in the notebook, but under September 1783, the value is changed to 33,000." Sizes.com.

[418] In Watt and Boulton's factory the word "horse," not "horsepower" was used, e.g., a "8-horse engine." Modern measurements show that the average horse can put out about 0.6 horsepower through an 8-hour workday.

[419] Slightly different values have been used in certain industries.

[420] [BABC].

[421] [COLV, pp. 420–421].

horsepower hour per ton-day of refrigeration In the refridgeration industry, during the early nineteenth century, a unit = 0.008 843 97 coefficient of performance = about 0.041 666 7 hp/ton of refridgeration = about 0.745 700 kWh/ton-day of refrigeration.

horsepower year An obsolete unit of work = 8760 metric horsepower hours = about $2.230\ 42 \cdot 10^7$ Btu = about $5.616\ 88 \cdot 10^9$ cal_{IT} = about 6532.33 kWh.

hotillion See *zillion*.[422]

hour (h or hr) A unit of angular measure used in astronomy = 1/24 circle = 15°.

hourglass, **sandglass**, or **sand-timer** Device for the measurement of time. It consists of two glass bulbs placed one above the other which are connected by a narrow tube. One of the bulbs is usually filled with fine sand[423] which flows through the narrow tube into the bottom bulb at a given rate. Once all the sand has run to the bottom bulb, the device is inverted in order to measure another time period.[424]

house A unit of angle measure in astrology = 1/12 circle = 30°. Each sign of the Zodiac is called a house.

hour's travel Name of variable distance that is normally travelled in an hour. For walking = about 5 km; by car = about 100 km.

HP [abbreviation for hauteur × poids] A symbol used for the cheval-vapeur in France,[425] prior to the use of this symbol in England for horsepower. It was later succeeded by the symbol CV, and then ch.

HP See *horsepower*.

HP An abbreviation for high pressure.

hp or h.p. An abbreviation for horsepower.

hPa The SI abbreviation for hectopascal, usually used on meteorological charts in North America.

hp h or **hp-h** An abbreviation for horsepower hour.

hp hr A non-recommended abbreviation for horsepower hour.

hpz An abbreviation for hectopièze.

hr A non-recommended abbreviation for hour.

hsien [Mandarin modified Wades-Giles and Mandarin Wades-Giles: "ten-millionth"] See *xian*.

HT A French abbreviation for *haute tension*.

Ht An abbreviation for Hitler.

HU An abbreviation for Haugh unit.

HU An abbreviation for Hounsfield unit.

hubble or **hubble length (L_H)** A unit of length, sometimes used in astronomy, = 10^9 light years = about $9.460\ 5 \cdot 10^{21}$ km = about $63.240 \cdot 10^{12}$ AU = about 306.595 megaparsecs (MPC)[426]. The unit honors the American astronomer Edwin P. Hubble (1889–1953), who discovered that the degree of redshift observed in light coming from a galaxy increased in proportion to the distance of that galaxy from the Milky Way.

huneker A name playfully proposed by the American Professor Douglas R. Hofstadter[427] (b. 1945) for a unit measuring a sentient being's quantity of soul. He provides two set points: the average person at about 100 hunekers, and a mosquito at 0.000 000 01 hunekers. The unit is named after the American music writer and critic James G. Huneker (1857–1921), who wrote the prefaces for the Schirmer edition of Chopin's études. In his preface to one étude, Huneker advised that it not be attempted by "small-souled men."[428]

hydrometer An instrument used for measuring the gravity, density, velocity, force, &c. of

[422] Also a name given, by the American googologist Jonathan Bowers (b. 1969), to the giant number 10^ (3 10 ^ (3 10^300) + 3). See www.polytope.net

[423] Alternatives to sand that have been used are powdered eggshell and powdered marble.

[424] Factors affecting the amount of time that the hourglass measures include: the volume of sand, the size and angle of the bulbs, the width of the neck, and the type and quality of the sand.

[425] [DENI2, p. 42].

[426] In practice, most astronomers use the megaparsec for measuring such distances.

[427] [HOFS2].

[428] [HUNE, p. 157].

water and other fluids, and the strength of spirituous liquors.

hydrometer degree (deg-TH) A unit of concentration of calcium and magnesium in water (hardness of water), introduced by the U.S. Geological Survey, = 1 mg of $CaCO_3$ per 1000 cm^3 of H_2O = 1 ppm of $CaCO_3$.

hydrometer degree (German) (deg-THG or **deg-d)** A unit of concentration of calcium and magnesium in water (hardness of water) = 10 mg of $CaCO_3$ per 1000 cm^3 of H_2O.

hydrometer degree See *degree Clark*.

hygrograph A scientific instrument used to record and plot changes automatically in relative humidity in an environment, by measuring changes in length of human hair as it absorbs water vapour. It was used c. 1920–1940 and invented by the London-based company Negretti & Zambra.

hyl [<Gr.: *hyle* = "matter"] In Germany and northern Europe, an obsolete MKS unit of weight = 9.806 65 kg. In eastern Europe, there was also another unit called a **hyl**, defined as the mass that is accelerated at one metre per second per second by one gram of force. This definition is identical to the other unit called a hyl, except that a gram-force is substituted for a kilogram-force (1 kgf = 9.806 65 N). To convert this later unit into one which would be coherent in a system based on the kilogram-force, it must be multiplied by 1000. Then, this later unit (also called a **kilohyl**) is identical to the hyl as first defined.

hyperbolic logarithm See *napierian logarithm*.

Hz An abbreviation for hertz.

9 I

I A French abbreviation for *intensité*.

i A mathematical unit = the square root of −1. Although often called the imaginary unit,[429] *i* is quite real in many applications. For example, in vector geometry, it is used to represent a counterclockwise rotation by 90°. The Swiss mathematician Leonhard Euler (1707–1783) introduced the symbol *i* for the imaginary unit in 1777.[430]

i A Chinese word and prefix (in Mandarin, Wades-Giles and Mandarin-modified Wades-Giles) for a hundred million.

i. An abbreviation for imperial.

iad An abbreviation for integral absorbed dose.

IBP An abbreviation for initial boiling point.

IBU An abbreviation for international bitterness (or bittering) unit.

IC An abbreviation for international candle.

I.C.A.N. An abbreviation for International Commission for Air Navigation.

I.C.A.O. An abbreviation for International Commission for Aviation Organization.

icfm An abbreviation for inlet cubic feet per minute, a unit traditionally used to measure the capacity of air compressors.

I.C.R.U. An abbreviation for International Commission on Radiological Units.

$\mathbf{I_{eff}}$ A French abbreviation for *Intensité Efficace* = effective current.

IEN Galileo Ferraris An abbreviation for Istituto Elettrotecnico Nazionale Galileo Ferraris.

IERS An abbreviation for International Earth Rotation Service.

IFU An abbreviation for International Flux Unit.

IHP An abbreviation for Indicated Horse Power.

IK A German abbreviation for *Internationale Kerze* = international candle.

$\mathbf{I_{max}}$ A French abbreviation for *Intensité Efficace* = maximum current.

IMEP An abbreviation for International Measurement Evaluation Programme.

IMGC An abbreviation for Istituto di Metrologia Gustavo Colonnetti (in Torino).

$\mathbf{I_{min}}$ A French abbreviation for *Intensité Minimum* = minimum current.

imp. An abbreviation for imperial.

429 [NAHI].

430 [CONW, pp. 211–216].

Impèrial A large wine bottle, traditionally a Bordeaux-shaped bottle, holding about 6 L, same size as the Methuselah for champagne.[431] See also *Methuselah*.

IMS An abbreviation for Israel Metrological Society.

in or **in.** An abbreviation for inch.

in² An abbreviation for square inch.

in³ An abbreviation for inch cubed and cubic inch.

in d. An abbreviation for the Latin *in die*, daily, a unit of frequency used in medical prescriptions.

incast In Britain, the name for a margin of extra commodity cast into a measure.[432]

inch cubed (in³) A unit of modulus of section.

inch of mercury (conventional) (in Hg) An obsolete unit of atmospheric pressure = 0.491 lb/in^2 = 33.863 9 mbar = 3.387 kPa. In the U. S., atmospheric pressure is customarily expressed as the height of a column of mercury exerting the same pressure as the atmosphere. When a traditional mercury barometer is used, this height is read directly as the height of the mercury column. In the symbol for the unit, Hg is the chemical symbol for mercury.

inch of mercury (32 °F) An obsolete unit of pressure = 3.386 38 kPa.

inch of mercury (60 °F) An obsolete unit of pressure = 3.376 85 kPa.

inch of water (conventional) (in H_2O) or **inch of water column (in WC)** An obsolete unit of pressure, used in plumbing to describe both water and gas pressures. A pressure of 1 inch of water equals 249.088 9 Pa = 2.490 89 millibars = about 0.0360 psi = about 0.073 48 in Hg.

inch of water (39.2 °F) An obsolete unit of pressure = 249.082 Pa.

inch of water (60 °F) An obsolete unit of pressure = 248.840 Pa.

inch of water gauge (in wg or **″wg)** Another common name for the *inch of water column* = about 5.184 lb/ft^2.[433] The word "gauge" (or "gage") after a pressure reading indicates that the pressure stated is actually the difference between the absolute, or total, pressure and the air pressure at the time of the reading.[434]

inch per minute (in/min) A unit of velocity = $2.54 \cdot 10^{-2}$ m/min = about $4.233\ 33 \cdot 10^{-4}$ m/s.

inch per second (in/s) A unit of velocity = $2.54 \cdot 10^{-2}$ m/s.

inch pound (in lb) An obsolete unit of work or energy = 1/12 ft-lb = about 0.112 985 J.

inch squared per hour (in²/h) A unit of kinematic viscosity = 0.179 211 cSt = about $6.451\ 6 \cdot 10^{-4}$ m^2/h.

inch squared per second (in²/s) A unit of kinematic viscosity = 645.16 cSt = about $6.451\ 6 \cdot 10^{-4}$ m^2/s.

inch to the fourth power (in⁴) A unit of second moment of area = $4.162\ 31 \cdot 10^{-7}$ m^4.

inerta (i) A proposed, by the Russian physicist M. F. Malikov, but never used name for the CGS unit *kilohyl*. See *kilohyl*.

inertial mass A term in physics for the mass of a body as determined by the second law of motion from the acceleration of the body when it is subjected to a force that is not due to gravity.

inferno A unit of stellar temperature, suggested in 1968[435] by Russian-born American theoretical physicist George Gamow (1904–1968), = 10^9 K.[436]

in Hg An abbreviation for inch of mercury.

in H_2O An abbreviation for inch of water.

inhour (ih or **inhr)** [acronym for "inverse hours"] A dimensionless quantity used mainly in the U.S. in nuclear engineering to describe the "reactivity" of a nuclear reactor. The ratio *R* between the number of neutrons created and the number consumed in each cycle of fission must be very close to 1 in order for the reaction to be controlled. The reactivity is the difference

[431] [HAIN, p. 10].

[432] "For example, an extra lb of wool in a stone of wool" [ZUPK5, p. 199].

[433] [IHLS, p. 415].

[434] [REDM, p. 108] and [ITC, p. 33].

[435] [GAMO].

[436] See also: [FRIE, p. 170].

$k = R - 1$ between this ratio and 1. One inhour is the reactivity which will cause the number of neutrons to increase by a factor of e = 2.718 28 in one hour; hence, a reactivity of *t* inhours will cause the number of neutrons to increase by a factor of *e* in 1/*t* h.[437] The exact size of the unit varies according to the design of the reactor. Enrico Fermi (1901–1954), the Italian–American physicist who built the first nuclear reactor, is usually considered to have introduced this unit in 1947.[438] See also *dollar*, *milli-k*, *nile*, and *ppc*.

INM or **I.N.M.** A rarely used abbreviation for international nautical mile.

INMETRO An abbreviation for Instituto Nacional de Metrologia, Normalizaçao e Qualidade Industrial.

INMS An abbreviation for Institute for National Measurement Standards.

INRIM An abbreviation for Istituto Nazionale di Ricerca Metrologica.

Institute for National Measurement Standards (INMS) The name of the National Institute for Standards and Metrology in Canada.

Istituto Elettrotecnico Nazionale Galileo Ferraris (IEN Galileo Ferraris) The name of the National Institute for Electrotechnical Standards in Italy.

integral absorbed dose (iad) See *gram rad*.

international ampere or **silver ampere** (A_{int}) An obsolete unit of electric current in the international system of electrical and magnetical units, 1893–1948, defined as that unvarying current that would deposit 0.001 118 000 g of silver per second from a solution of silver nitrate in water. The amount of silver was chosen to make the international ampere equal to the absolute practical ampere. It was adopted at a meeting of the British Association for the Advancement of Science at Edinburgh in 1892, and became the legal definition of the ampere in the U.S. by Public Bill 105, which passed in July 1894. 1 international ampere = about 0.999 85 A.

[437] See also: [GLAS, pp. 247–248].

[438] According to Sizes.com, Lothar Wolfgang Nordheim (1899–1985) published a paper, in late 1946, that contains an inhour formula. See [NORD, Eq. 3].

international biological standards, **international units (I.U.** or **IU)**, or **units of activity** Standards and reference reagents, established to provide a means of ensuring uniformity throughout the world in the designation of the potency, activity, or specificity of preparations that are used in the prophylaxis, therapy, or diagnosis of human and some animal diseases, and that cannot be expressed directly in terms of chemical and physical quantities. The quantities are expressed as international units (IU).

International Bitterness Units (IBU or **BU)** or **International Bittering Units** An international system of units used by brewers in estimating the bitterness of beer and ale, based on the quantity and quality of hops used. IBU = H (A + (B/9))/0.3, in which H = the concentration of hops in g/L, A = the concentration of alpha acids (humulone, cohumulone and adhumulone) in the hops, expressed as a percentage, and B = the concentration of beta acids (β-myrcene, β-caryophyllene, and -farnesene) in the hops, expressed as a percentage. 9 represents the flavoring power of alpha acids is about nine times greater than that of beta acids and 0.3 represents an approximate 30% rate of efficiency in hop extraction caused by vaporization or precipitation.[439] Measurements from 0 to about 70 IBU are possible, but most beers measure between 10 and 30 IBU.

international candle (IC) An obsolete unit of luminous intensity first defined in 1909 at a meeting of representatives of the Laboratoire Central de l'Electricité in France, the National Physical Laboratory in Britain, the Bureau of Standards in the U.S. and the Physicalishe Technische Reichanstalt in Germany. The Germans decided to let 1 international candle equal $\frac{9}{10}$th of the output of a Hefner lamp, while the other nations established a standard using an electric lamp with a carbon filament. In 1921, the Commision Internationale de l'Eclairage redefined the international candle in terms of a carbon filament incandescent lamp. In 1937, the international candle was redefined by saying the

[439] [RABI, p. 43].

luminous intensity of a blackbody at the freezing point of liquid platinum would be 58.9 international candles/cm^2. In 1946, the CIPM replaced the international candle with the new candle (cd). 1 IC = about 1.02 cd.

International Commission on Radiological Units (ICRU) An organization established in 1925 by the International Congress of Radiology. Its principal objectives are "… the development of internationally acceptable recommendations regarding (1) quantities and units of radiation and radioactivity; (2) procedures suitable for the measurement and application of these quantities in diagnostic radiology, radiation therapy, radiation biology, and industrial operations; and (3) physical data needed in the application of these procedures, the use of which tends to assure uniformity in reporting."[440]

International Committee for Weights and Measures (CIPM) A committee consisting of eighteen scientists elected at the previous CGPM, each from a different nation that is signatory to the Metre Convention. The committee receives reports, recommends modifycations to the SI to the CGPM, and can pass resolutions clarifying aspects of the SI without the approval of the CGPM. It also oversees the International Bureau of Weights and Measures.

international coulomb (C_{int}) An obsolete unit of electric charge = the quantity of electricity passing any section of an electric circuit in 1 s when the current is 1 international ampere = about 0.999 835 C.

international farad (F_{int}) An obsolete unit of capacitance = the capacitance of a capacitor when a charge of 1 international volt is between the terminals = about 0.999 52 F.[441]

international flux unit See *jansky*.

international foot A current foot unit of the English-speaking countries = exactly 30.48 cm.

international henry (H_{int}) An obsolete[442] unit of inductance and permeance = the inductance that produces an electromotive force of 1 international ampere per second = about 1.000 495 absolute henry[443] or about 1.000 18 H[444]. See also *quadrant*.

international insulin unit A unit of pure crystalline product of insulin = 1/22 mg = 0.045 mg, now adopted as the standard.[445]

international joule (J_{int}) An obsolete unit of work, energy and heat = the energy required to transfer 1 international coulomb between two points having a potential difference of 1 international volt = about 1.000 18 J.[446]

International Measurement Confederation (IMEKO) A non-governmental federation, founded in 1958, of 35 member organizations individually concerned with the advancement of measurement technology. The seat of the IMEKO Secretariat is in Budapest, Hungary.

international nautical mile (INM or **I.N.M.)** A nautical mile as currently defined by the International Hydrographic Conference in 1929 as = exactly 1852 m. This long name is sometimes used to distinguish the current nautical mile from older units.[447]

international practical temperature scale (I.P.T.S. or **ITS)** The name of a thermodynamical temperature scale. In 1954, the 10th CGPM changed the thermodynamic basis of the temperature scale. Instead of the scale being based upon two fixed points, the freezing and boiling points of water, it became based upon just one fundamental fixed point, the triple point of water, which was given the value of 273.16 K.

international prototype for the kilogram A prototype, made from an alloy of platinum and iridium, of 39 mm height and diameter, that has

440 www.icru.org

441 [GRAF, p. 389].

442 The unit was named henry during the late nineteenth century. See: [BARK] and [HOUS, p. 268]. The international henry was, according to [JIEE], replaced in 1948 by the absolute henry.

443 [MELA, p. 145].

444 [HAWK, p. 222] and [GRAF, p. 389].

445 www.enacademic.com

446 [GRAF, p. 389].

447 Bureau des Longitudes. *Annuaire pour l'an 1966*.

been used since 1889[448] by the SI as precisely the mass of the standard mass. It is kept at the Bureau International des Poids et Mesures, near Paris.

international siemens (S_{int}) An obsolete unit of conductance = 0.999 51 S.

International System of Electrical and Magnetic Units A practical system of electrical units defined by the International Electrical Congress at Chicago in 1893. The units, on which the International System was based, were those of the CGS electromagnetic system. Since 1884, the ohm was defined as the resistance of a column of mercury with a cross-sectional area of 1 cm^2 and a length of 106.0 cm = about 1,000,000,000 CGS units of resistance. The 1893 Congress defined the international ohm as exactly 1,000,000,000 units of resistance of the CGS electromagnetic system and stated that it could be represented for practical purposes by a column of mercury 106.3 cm long. This change in the ohm was enough to alter the values of all the other electric units; hence the need for a new name for the system. The International System was later modified by the London Electrical Conference in 1908, and discarded by the CGPM in 1948.

international table calorie (cal_{IT}) See *calorie (international-).*

international table kilocalorie ($kcal_{IT}$) See *calorie (international-).*

international tesla (T_{int}) An obsolete unit of magnetic flux density = 1.000 34 T.

international unit (IU) Various units of biological potency used in pharmacology to measure the mass of certain substances based on their expected effects. For each substance to which this unit applies, there is an international agreement specifying the biological effect expected with a dose of 1 IU.

international watt (W_{int}) An obsolete unit of electrical power = 1.000 17 W.

international weber (Wb_{int}) An obsolete unit of magnetic flux = 1.000 34 Wb.

[448] It was, at the time, replacing a prototype, made of platinum by the French chemist Louis Lefévre-Gineau (1751–1829) in 1799.

intrinsic viscosity or **Staudinger index** A number or index defined as the limiting value of the reduced viscosity ($\eta i/c$) or the inherent viscosity (ηinh) at infinite dilution of the polymer, i.e.,

$$[\eta] = \lim_{c\to 0} (\eta i/c) = \lim_{c\to 0} \eta \text{inh}$$

cm^3/g is recommended as a unit by the IUPAC.

inverse femtobarn (fb^{-1}) A unit for estimating the number of particle collision events per femtobarn of target cross-section over a period of time, by detecting the luminosity of the collisions measured over this time. Thus, if a detector has accumulated 80 fb^{-1} of integrated luminosity, one expects to find 80 events per femtobarn of cross-section within this data.

iodine number, **iodine adsorption number**, or **iodine value** A name in biochemistry for the mass of iodine in grams that is absorbed by 100 g of a chemical substance.

ionic strength (μ or I) A measure of the intensity of the electrical field existing in a solution. The ionic strength[449] is defined as half of the total sum of the molality (m_i) of every ionic species (i) in the solution times the square of its valence (z_i): $\mu = ½\,\Sigma(m_i z_i^2)$.

ipm An abbreviation for inches per minute.

ipr An abbreviation for inches per revolution.

ips An abbreviation for inches per second.

ips An abbreviation for instructions per second.

I.P.T.S. An abbreviation for international practical temperature scale.

ipy An abbreviation for inches per year (in/yr), a traditional unit for corrosion rates.

IR An abbreviation for infrared.

iron In Britain, during the eighteenth–twenty-first centuries, a unit measuring the thickness of leather used in making shoes, especially the soles of the shoes. One iron is = 1/40 line = 1/48 in = 0.529 17 mm. Rubber solings are

[449] Term introduced in 1921. See [LEWI].

standardized in increments of 3, 6, 9, 12, 15, 18, 21 and 24 irons.[450]

I.S.C.C. An abbreviation for Inter-Society Color Council.

ISHM An abbreviation for International Society for Historical Metrology.

ISO An abbreviation for International Organization for Standardization.

I_T or **IT** A French abbreviation for *Intensité Totale* = total current.

IT calorie A common name for the international steam table calorie. See *calorie (international)*.

I.T.S. An abbreviation for international temperature scale.

IU, **I.U.**, or **i.u.** An abbreviation for International Unit. See *UI*.

IUAP An abbreviation for International Union of Pure and Applied Physics.

IVM An abbreviation for International Vocabulary of Metrology. Same as *VIM*.

10 J

J An SI and metric abbreviation for joule.

J An abbreviation for jour.

j A terminal symbol following the one, two or even three i symbol, e.g., iij for the value 3.

jack A mug or pitcher made of leather and waterproofed with wax or tar, used in colonial America, of no certain volume.[451]

Jackson Turbidity Unit (JTU or **jtu)** A unit formerly used in measuring water quality. The turbidity of water was measured by lighting a candle under a tall glass tube and filling the tube with the water sample until an observer looking down the tube could no longer see the candle flame through the water. The height of the water column determines the turbidity in Jackson turbidity units, using a table constructed for this purpose. A depth of 21.5 cm corresponds to 100 JTU.[452] See also *formazin turbidity unit* (FTU), *Keiselgur turbidity unit* (KTU) and *nephalometric unit* (NTU).

jacobi's unit A name for a copper wire weighing 345 grains (about 22.4 g) that is 25 pieds (about 8.12 m).[453]

jacobi's unit of current A premetric unit of electric current used in investigations of electricity. It is, in concept, = that electric current which in one minute yields a cubic centimetre of Knallgas (German word for "explosion gas", but actually an apt name for a 1:2 mixture of oxygen and hydrogen) measured at a temperature of 0°C and a pressure of 760 mm Hg = about 0.096 57 A.[454] The unit is named after the Prussian engineer and physicist Moritz Hermann (Boris Semyonovich) von Jacobi (1801–1874). See also *jacobin's unit of resistance*.

jacobi's unit of resistance A premetric unit of electric current used in investigations of electricity. It is, in concept, = the resistance of 1 m of wire with a circular cross-section, 1 mm in diameter, and made of a particular copper alloy. According to the British Professor Fleeming Jenkin (1833–1885), it was about 0.636 7 of a B.A. ohm.[455] The unit was named after the Prussian engineer and physicist Moritz Hermann (Boris Semyonovich) von Jacobi (1801–1874), who was known for his supposed discovery, in 1837, of galvanoplastics, but his reputation faded when his ideas were later shown to be mistaken. Jacobi sent lengths of wire representing this unit to numerous prominent scientists in 1848.

jalon A form of an old North French word mentioned as the etymological source of the English word gallon.[456]

jansky (Jy) [the same in plural], **flux unit (fu** or **f.u.)**, or **international flux unit (IFU)** A unit used in radio astronomy to measure the flux density of radio signals from space. One jansky

[450] [CLAR2, p. 10].

[451] [LEDE, p. 123].

[452] [WHO, p. 307].

[453] [SCHO2, p. 102].

[454] [GANO, p. 797].

[455] [BAAS, p. 192].

[456] [WEB13].

equals a flux of 10^{-26} W/(m^2Hz). The unit was proposed in 1951.[457] It was adopted as the jansky by the International Astronomical Union in August 1973. The unit is named after the American electrical engineer Karl G. Jansky (1905–1950), who, in December 1930, detected and identified electromagnetic radiation of wavelength 15 reaching the surface of the Earth from the Milky Way.[458]

jar An obsolete unit of electric capacitance in the British Admiralty, approximately = the capacitance of one of the Leiden or Leyden jars[459] used in electrical experiments during the eighteenth century.[460] Benjamin Franklin (1706–1790) is said to have measured the storage power of his electrical equipment in jars. There are $9 \cdot 10^8$ jars in a farad, so 1 jar = 10^3 statferads = about 1.112 65 nF.[461]

jerk A unit of change in acceleration sometimes used by engineers. One jerk is = a change in acceleration of 1 ft/s^3 = 0.304 8 m/s^3 = about 0.914 4 kille = about 0.031 08 g/s.[462] See also *kille*.

jillion See *zillion*.

jimmyjohn Southeastern U.S. slang for a demijohn jug of any size. See *demijohn*.

J/K An abbreviation for joule per kelvin.

J/(kg · K) An abbreviation for joule per kilogram-kelvin.

Jones A unit of detectivity, that is, the ability of an electronic device to detect radiant energy such as light waves or infrared radiation. In a 1959 paper.[463] the American physicist Robert Clark Jones (1916–2004) defined the "specific detectivity" of a device to be $D^* = (Aw)^{1/2}/N$, in which A is the area of the detector, w is the frequency bandwidth, and N is the power of the noise generated by the device. The quantity D^* (called the Jones) is measured in the complex unit cm·$\mathrm{Hz}^{1/2}$/W, and is a normalized detectivity.

Josephson constant ($K_{j\text{-}90}$) A number based on the Josephson effect[464] = 483 597.852 5 (30) GHz/V[465]. The CIPM recommended in October 1988[466] that, from January 1, 1990, the practice of using the Josephson constant as a practical standard of electrical potential difference should be adopted throughout the world in National Standards Laboratories. The number was named after the British physicist Professor Brian David Josephson (b. 1940), whose discovery of the Josephson effect as a 22-year-old graduate student won him the 1973 Nobel Prize for Physics, which he shared with Leo Esaki (b. 1925) and Ivar Giaever (b. 1929).

joule (J) An MKSA and SI unit of work, energy, heat, enthalpy, exchange integral, level width, work function, exergy, and anergy. One joule is defined as being the work done by a force of one newton acting to move an object across a distance of 1 m in the direction in which the force is applied. Equivalently, since kinetic energy is one half the mass times the square of the velocity, one joule is the kinetic energy of a mass of 2 kg moving at a velocity of 1 m/s = 10^7 ergs = about 0.737 562 foot-pound = about $9.478\ 170 \cdot 10^{-4}$ Btu = 0.238 846 (small) calories = $2.777\ 778 \cdot 10^{-4}$ Wh. The joule was proposed by the British Association in 1888,[467] and adopted in 1889 by the International Electrical Congress (IEC). When the CGPM first defined SI, in 1960, it included the joule as one of the derived units. The joule is named after the British physicist James Prescott Joule (1818–1889), who demonstrated the equivalence of mechanical and thermal energy in a famous experiment in 1843.

457 [BROW2].

458 See: [JANS].

459 The Leyden jar, built in the mid-1700s at the University of Leyden in Holland, consisted of a narrow-necked glass jar coated inside and out by a thin metal foil. With the outer foil being grounded, the inner could be charged by means of an attached rod and chain from a source of static electricity.

460 In 1937, the Admiralty began using the farad instead. See: [ADMI, p. A2].

461 See also [GRAY], [HARR] and [PHIL].

462 [HVIS, p. 30].

463 [JONE].

464 See: [HARR2] and [CLOT].

465 According to CODATA 2014.

466 [TAYL].

467 *Rep. Brit. Ass.*, 1888, p. 56.

joule per cubic metre (J/m^3) An SI unit of energy density, calorific value on a volume basis, and refrigerating capacity per unit volume, = 10 erg/cm^3 = about 2.683 92 · 10^{-5} Btu/ft^3 = 2.388 46 · 10^{-4} kcal$_{IT}$/m^3.

joule per degree Celsius (J/°C) See *joule per kelvin*.

joule per kelvin (J/K) An SI unit of heat capacity, entropy, Boltzmann constant, Massieu function, and Planck function = 2.388 46 · 10^{-4} kcal$_{IT}$/°C.

joule per kilogram (J/kg) An SI unit of specific energy, specific enthalpy, specific exergy, and specific anergy. It equals 1 Gy = 1 Sv = 10,000 erg/g = about 6.241 46 · 10^{-21} eV/g = about 0.101 972 kp · m/kg = about 4.299 23 · 10^{-4} Btu/lb = about 2.388 46 · 10^{-4} kcal$_{IT}$/kg.

joule per kilogram degree Celsius (J/(kg °C)) See *joule per kilogram kelvin*.

joule per kilogram kelvin (J/(kg K)) An SI unit of specific heat capacity and specific entropy = 10 000 erg/(g °C) = about 2.388 46 · 10^{-4} Btu/(lb °F) = about 2.388 46 · 10^{-4} kcal$_{IT}$/(kg °C).[468]

joule per kilogram second (J/(kg s)) See *watt per kilogram*.

joule per metre (J/m) An SI unit of linear stopping power and linear energy transfer = 10,000 erg/cm = 1 N = about 6.241 46 · 10 ^{18} eV/m.

joule per metre to the fourth power (J/m^4) An SI unit of spectral concentration of radiant energy density (in terms of wavelength) = 1 Pa/m.

joule per mole (J/mol) An SI unit of molar internal energy and chemical potential.

joule per mole degree Celsius (J/(mol °C)) See *joule per mole kelvin*.

joule per mole kelvin (J/(mol·K)) An SI unit of specific heat capacity, molar gas constant and molar entropy.

joule per pound degree Celsius (J/(lb °C)) See *joule per pound kelvin*.

[468] [TAYL2, p. 61].

joule per pound kelvin (J/(lb·K)) An SI unit of specific heat capacity and molar entropy = 2.204 62 J/(kg·K).

joule per second (J/s) See *watt*.

joule per square metre (J/m^2) An SI unit of energy fluence and radian exposure = 1 N/m = about 6.241 46 · 10^{18} eV/m^2.

joule per square metre second (J/(m^2 · s)) See *watt per square metre*.

joule per square metre second kelvin (J/(m^2 · s · K)) See *watt per square metre kelvin*.

joule per tesla (J/T) See *ampere square metre*.

joule reciprocal hertz (J/Hz) See *joule second*.

joule reciprocal tesla (J/T) See *ampere square metre*.

joule second (J · s) An SI unit of Planck constant and action = 10^7 erg · s.

joule square metre (J · m^2) An SI unit of atomic stopping power = 10^{11} erg · cm^2.

joule square metre (J · m^2/kg) An SI unit of weight stopping power = 10^8 erg · cm^2/g.

JTU An abbreviation for Jackson Turbidity Unit.

julillion See *zillion*.

Jupiter A unit of weight, now being used in astronomy to express the masses of new planets being discovered in orbit around various stars. It is = the mass of the planet Jupiter, estimated to be about 1.899 · 10^{27} kg = about 0.000 955 Sun.

11 K

K An abbreviation for kayser.

K An informal abbreviation for thousand, used in expressions in which the base unit is understood, such as “10K run” (10 km) or “900K disk” (900 kilobytes or kibibytes).

K An abbreviation for kelvin.

K Until 1960, an abbreviation for metric prefix kilo-.

°K An abbreviation for degree Kelvin. The term degree and the prefix symbol for degree were abolished in 1968. See *kelvin*.

k An abbreviation for the prefix kilo-, e.g., kg = kilogram. See also *K*.

k An occasionally used abbreviation for kΩ. A deprecated practice.

K factor A name given to the γ-ray dose rate in roentgens per hour at a distance of one centimetre from a one milliecurie point source of radiation. Each γ emitter has its own K factor.[469]

K_B An abbreviation for Boltzmann constant.

kabillion, **kajillion** See *zillion*.

kal An obsolete unit of power, used in the U.S. during the late nineteenth century, defined as one pound of water at 100° F evaporated into steam of 70 pounds per square inch = about 1110.2 Btu. 30 kals per hour = 1 commercial boiler horsepower.[470]

kammarton or **normalton** A name in Sweden for the A note above middle C. In 1939, at an international conference, it was recommended as being 440 Hz.[471] This standard was taken up by the International Organization for Standardization in 1955, and reaffirmed in 1975 as ISO 16. It serves as the audio frequency reference for the calibration of pianos, violins, and other musical instruments.

kanne A name proposed for the *litre*.

Kaplan-Lipmann unit See *Lipmann unit*.

kapp, **Kapp line**, or **kappline** An obsolete measure of magnetic induction and flux. Each line represents a flux of 6000 CGS lines of magnetic force = 6000 Mx. If defined in a 3D-system, it corresponds in the 4D electromagnetic sector of SI to 6μWb. The unit is named after the British scientist Gisbert Kapp (1852–1922).[472]

Kaprekar's constant The name of a number showing up when using the Kaprekar process, a mathematical phenomenon discovered by Indian mathematician, Shri Dattathreya Ramachandra Kaprekar (1905–1986) in 1949 and published in 1955. He states: *"Start with a four-digit number whose digits are not all equal, arrange the digits in ascending and descending order, subtract and repeat the process. Then the process terminates on the number 6174 after seven or fewer steps."*[473]

Kaprekar number The name of an integer which, when multiplied by itself, yields a number whose decimal representation, when cut "in half down the middle," yields two integers whose sum is the original number. Let X be a non-negative integer, then X is a Kaprekar number for base b if there exist non-negative integers n, A and B satisfying the following three conditions:

$0 < B < b^n$

$X^2 = Ab^n + B$

$X = A + B$.

So, an integer is n-Kaprekar if, when we split its square just left of its rightmost n digits and add the "halves," we obtain the original integer. Thus. 4879 is 5-Kaprekar since 4879^2 is 23,804,641 and 238 + 04641 = 4,879. The set of n-Kaprekar integers is in one-to-one correspondence with the set of unitary divisors of $10^n - 1$. The Kaprekar numbers are named after the Indian mathematician Shri Dattathreya Ramachandra Kaprekar (1905–1986).[474]

Karmen unit The name for "the amount of transaminase that under specified conditions will cause a change of 0.001 in the absorbance of NADH when measured at 340 nm in a 1 cm light path." [475]

katal (kat) [pronounced "cattle"] A derived SI unit of catalytic activity, used especially in the chemistry of enzymes.[476] A catalyst has an activity of one katal if it enables a reaction to proceed at the rate of 1 mole/s.[477] The International Union of Biochemistry adopted a unit in 1964 which was generally nameless (though sometimes called an "international unit") but had the

469 [RADI, p. 19].

470 [TRAN2, p. 84].

471 Also known as *concert pitch*.

472 [KAPP].

473 A sample: Let's start with an arbitrarily chosen number, 2981. Sorting the digits in both ascending and descending order yields 1289 and 9821. 9821 − 1289 = 8532. Sorting the digits again yields 2358 and 8532. 8532 – 2358 = 6174, as predicted.

474 [KAPR], [CHAR], [WELL, p. 151], and [IANN]

475 www.enacademic.com

476 See also: [METR].

477 [IUB3].

symbol "U." Before 1969, the International Union of Pure and Applied Chemistry and the International Federation for Clinical Chemistry recommended adoption of a unit to be called the catal, = the catalytic amount of a system which catalyses as many cycles per second of a stated reaction scheme as there are atoms in 0.012 kg of the pure nuclide ^{12}C.[478] When the katal was first proposed,[479] it was conceived as a unit of rate of reaction, but the 1978 Recommendation distinguishes between catalytic activity and rate of reaction. The katal was officially added to the SI by Resolution 12 of the twenty-first CGPM in October 1999, on the recommendation of the International Federation of Clinical Chemistry and Laboratory Medicine.

kaya [= "piece"] The name for one piece of something in Brunei, Malaysia, and Singapore.

kayser (K or **Ky)** or **rydberg** The CGS unit used to measure light and other electromagnetic waves. The "wave number" in kaysers equals the number of wavelengths per centimetre. The energy represented by one kayser is 123.984 244 · 10^{-6} eV. The unit, approved in 1952,[480] honors German physicist Heinrich Gustav Johannes von Kayser (1853–1940), who compiled the *Handbuch der Spectroscopie*.[481] The unit is often abbreviated as K, although this conflicts with the abbreviation for the kelvin. See also *rydberg*.

kazillion See *zillion*.

kB An abbreviation for kilobyte.

kBd An abbreviation for kilobaud.

kbps An abbreviation for kilobits per second.

kB/s An abbreviation for kilobytes per second.

kc An abbreviation for kilocycle (per second). See *kilohertz*.

kcal An abbreviation for kilocalorie.

kcal$_{15}$ An abbreviation for kilocalorie 15 ºC.

kcal$_{IT}$ An abbreviation for kilocalorie I.T.

[478] [DYBK, p. 28].

[479] [IUPAC].

[480] [MEGG1] and [MEGG2].

[481] Band 1: 1900, Band 2: 1902, Band 3: 1905, Band 4: 1908, Band 5: 1910, Band 6: 1912, Band 7.1: 1927, Band 7.2: 1934, Band 8.1: 1932.

kcal$_{th}$ An abbreviation for thermochemical kilocalorie.

kc/s An abbreviation for kilocycles per second.

Keiselgur Turbidity Unit (KTU) A unit formerly used in measuring water quality, defined as the turbidity of water when 1 mg of silica is mixed in 1 L of distilled water. The unit is equal to the Jackson turbidity unit, which equals 6.9 times an FTU unit.[482] See also *Mastic turbidity unit* (MTU).

kelvin (K) or **thermodynamic temperature scale** The SI unit of thermodynamic temperature, temperature differences and other temperatures, previously called the degree Kelvin. The unit was established by the ninth CGPM in 1948 as "the degree absolute" and with the symbol ºK. The 11th CGPM in 1960 changed the name to "degree Kelvin." In 1967/1968, the thirteenth CGPM defined the temperature of the triple point of water to be exactly 273.16 K, and decided to change the name of the unit to kelvin and the symbol to K, but allowed the older usage to continue for the time being.[483] Since this temperature is also = 0.01°C, the temperature in kelvins is always = 273.15 plus the temperature in degrees Celsius. In 1980, the CIPM stated that it would no longer permit use of "degree Kelvin." One kelvin represents the same temperature difference as one degree Celsius and the kelvin equals exactly 1.8 ºF.

For temperatures:

x K = (x − 273.15) ºC = (1.8x − 459.67) ºF = 1.8x ºR.

For temperature intervals:

1 K = 1 ºC = 1.8 ºF or ºR.

The unit is named after the English mathematician and physicist William Thomson (1824–1907), later Baron Kelvin. His work in thermodynamics coordinating the various existing theories of heat established the law of the conservation of energy as proposed by the English physicist James Prescott Joule (1818–1889).

[482] [WHO, p. 307].

[483] [METR2].

kelvin A name sometimes used for the kilowatt hour.

kelvin per metre (K/m) The SI derived unit of temperature gradient.

kelvin per pascal (K/Pa) The SI derived unit of Joule-Thomson coefficient.

kelvin per watt (K/W) The SI derived unit of thermal resistance.

kemple In international coffee trading, a unit of weight = 199.6 kg.[484]

kerma [name derived from: kinetic energy released in material] The unit of exposure that represents the kinetic energy transferred to charged particles per unit mass of an irradiated medium when indirectly ionizing uncharged particles, such as photons or neutrons, traverse the medium. If all of the kinetic energy is absorbed "locally," the kerma is = the absorbed dose. The kerma may be expressed in J/kg, erg/g, or in gray, and, unless otherwise specified, refers to the energy liberated per unit mass in a small sample of tissue. The quantity must always be defined with respect to the specific material in which the interactions are taking place (e.g., air kerma, water kerma, etc). The term *free-in-air kerma* refers to the amount of radiation at a location before adjustment for any external shielding from structures or terrain. It was authorized by the ICRU in 1962.[485]

keV An abbreviation for kilo electron volt.

key Slang for kilo, meaning kilogram.[486]

Kft A misspelled symbol for kilofoot.

kft An abbreviation for kilofoot.

KG An occasionally used, in the context of upper-case-only printing, improper abbreviation for kilogram.

kg A pre-SI metric abbreviation for kilogram.

kg An abbreviation for kilogram.

kg* An abbreviation for kilogram-weight.

Kg-f, kg-f, or kgf An abbreviation for kilogram-force.

kg/m An abbreviation for kilogram per metre.

kg/m² An abbreviation for kilogram per square metre.

kg/m³ An abbreviation for kilogram per cubic metre.

kgph An abbreviation for kilogram per hour.

kgpm An abbreviation for kilogram per minute.

kgps An abbreviation for kilogram per second.

kHz An abbreviation for kilohertz.

kibi- (Ki-) A binary prefix meaning 2^{10} = 1024. This prefix, adopted by the International Electrotechnical Commission (IEC) in 1998, replaces kilo- for binary applications in computer science. Thus, 1024 bytes of storage is officially a kibibyte, not a kilobyte. The prefix is a contraction of "kilobinary."

kibibit See *kilobit*.

kibibyte See *kilobyte*.

Kienbock's unit (X), **Kienböck unit**, or **x-ray unit** An obsolete unit of x-ray exposure = 0.1 erythema dose.[487] The unit was named after the Austrian roentgenologist Robert Kienbock (1871–1953).

kil- A contracted form of the metric prefix kilo-, as in kilohm = 1 kΩ.

kilare (ka or **Ka** (pre-SI)) A contracted form of kilo + are = 10 ha.

kilerg A contracted form of kilo + erg = 1000 erg.

kiliare A rare contracted form of kilo + are. See *kilare*.

kille A unit of change in acceleration, proposed in late 2008 by the Swedish engineer Jan Gyllenbok (b. 1963), = 1/3 m/s^3= about 1.093 613 jerks.[488] See also *jerk*.

kilo An informal and undesirable abbreviation for a kilogram.

kilo- (k-) The SI and metric multiplier prefix meaning 1000. The prefix is a modification of *chilioi*, the Greek word for a thousand.

kilo- (k-) When measuring the memory of a computer, the prefix kilo- often means 2^{10} = 1024 instead of 1000. By a 1998 resolution

[484] [WINT, p. 886].

[485] See also: [SOLO].

[486] Often used for marijuana.

[487] www.enacademic.com

[488] http://metrobloggen.se/metrology/

of the International Electrotechnical Commission, the new prefix kibi- (Ki-) should replace kilo- for 2^{10}.

kiloampere (kA) The SI unit of electric current = 1000 A.

kilobar (kbar or **kb)** A metric unit of pressure, used particularly in industrial applications and in geology for measuring high pressures. The kilobar = 1000 bars = 100 MPa.

kilobase (kb) A unit of genetic information = the information carried by 1000 pairs of the base units in the double-helix of DNA; also used as a unit of relative distance = the length of a strand of DNA containing 1000 base pairs.

kilobecquerel (kBq) The SI unit of radioactivity = 1000 atomic disintegrations per second = about 27.027 nCi.

kilobit (kbit or **kb)** or **kibibit** A unit of information = 1024 bits = 128 bytes, now mandated to be called a *kibibit*.

kilobyte (kB) or **kibibyte** A unit of information = 1000 bytes. As a unit of computer storage, the kilobyte is usually = 1024 bytes, although this should now be called a *kibibyte*.

kilocalorie (kcal) or **kilocalorie (I.T.) ($kcal_{IT}$)** An ambiguous metric unit of energy and heat. There are two "calories" in common use: calorie, the small calorie, or gram calorie = 4.186 8 kJ, and Calorie, the large calorie, or kilogram calorie = 4.186 8 MJ. The term kilocalorie is often used for 1000 calories, which is the same as one Calorie (large calorie).

kilocalorie metre per square metre hour degree Celsius ($kcal_{IT} \cdot m/(m^2 \cdot h \cdot {}^{o}C)$) See *kilocalorie metre per square metre hour kelvin*.

kilocalorie metre per square metre hour kelvin ($kcal_{IT} \cdot m/(m^2 \cdot h \cdot K)$) A unit of thermal conductivity = 1.163 W/(m· K).

kilocalorie per cubic metre ($kcal_{IT}/m^3$) A unit of calorific value (volume basis) = 4186.8 J/m^3 = about 0.112 37 Btu/ft^3.

kilocalorie per cubic metre hour ($kcal_{IT}/(m^3 \cdot h)$) A unit of heat release rate = 1.163 W/m^3 = about 0.112 37 Btu/(ft^3 · h).

kilocalorie per hour ($kcal_{IT}/h$) A unit of heat flow rate = 1.163 W = about 3.968 32 Btu/h.

kilocalorie per degree Celsius ($kcal_{IT}/{}^{o}C$) See *kilocalorie per kelvin*.

kilocalorie per kelvin ($kcal_{IT}/K$) A unit of heat capacity = 4186.8 J/K.

kilocalorie per kilogram ($kcal_{IT}/kg$) A unit of specific internal energy and calorific value (mass basis) = 4186.8 J/kg = 1.8 Btu/lb.

kilocalorie per kilogram degree Celsius ($kcal_{IT}/(kg \cdot {}^{o}C)$) See *kilocalorie per kilogram kelvin*.

kilocalorie per kilogram kelvin ($kcal_{IT}/(kg \cdot K)$) A unit of specific heat capacity = 1 Btu/(lb · ºF) = 1 Btu/(lb · ºR) = about 4186.8 J/kg.

kilocalorie per metre hour degree Celsius ($kcal_{IT}/(m \cdot h \cdot {}^{o}C)$) See *kilocalorie per metre hour kelvin*.

kilocalorie per metre hour kelvin ($kcal_{IT}/(m \cdot h \cdot K)$) A unit of thermal conductivity = 1.163 W/(m · K).

kilocalorie per square metre hour ($kcal_{IT}/(m^2 \cdot h)$) A unit of density or heat flow rate = 1.163 W/m^2.

kilocalorie per square metre hour degree Celsius ($kcal_{IT}/(m^2 \cdot h \cdot {}^{o}C)$) See *kilocalorie per square metre hour kelvin*.

kilocalorie per square metre hour kelvin ($kcal_{IT}/(m^2 \cdot h \cdot K)$) A unit of coefficient of heat transfer = 1.163 W/(m^2 · K).

kilocurie (kCi) A unit of radioactivity = 1000 curies = 37 TBq, that is, 37 trillion atomic disintegrations per second. The strength of the powerful radiation sources used in cancer therapy are customarily stated in kilocuries.

kilocycle (kc) A term sometimes used as an informal name for the kilohertz = 1000 cycles.

kilofoot (kft or the misspelled **Kft)**[489] In the United States, during the late twentieth–early twenty-first centuries, a unit of length used in telecommunications to describe telephone line lengths, and in aeronautics and meteorology to describe altitudes. It is = 1000 feet = 304.8 m.

kilofors (kf) A unit suggested in 1957[490] by the SUN Commission as a renaming of the *kilogram-force*.

[489] By SI usage rules, the "k" for kilo- should not be capitalized.

[490] [SUNC] and [PHYS].

kilogauss (kGs) The metric unit of magnetic flux density = 1000 gauss = 0.1 tesla. The strength of industrial magnets and solenoids is often expressed in kilogauss, although this unit is being gradually replaced by the *tesla*.

kilogram (kg) The base SI and MKS unit of weight. At the end of the eighteenth century, a kilogram was the mass of 1 dm^3 of water. In 1889, the first CGPM sanctioned the international prototype of the kilogram, and declared: This prototype shall henceforth be considered to be the unit of weight. Even today, the kilogram is defined as the mass of the standard kilogram, a platinum-iridium bar in the custody of the International Bureau of Weights and Measures (BIPM)[491] at Sèvres, France. 1 kg = about 2.204 622 6 lb = 5000 metric carat. The unit is unique in being the only SI unit still defined by a physical prototype, and the only one that incorporates one of the decimal multiplier prefixes in its name.

kilogram calorie See *calorie*.

kilogram equivalent mass A name used in chemistry for mass of element or radical = its kilogram atomic weight divided by its valency.

kilogram force See *kilogram of force*.

kilogram metre, **kilogram-meter** or **kilogramme-metre (kg-m)** MKS unit of work or energy, equal to the work done by a force of 1 kg when its point of application moves through a distance of 1 m in the direction of the force = about 7.2 foot-pounds.

kilogram metre per second (kg · m/s) The SI unit of momentum = 7.233 01 lb · ft/s.

kilogram metre per second squared (kg · m/s²) See *newton*.

kilogram metre squared (kg · m²) The SI unit of momentum of inertia = 23.73 04 lb · ft^2.

kilogram metre squared per second (kg · m²/s) The SI unit of momentum of momentum = 23.73 04 lb · ft^2/s.

kilogram-metre per minute An obsolete unit of electrical power = 7.236 71 ft-lb/min = 0.163 528 W.

kilogram mole, **kilogram molecule**, and **kilogram molecular weight (kgmol** or **kgmole)** Various obsolete names for a unit of the amount of a chemical compound. One kilogram mole of a compound = the molecular weight of a molecule of that compound measured in atomic mass units. The correct name for this unit is the *kilomole* (kmol).

kilogram molecular weight See *kilogram mole*.

kilogram molecule See *kilogram mole*.

kilogram of force or **kilogram force (kgf)** A unit of force, rather frequently used in engineering and physics, = the gravitational force on a mass of one kilogram. One kilogram of force equals exactly 9.806 65 N = 2.204 622 6 pounds of force.

kilogram per cubic centimetre (kg/cm³) The SI unit of weight density = 10^6 kg/m^3.

kilogram per cubic decimetre (kg/dm³) The SI unit of weight density = 10^3 kg/m^3.

kilogram per cubic metre (kg/m³) The SI unit of weight density and mass concentration = about 0.062 428 lb/ft^3.

kilogram per cubic metre pascal (kg/(m³ · Pa)) The SI unit of unitary mass density.

kilogram per hectare (kg/ha) A metric unit of surface density.

kilogram per hour (kg/h) The SI unit of weight flow rate = 2.204 62 lb/h.

kilogram per kilogram (kg/kg) The SI unit of weight fraction. Kilogram per kilogram may be represented by the number 1.

kilogram per litre (kg/l or kg/L) An obsolete SI unit of weight density. See *kilogram per cubic decimetre*.

kilogram per metre (kg/m) The SI unit of linear density, used for wires, etc., = 0.671 969 lb/ft.

kilogram per metre second (kg/(m · s)) See *pascal second*.

kilogram per metre square second (kg/(m · s²)) The SI unit of energy density = 1 J/m^3.

kilogram per mole (kg/mol) The SI unit of molar mass.

kilogram per pascal second metre (kg/(Pa · s · m)) The SI unit of water vapour permeance.

kilogram per pascal second square metre (kg/(Pa · s · m²)) The SI unit of water vapour permeability.

[491] See also [BIPM, p. 95].

kilogram per second (kg/s) The SI unit of weight flow rate = 2.204 62 lb/s.

kilogram per square centimetre (kg/cm^2) An obsolete SI unit of surface density = 10,000 kg/m^2.

kilogram per square centimetre (kg/cm^2) A name and abbreviation often incorrectly used for kilogram-force per square centimetre.

kilogram per square metre (kg/m^2) The SI unit of surface density, used in agriculture and for sheet metal and plating, = 8921.79 lb/acre.

kilogram-calorie (kcal) An obsolete name for kilocalorie.

kilogram-force, kilogram force (kgf), or kilopond The MKS base unit of force = 2.204 62 lbf = 9.806 65 N. The kilogram-force is defined so that the conversion from newton to kilogram-force has the same numerical value as the standard gravitational acceleration of free fall = 9.806 65 m/s^2.[492] In 1934, the Swedish Royal Mint declared the kilogram to be a unit of weight.[493] The word "kilopond" was used internally by the Physikalisch-Technische Reichanstalt, the official German standards laboratory, as early as 1939. In 1945, Sweden adopted the kilopond as its unit of force. In 1955 and 1957, the Technical Committee of the International Standards Organization recommended the adoption of both the kilopond and kilogram-force as synonym units for force. In August 1958, the kilopond was recommended as the unit of force by the Verein Deutscher Ingenieure.[494]

kilogram-force metre (kgf · m) The MKS unit of moment of force, moment of torque, work and energy = 7.233 01 lbf. ft = 9.806 65 J.

kilogram-force metre per kilogram (kgf · m/kg) The MKS unit of specific internal energy and specific latent heat = 9.806 65 J/kg.

kilogram-force metre per kilogram degree Celsius (kgf · m/(kg · °C)) The MKS unit of specific heat capacity = 9.806 65 J/(kg · K).

kilogram-force metre per second (kgf · m/s) The MKS unit of power = 9.806 65 W.

kilogram-force metre second (kgf · m · s) The MKS unit of action = 9.806 65 Js.

kilogram-force metre second squared (kgf · m · s^2) The MKS unit of moment of inertia = 9.806 65 kg · m^2.

kilogram-force per centimetre (kgf/cm) The MKS unit of surface tension = 980.665 N/m.

kilogram-force per cubic metre (kgf/m^3) The MKS unit of specific weight = 9.806 65 N/m^3.

kilogram-force per metre (kgf/m) The MKS unit of surface tension = 9.806 65 N/m.

kilogram-force per metre second degree Celsius (kgf/(m · s · °C)) The MKS unit of coefficient of heat transfer = 9.806 65 W/(m^2 · K).

kilogram-force per second degree Celsius (kgf/(s · °C)) The MKS unit of thermal conductivity = 9.806 65 W/(m · K).

kilogram-force per squared centimetre (kgf/cm^2) The MKS unit of pressure = 1 at = about 0.980 665 bar = about 98 066.5 Pa.

kilogram-force per squared metre (kgf/m^2) The MKS unit of pressure = 9.806 65 Pa.

kilogram-force second (kgf · s) The MKS unit of momentum = 9.806 65 kg · m/s.

kilogram-force second per square metre (kgf · s/m^2) The MKS unit of dynamic viscosity = 9.806 65 Pa · s.

kilogram-force second per square per metre (kgf · s^2/m) The MKS unit of weight = 9.806 65 kg.

kilogram-force second per square per metre to the fourth power (kgf · s^2/m^4) The MKS unit of density = 9.806 65 kg/m^3.

kilogramme An occasionally used, incorrect alternative name for kilogram.

kilogram-mole See *mole*.

kilogram-molecule (M or M»)[495] A unit of quantity of substance = a quantity such that the number of molecules it contains is = Avogadro's constant. The unit is a predecessor of the *mole*.[496]

[492] See also: [OHAN, p. 96].

[493] [BÄCK, p. 227].

[494] [RUPP, p. 238].

[495] [ACSFS, p. 8].

[496] See also: [PHIL2, p. 93] and [SAS].

kilogram-weight (kg* or **kg(wt))** An obsolete name and abbreviation for kilogram-force.

kilohertz (kHz) A common unit of frequency = 1000 per second = 1 per millisecond. AM radio stations have signal frequencies measured in kilohertz.

kilohyl (khyl), **kilohyle**, **metric technical unit of weight (TME)**, **metric slug**, **mug** or **par** The MKFS unit of weight = 9.806 65 kg. The Russian physicist M. F. Malikov proposed that the unit be called *inerta* (i), but that name was never accepted.[497]

kilohyl per cubic metre (khyl/m^3) The MKS unit of density. The name and abbreviation are sometimes used, incorrectly, for kilogram-force second squared per metre to the fourth power.

kilojoule (kJ) A common metric unit of work or energy, comparable to the British thermal unit (Btu). In fact, one kilojoule equals about 0.947 817 Btu. In other energy units, the kilojoule is also equivalent to about 0.238 846 kcal = 0.277 778 Wh = 737.562 ft-lb in the traditional British system.

kiloline A metric unit of magnetic flux = 1000 lines = 10 μWb.

kilomega- (kM-) An obsolete metric prefix denoting 10^9 (1 U.S. billion). This prefix has been replaced by *giga-* (G-).

kilometre (km; pre-SI: **Km)** An SI and metric unit of distance. One kilometre = exactly 1000 m = about 0.621 371 19 mile = 1,093.6133 yd = 3 280.8399 ft. The unit is sometimes pronounced with the accent on the first syllable and sometimes on the second.

kilometre per hour (km/h) An obsolete SI and metric unit of velocity = 5/18 m/s = 0.621 371 19 mile/h = 0.911 344 42 ft/s.

kilomole (kmol) A common unit of amount of a substance.

kilonewton (kN) A common metric unit of force, the kilonewton equals 1.000 N. It is defined as the force that will accelerate a mass of 1 metric ton at the rate of 1 metre per second. One kilonewton equals 101.972 kilograms of force = 224.809 pounds of force = 7233.01 poundals.

kilohm A unit of electric resistance = 1000 Ω.

kilo-oersted (kOe) The CGS unit of magnetic field strength equivalent in MKS units to 79,577.472 ampere-turns per metre. The unit, used for stating the field strengths of industrial magnets, is almost always spelled with the hyphen.

kiloparsec (kpc) A unit of length used in astronomy,[498] the kiloparsec equals 1000 parsecs = 3261.631 light years = 3.085 678 · 10^{16} km.

kilopascal (kPa) A common metric unit of pressure = 1000 Pa = about 0.145 038 lbf/in^2 = 20.8855 pounds per square foot = 7.502 mm Hg = 0.295 3 in Hg = 4.015 in WC = 0.334 6 foot of head (ft hd).

kilopond (kp) Another name, most commonly used in Central Europe and Scandanavia, for the kilogram of force. See *kilogram-force*.

kilorad (krad) A common unit of radiation dose = 1000 rads = 10 grays = 10 joules of energy per kilogram of mass.

kilostere A metric unit of volume = 1000 m^3.

kiloton (kt or **kton)** An ambiguous unit of weight. Ambiguous because it may refer to 1000 U.S. tons (907,185 kg), 1000 British tons (1 016,047 kg), or 1000 metric tons (1 million kg). To avoid this confusion, the metric unit should be written as 'kilotonne.'

kiloton (kton) A unit of explosive energy = the energy released by exploding 1000 U.S. tons of TNT (trinitrotoluene) = about 4 billion Btu = about 4.18 · 10^{12} J.

kilovar [kilovolt + ampere +radioactivity] **(kvar)** A unit of reactance = equal to 1000 volt-amperes reactive.

kilovolt (kV) A common unit of electric potential = 1000 V. Electric distribution lines operate at potentials of anywhere from several to several hundred kilovolts.

[497] [SENA].

[498] The Solar System is located about 8 kpc from the center of the Milky Way galaxy.

kilovolt ampere (kV·A) A common unit of load in power engineering, used in rating transformers and such, = 1000 V A.

kilowatt (kW) An SI and metric unit of power, equivalent to 1000 W = about 1.341 022 horsepower = 737.562 foot-pounds per second.

kilowatt hour (kW·h or kw hr), the Board of Trade unit, or **kelvin** An obsolete SI unit of electric energy defined as the energy contained in a current of 1000 A flowing under an electromotive force of 1 V during 1 h = 1000 W/h = 3.6 MJ of energy = about 3412.141 Btu = 859.846 $kcal_{IT}$. The unit was first specified in the Board of Trade Orders made under the Electricity Act of 1882.[499]

kimple See *kemple*.

kine [Gr: = "move"] A proposed CGS unit of velocity = 1 cm/s = about 118.112 ft/h. The name was suggested by the British Association in 1888.[500]

kinematic viscosity The ratio of dynamic viscosity to density.

King unit or **King-Armstrong unit** The name of the quantity of phosphatase that, acting upon disodium phenylphosphate in excess, at pH 9 for 30 min, liberates 1 mg of phenol.[501] The unit is named after the Canadian physician Arthur Riley Armstrong (b. 1904).

kip An informal unit of weight, sometimes used by engineers and to express the amount of load on a structure, = 1000 lb = 453.59 kg.

kip or **k.i.p.** [<: kilo + imperial + pound] An informal unit of force, used by architects and structural engineers in the U.S. to describe deadweight loads, = 1000 pounds of force = about 4.448 222 kN.[502]

kip per square inch (ksi or **kip/in^2)** A unit of pressure in the U.S. = 6894.757 kPa.

kips An abbreviation for kilo (thousand) instructions per second.

kJ An abbreviation for kilojoule.

KL, **Kl**, **kL**, or **kl** An abbreviation for kilolitre. Prior to SI, usually KL or Kl.

klb [kilo + lb] An abbreviation for kilopound, the typical precision for many specifications in the U.S. (e.g., truck weights).

Klitzing constant or **von Klitzing constant (R_k)** A constant derived from the quantized Hall effect discovered in 1980 by the German physicist Klaus von Klitzing (b. 1943) when he studied the Hall voltage of MOS field effect transistors at low temperatures in high magnetic fields. It is $= h/e^2 = \mu_0 c/2\alpha = 25\ 812.807\ 572\ (95)\ \Omega$, and was recommended by the CIPM in 1988[503] to be used as the international standard of the Hall resistance from January 1, 1990.[504]

kloc [kilo lines of code] In the U.S., during the mid-twentieth century, a unit of computer programming output[505] = 1000 lines of code.

KM An improper abbreviation for kilometre, often used in the context of upper-case-only printing.

Km or **km** An abbreviation for kilometre. The upper-case K is prior to SI.

Km^2 or **km^2** An abbreviation for square kilometre. The upper-case K is prior to SI.

kmc or **KMC** An abbreviation for kilomegacycles (per second) = 1 GHz.

Kn An abbreviation for the Knudsen number.

kN An abbreviation for kilonewton.

KN An informal abbreviation for international knot.

kn An abbreviation for international knot.

knot or **international knot (kn** or **kt)** A unit of velocity used to express speeds at sea = one nautical mile per hour. The word comes from the former method of measuring a ship's speed, which involved use of a knotted cord called the

[499] Electric Lighting Order Confirmation Act (GB), 46 Vict., c. 216 (1883).

[500] *Rep. Brit. Ass.*, 1888, p. 27.

[501] See also [KING2].

[502] According to [JERR], it came to use in the U.S. before 1939, first appearing in a book published in England as late as 1948, in [BUTT, p. 5].

[503] [METR4].

[504] [METR3].

[505] Mentioned on Robert X. (Bob) Cringley's TV-series and video-production *Triumph of the Nerds*, RM Associates and PBS, in 1996.

log line. One knot equals about 1.150 78 mile/h = 1.852 km/h =0.514 3 m/s.[506]

knot or **U.K. knot** In Britain, a premetric unit of velocity for ships and aircraft, in use until 1975. It was equal to 1 U.K. nautical mile per hour = 6 080 ft/h = about 0.514 773 m/s = 1.853 18 km/h = 1.000 64 kn.

knot or **U.S. knot** A unit of velocity, in use until 1954 in the U.S., = 6080.2 ft/h = about 0.514 79 m/s = 1.853 2 km/h.

Knudsen number (K_n **or** N_{Kn}**)** A dimensionless hydrodynamic number used in momentum and mass transfer in general, and very low pressure gas flow calculations in particular, defined as λ/l, in which λ = length of mean free path, and l = characteristic dimension.[507] The number is named after the Danish scientist Martin Hans Christian Knudsen (1878–1943).

kO An abbreviation for kilooctet (French for *kilobyte*).

kolonne [<G: *kolonne* = "column"] An independent German military transportation unit, varying from company to platoon size, transporting equipment or supplies.

konimeter See *conimeter*.

kops An abbreviation for kilo (thousand) operations per second.

Korea Research Institute of Standards and Science (KRISS) The name of the National Institute for Standards and Metrology in Korea.

kp An abbreviation for kilopond.

kPa An abbreviation for kilopascal.

kpc An abbreviation for kiloparsec.

kph An informal abbreviation for kilometres per hour. The correct symbol is km/h.

kramet In December 1884, by the Swedish-American inventor John W. Nystrom (1825-85) proposed name for the kilogram-metre.

Krebs unit (KU) A unit used as a measure of consistency, particulary with reference to paints, coatings and related materials. The unit is named after the British chemist Hans Adolf Krebs (1900–1981) and was devised by the Krebs Pigment & Color Corp., Delaware.

[506] In 1978, CIPM accepted the knot to be used with SI.

[507] [IVCH, pp. 74–77] and [IPSE, p. 199].

KRISS An abbreviation for Korea Research Institute of Standards and Science.

ksf, ksi A symbol for kips (kilopounds) per square foot or per square inch, obsolete engineering units of pressure or stress. 1 ksf = 47.880 257 kPa and 1 ksi = 6.894 757 MPa.

kT An abbreviation for kiloton (= explosive power).

KT An abbreviation for karat.

KTU An abbreviation for Keiselgur Turbidity Unit.

KU An abbreviation for Krebs unit.

kunitz or **Kunitz unit** A unit of enzymatic activity of ribonuclease. It is used in biochemistry to describe the concentration or activity of the enzyme ribonuclease, which attacks ribonucleic acid (RNA). One Kunitz unit catalyzes an increase in absorption of 0.001 at 260 nm/min at 25 °C and pH 5.0 when acting on highly polymerized calf thymus DNA.[508] It can also be expressed as the amount of enzyme that liberates folin-positive amino acids and peptides equivalent to 1 μmol tyrosine at 37°C and pH 7.5, using heamoglobin as a substrate. The unit is named after the Russian–American biochemist Moses Kunitz (1887–1978), who proposed the standard test in 1946.[509]

kVA An abbreviation for kilovoltampere.

kvadrat- (sometimes shortend **kvad.**) A prefix, used in Scandinavia, meaning "square." In particular, a kvadratmeter is a square metre. The prefix is common to Danish, Norwegian, and Swedish.

kW An abbreviation for kilowatt.

kWh An abbreviation for kilowatt hour = 3.6 MJ.

kWyr An abbreviation for kilowatt year = 8766 kWh = about 32 GJ.

kya A common abbreviation in English-speaking countries for "thousand years ago." The "k" is the metric symbol for kilo- (1000). The symbol *kyr* (kiloyear) is also used.

[508] According to [FENN, p. 261], the amount of the enzyme ribo-nuclease "required to cause a decrease of 50% per minute in the ultraviolet light of wavelength 300 nm absorbed at 25°C by a 0.05% solution of yeast nucleic acid in a 0.05 molar acetate buffer solution of pH 5.0."

[509] [KUNI].

kYr An abbreviation for kiloyear = 1000 years.

kyu In typography and graphic design, during the twentieth century, a metric unit of length. The kyu, originally written as **Q**, is = exactly 0.25 mm = about 0.71 point = about 14.173 twips. The spelling “kyu” was introduced by the software company Macromedia.

12 L

L An abbreviation for lambert.

L An abbreviation for litre (UK) and liter (US).

L The Roman numeral for 50.[510]

l An abbreviation for litre (U.K.) and liter (U.S.).

$\mathbf{l_n}$ An abbreviation for the German unit Normliter.

la or **La** An abbreviation for lambert.

Laboratoire Central des Industries Electriques (LCIE) The name of the National Institute for Electrical Standards in France.

lambda A unit of relative distance used in the design of integrated circuits in microelectronics. The “feature size” of a design is the width of its smallest element, and one lambda equals one half the feature size.

lambda (λ) An obsolete metric unit of capacity = 1 mm^3 = 1 μL.[511] The unit was proposed by the American chemist Paul Leland Kirk (1902–1970), a pioneer investigator in the field of quantitative chemistry on the microgram scale, in 1933,[512] and has been used in ultramicrochemistry in measuring very small samples.[513]

[510] 50 was N, И, K, Ψ, ⋔, etc., but was perhaps most often represented with a chicken-track shape like a superimposed V and I. This flattened to ⊥ (an inverted T) by the time of Augustus, and soon thereafter became identified with the graphically similar letter L.

[511] BIPM. *Proc.-Verbeaux Com. Int. Poids et Mesures*, 1880, p. 30.

[512] [KIRK2].

[513] See: [IEEE, Sect. 3.3.3].

lambert (L, Lb, or **La)** An obsolete CGS unit, in use in the period between 1920s–1950s, of illuminance or brightness of a surface. It describes the illumination of a surface that emits or reflects one lumen per square centimetre = $10^4/4\pi$ cd/m^2 = about 3183.099 cd/m^2. The unit, which was replaced by the apostilb in 1949,[514] is named after the German photometrician and physicist Johann Heinrich Lambert (1728–1777),[515] who showed that the illumination of a surface is inversely proportional to the square of the distance from the light source.

lane metre A unit of deck area for cargo vessels designed so that containers or other cargo can be rolled on and off the decks of the ship. A lane is a strip of deck 2 m wide. A lane metre is an area of deck one lane wide and one metre long, that is, 2 m^2.

langley (Ly) A CGS unit of heat transmission, most especially used to express the rate of solar radiation received by the earth, = 1 cal_{th}/cm^2 = exactly 41.840 kJ/m^2. Sometimes said to equal 1 cal_{IT}/cm^2 = 41.868 kJ/m^2, or 1 cal_{15}/cm^2 = 41.855 kJ/m^2.[516] The unit was proposed by the German geophysicist Franz Linke (1878–1944) in 1942,[517] and is named after the American astronomer Samuel Pierpont Langley (1834–1906),[518] the first director of the Astrophysical Laboratory at the Smithsonian Institute in Washington. The solar power reaching the Earth’s surface is about 2 Ly/s. See also *pyron*.

langley per minute (Ly/min) A CGS unit of irradiance = 1 $cal_{IT}/(cm^2\ s)$ = 697.8 W/m^2. The unit was especially used as a unit of insolation (= *in*coming *sol*ar radi*ation*).

lap An informal unit of length used in athletic competitions. In “Track & Field,” a lap is the length of one trip around a running track. This may vary from track to track, but at the level of

[514] [WALS, p. 138].

[515] [LÖWE].

[516] In 1947, a proposal was made to change the dimensions to J/m^2. See [NATUR3].

[517] [LINK].

[518] [ABBO].

serious competition, most tracks have a standard length. In English-speaking countries, this was formerly ¼ mile = 1320 ft = 402.336 m. Tracks used in most competitions today have a length of exactly 400 m. In swimming, a lap is one tour of the pool, a distance of exactly 100 m.

large . . ., larger . . . The name for a general qualifier distinguishing a larger form of some ambiguous measure.

large numbers Nomenclatures for naming large decimal numbers beginning with 10^9. There are two systems,[519] the British system[520] (in which the prefix stands for *n* in 10^{6n}) and the American system[521] (in which the prefix stands for *n* in $10^{(3+3n)}$).

lat or **LAT** An abbreviation for latitude.

l atm An abbreviation for litre atmosphere.

lb, **lbf**, and **lbm** The traditional English symbol for the pound, lb, is derived from the Latin *libra*, scale. The symbols lbf and lbm are used to distinguish between pounds of force and pounds of mass, respecttively.

lb An abbreviation for $\log_2$.

Lb An abbreviation for lambert.

LB An abbreviation for pound-force (lbf).

lb tr An abbreviation for troy pound.

Lb An abbreviation for lambert.

LCIE An abbreviation for Laboratoire Central des Industries Electriques.

Le An abbreviation for Lewis number.

lenat A jocular unit of bogosity, derived from Quantum Bogodynamics, a hacker culture that characterises the universe in terms of sources of fictional fundamental particles called bogons. The unit, considered too large a unit for practical use, is named after the former American researcher into artificial intelligence and CEO of Cycorp, Inc., Douglas B. Lenat (b. 1950).

length (lg) An informal unit of distance. The distance between competitors in horse races, boat races, and similar situations is naturally expressed in lengths, with one length = the average length of a horse, boat, etc. In horse racing, as the horses are moving at different speeds, the distance between the horses changes as they near the finish line. To avoid this uncertainty, the reported distance in lengths is often computed as five times the difference in their running times in seconds. This means the length is actually interpreted as a unit of time = 1/5 s.

lentor [<L: *lentus* = pliant, tough, slow] A CGS and metric unit of kinematic viscosity, used in rheology between 1920 and 1940. It is now called a stoke/stokes.

lenz A proposed special name for a unit of magnetic field strength in SI, with dimensions of amperes per metre. It was rejected at the first meeting of the Comité Consultatif des Unités in 1967.[522]

leo [Galileo Galilei (1564–1642), Italian astronomer] A metric unit of acceleration = 10 m/s^2 = 393.700 79 in/s^2 = 32.808 399 celos.[523]

LET An abbreviation for linear energy transfer.

lethal dose (LD) A measure used in pharmacology to express the percentage of a population killed by a dose of the substance being studied. The measurement is often given as a subscript. For example, the potency of a drug or pesticide is commonly expressed by stating the size of the LD_{50} dose: the amount of the substance which kills 50% of the test population.

Lewis number (*Le*) A dimensionless number used in combined heat and mass transfer calculations,[524] defined as $Le = k/(D_v \rho C_p)$, in

[519] The British style guide *The Times Style and Usage Guide*, by Tim Austin, defines "billion" as "one thousand million, not a million million."

[520] The British names for large numbers originate from the late fifteenth century, when the French physician and mathematician Nicolas Chuquet (1445–1488) used the Latin prefixes to denote successive powers of 10^6 and the suffix "-llion" to refer to one million. He coined the words *byllion* and *tryllion* and used them to represent 10^{12} and 10^{18}, respectively.

[521] French mathematicians of the 1600s who used billion and trillion for 10^9 and 10^{12}, respectively. This usage became common in France and America, while the original Chuquet nomenclature remained in use in Britain and Germany. The French decided, in 1948, to revert to the Chuquet system.

[522] [TERR].

[523] See http://www.engnetglobal.com

[524] See also: "The Lewis Number Under Supercritical Conditions" at www.nasatech.com

which k = thermal conductivity, D_v = diffusivity, ρ = density, and C_p = heat capacity, or as $Le = \alpha/D_v$, in which α = thermal diffusivity.[525] For gases, *Le* varies from 0.8 to 1.2, and for liquids, from 70 to 100. The Lewis number can also be expressed as *Sc*/*Pr*, in which *Sc* = the Schmidt number and *Pr* = the Prandtl number. The name for the number was proposed in 1948,[526] but the idea of the number was mooted by Professor Warren Kendall Lewis (1882–1975) in 1939.[527]

Lf d. An abbreviation for limes flocculating dose.

li An abbreviation for link.

light watt A unit measuring the relative power output of a light source. For a monochromatic light source, the power in light watts equals 683*V(l)*, in which *l* is the wavelength of the light and *V(l)* is the relative power in W/lm required to produce a constant brightness sensation in the eye at wavelength *l*. Values of *V*(*l*) are defined by the International Commission on Illumination (CIE). The maximum value of *V*(*l*) is 1/683 W/lm = 1.464 mW/lm at the wavelength *l* = 555 nm, the wavelength to which the eye is most sensitive. When the source delivers light over a range of frequencies, it is necessary to compute 683 times the integral of *V(l)* multiplied by the fraction of energy delivered at wavelength *l*. See also *candela* and *talbot*.

light year (ly, l.y., or **LY)** A unit of length, used in astronomy, equal to the distance travelled by electromagnetic radiation in one tropical year through a vacuum.[528] Since light travels at 299,792,458 m/s, and there are 31,556,925.9747 s in a tropical year, one light year equals 9,460,528,401,200 km. The Julian year of 365.25 days contains 31,557,600 s, so a light-year is 9,460,730,472,580,800 m.

[525] [FINL, p. 121].

[526] [KLIN].

[527] [LEWI2].

[528] According to [JERR], the unit was used for the first time in 1888: *Athenaeum*, March 1888, 313.

Limiting Viscosity Number (LVN) Name recommended in 1951[529] by the Commission on Macro-molecules of the International Union of Pure and Applied Chemistry for the term intrinsic viscosity. See also *intrinsic viscosity*.

line (li) A former name for the maxwell, the CGS unit of magnetic flux = 0.01 weber.

line of induction See *line of magnetic induction*.

line of magnetic induction or **line of induction** Conception for describing magnetic flux, introduced by the British electrochemist and physicist Michael Faraday (1791–1867), = 1 CGS unit of flux = 1 maxwell.[530] See also *kapp*.

linear energy transfer (LET) A unit of linear energy absorption of the medium from an ionizing particle, proposed in 1952.[531] It was defined as the energy lost by a charged particle per unit length of the medium it traverses. Values of LET are usually given in keV/μm.[532] 1 keV/μm = about $1.602 \cdot 10^{-10}$ J/m.

linear foot (or **"lineal" foot**) **(ft** or **lf)** Terms used loosely to describe a one-foot length of any long, narrow object. The correct term is linear foot; the word "lineal" refers to a line of ancestry, not to length. Boards, pipes, and fencing are typical objects measured and sold by the linear foot. In the moving industry, a linear foot is a one-foot length of a moving van, usually a volume of about 72 ft^3 = roughly 2 m^3. Occasionally the term "linear foot" is used as an alternate name for the board foot, but this is appropriate only if the board is 12 in wide.

[529] Report on nomenclature in the field of macromolecules. International union of pure and applied chemistry. *Journal of Polymer Science*, 1952: **8**, 270.

[530] In "A Treatise on Electricity and Magnetism", **II**, p. 219, by Maxwell: "It is a line that—(1) If a conductor be moved along it parallel to itself it will experience no electromotive force. (2) If a conductor carrying a current be free to move along a line of magnetic induction it will experience no tendensy to do so. (3) If a linear conductor coincide in direction with a line of magnetic induction, and be moved parallel to itself in any direction, it will experience no electromotive force in the direction of its length. (4) If a linear conductor carrying an electric current coincide in direction with a line of magnetic induction it will not experience any mechanical force."

[531] [ZIRK].

[532] [SHAN, p. 4] and [ALPE, p. 106].

Lipmann unit or **Kaplan-Lipmann unit**[533] A unit of quantity of coenzyme A, for the formation of which pantothenic acid is required, = 2.4 μg of pure coenzyme A (corresponding to 0.7 μg of pantothenic acid).[534] The unit is named after the German–American biochemist Fritz Albert Lipmann (1899–1986).

liq oz An abbreviation for liquid ounce.

liq pt An abbreviation for liquid pint.

liq qt An abbreviation for liquid quart.

liter or **litre** (**l** or **L**) [<L: *litra*] A common metric unit of capacity. In 1901, the third CGPM resolved that it is "the volume occupied by a mass of 1 kg of pure water, at its maximum density and at standard atmospheric pressure." As the 1901 definition made its size depend on a standard of mass (the International Prototype of the kilogram), its volume expressed in metres had to be determined experimentally, which led to the conversion factor 1 L = 1.000 028 · 10^{-3} m^3. In 1950, the CIPM declared that 1 L = 1.000 028 dm^3 was the best conversion. In 1964, the 12th CGPM (Resolution 6) abrogated the 1901 definition and declared "that the word 'liter' may be used as a special name for the cubic decimeter," and recommended that it not be used to present the results of high accuracy volume measurements.[535]

liter atmosphere or **litre atmosphere** (**L atm**) A unit of work or energy used in the study of confined gases, equal to 101.325 J = 0.09605 Btu = 74.73 f. lb.

litre per 100 kilometres (L/100 km) A unit of fuel consumption, = 3.540 06 · 10^{-3} Imp gal/mile.

litre per kilogram (L/kg) A unit of specific volume = 1 dm^3/kg.

litre per mole (L/mole) A unit of molar volume = 10^{-3} m^3/mol.

litre per second (L/s) A unit of volume flow rate = 10^{-3} m^3/s.

[533] [KAPL].

[534] [GSTI, p. 231].

[535] [GUIL2, pp. 256–258], [NBSM, p. 2], [ANSI], and [FRN90].

Lj The German abbreviation for *Lichtjahr* = light year.

LLD unit [LLD is an abbreviation for the organism *Lactobacillus lactis Dorner*] A unit of quantity of vitamin B_{12} based on biological activity. 11,000 LLD Units = 1 microgram vitamin B_{12} = 1 USP Unit (liver extract). The unit was probably first used by the American hematologist Professor Mary Shaw Shorb (1907–1990) in the 1940s.

LM An abbreviation for Lockhart-Martinelli parameter.

lm An abbreviation for lumen.

lmh An abbreviation for lumenhour.

lms An abbreviation for lumensecond.

Lockhart-Martinelli parameter (**LM**, **LOMA**, or **χ**) A dimensionless number used in internal two phase flow calculations that expresses the liquid fraction of a flowing fluid.[536] It's main application is in two-phase pressure drop and boiling/condensing heat transfer calculations.[537] It is defined as $m_l(m_g)^{-1}(\rho_g)^{1/2}\,(\rho_l)^{-1/2}$, in which m_l = the liquid phase mass flowrate, m_g = the gas phase mass flowrate, ρ_g = the gas density, and ρ_l = the liquid density.[538]

LOD An abbreviation for Limit of Determination.

logit A name proposed in 1952 for the *decibel*.

London bus A unit used, by British media, to refer to heights or lengths in comparison to the height (about 4.4 m) or length (about 8.4 m) of a London AEC Routmaster double-decker bus.

long or **LONG** An abbreviation for longitude.

long ton or **gross ton** A unit of weight, principally used for anthracite coal in Pennsylvania, for certain iron and steel products in bulk, and in estimating customs duties, in the U.S. = 2240 lb = about 1016.046 9 kg.[539]

longword See *word*.

[536] A modified Lockhart-Martinelli parameter was defined in 1997 as the ratio of the liquid and gas Froude numbers. See: [DELE].

[537] [MURD].

[538] An increasing LM parameter means an increasing liquid content or wetness of the flow.

[539] [COAL, pp. 5–6].

lood or **gros** A name given to 10 g in the Netherlands and Belgium, when those countries adopted the metric system in 1816 and 1820, respectively. The lood had previously been= ¹⁄₃₂ Amsterdam pond = about 15.44 g.

LOQ An abbreviation for Limit of Quantification.

LOMA An abbreviation for Lockhart-Martinelli parameter.

Lorentz or **Zeeman splitting constant (g_e)** A unit = the Bohr magneton stated in wave numbers. The lorentz is = 46.686 452 1(19) per Tesla metre (1/T m).[540] The unit is named after the Dutch theoretical physicist Hendrik Antoon Lorentz (1853–1928).

Loschmidt's number (N_L) or **Loschmidt's constant** A number of molecules in 1 m^3 of an ideal gas at standrad pressure = about 2.686 763 (23) · 10^{25} m^{-3}. It is named after the German chemist Johann Joseph Loschmidt (1821–1895), who first derived the unit in 1865. In Germany, it was sometimes called **Avogadro´s constant**.

loudness unit (LU) A unit proposed in 1937[541] and adopted by the American Standards Association in 1942.[542] It was defined as corresponding to a loudness level of zero phon. The frequency was not mentioned in the definition of the unit, to give a scale based on the loudness heard by an average listener.[543]

Lovibond color units See *degree Lovibond*.

LP An abbreviation for Low Pressure.

Lpf Symbol for litres per flush, a specification found on toilets. Low-flush toilets use 4.84 Lpf or less. 1 Lpf = 0.264 U.S. gallon per flush (gpf).

lpi An abbreviation for lines per inch, a unit used to state the resolution of display devices or to state the line spacing of printed pages.

Lpm, **LPM**, or **lpm** An abbreviation for litres per minute.

LPTF An abbreviation for Laboratoire Primaire du Temps et des Fréquences.

LT An abbreviation for Long Ton.

LT An abbreviation for Low Tension.

Lu The symbol for *Lundquist number*.

L_u The symbol for *Lundquist number*.

Lucas numbers The name for numbers that are derived with the same recurrence formula as the fibonacci numbers. L_{n}=L_{n−1} + L_{n−2} for all n ≥ 3. But L_{1}=1, and L_{2}= 3. This gives the sequence: 1, 3, 4, 7, 11, 18, 29, 47, 76, and 123.[544] The integer sequence is named after the French mathematician François Édouard Anatole Lucas (1842–1891).

lug A shallow box or crate for fruit, such as cherries, grapes, or peaches, or vegetables. The size of a lug varies with the item it contains.[545] Typical lugs hold about 7–13 kg of produce in a volume of roughly about 12 L. In California, this was originally a box having an inside width of 13 ½ in, an outside length of 17 ½ in, and a depth of from 4 ¼ to 7 ¼ in.[546] This unit is now common in the midwestern U.S.

lumberg A CGS unit of luminous intensity that came into use in the late 1930s = 1 lumen second. See *talbot*.

lumen (lm) The SI unit luminous flux[547] = the intensity in candelas multiplied by the solid angle in steradians (1/(4·π) of a sphere) into which the light is emitted.[548] Thus, the total flux of a one-candela light, if the light is emitted uniformly in all directions, is 4π lm.[549]

lumen hour or **lumen-hour (lm h)** A unit of quantity of light = one lumen of light flux continued for 1 h = 3.6 · 10^3 lm · s. It was adopted by the American Engineering Standards Committee and the Illuminating Engineering Society of New York in the 1920s.[550]

540 [WOAN, p. 7].
541 [FLET] and [RMP].
542 [JASA].
543 See also [FLET].

544 [HOGG] and [HILT, pp. 61–85].
545 Peaches: 55 lbs per lug-box, Sweet potatoes: 118 lbs per lug-box, etc. See also: [ARAF].
546 [CASS, p. 452].
547 It has been a legal unit in France since 1919. See [POIN].
548 According to [MOON]. André Blondel (1863–1938) proposed the unit in 1894, based on the international candle.
549 One lumen at 5550 Å equals 0.001 470 588 2 W.
550 [TIES].

lumen per square foot (lm/ft^2) The unit of illuminous exitance = about 10.763 9 lx.

lumen per square metre (lm/m^2) The unit of luminous exitance = 1 (cd sr)/m^2 = 1 lx.

lumen per watt (lm/W) The SI unit of luminous efficacy = 1 (m^3 cd sr)/(m^2 kg).

lumen per second (lm/s) The SI unit of quantity of light = 1 cd sr s.

lumensecond (lms) A unit of quantity of light = one lumen of light flux continued for one second.

lumerg [luminous erg] A name suggested, by the Optical Society of America in 1937,[551] for a unit for luminous energy = 10^{-7} lm s.

lunar distance (LD) A unit of length = the length of the semimajor axis of the Moon's orbit = approximately the average distance between the Earth and the Moon = about 384,401 km. The unit is used to measure the "miss distance" of asteroids passing near the Earth.

Lundquist number (Lu or L$_u$) A dimensionless number used in magnetohydrodynamics to characterize unidirectional Alfvén waves, defined as $B\sigma L(\mu/\rho)^{1/2}$, in which B = magnetic flux density, σ = electrical conductivity, μ = permeability, ρ = density, and L = length. It is the same as the magnetic Reynolds number when the flow and Alfvén speeds are the same.[552]

Lunge See *degree Baumé*.

lusec (name originated after WWII) A unit of power, during the twentieth century, used to express the leak rate in vacuum technology or to describe the capacity of a vacuum pump to pull a vacuum. One lusec represents a flow of 1 L·μmHg/s = 100 clusec (centilitre-micron per second) = 1.315 6 atm·cm^3/s = about 133.322 Pa·cm^3/s = 133.322 μW.[553]

lux (lx) [<L: *lux* = "light"] or **metre-candela** The SI unit of illuminance, defined as an illumination of 1 lm/m^2 = about 0.092 90 foot candle = 1 cd/(steradian · m^2). The unit was proposed in Germany in 1897[554] where it was associated with the metre-hefner. See also *lumen per square foot* and *footcandle*.

lux hour (lx h) A unit of light exposure = 3600 lx s.[555]

luxon See *troland*.

lux second or **luxsecond (lx s, lxs,** (sometimes written) **lux-sec)** The SI unit of light exposure = 1 (s cd sr)/m^2.[556]

LW An abbreviation for Long Wave.

LWIR An abbreviation for Long-Wavelength Infrared.

lx An abbreviation for lux.

lxs An abbreviation for luxsecond.

ly An abbreviation for langley.

ly or **l.y.** An abbreviation for light year.

13 M

M A symbol for the Roman numeral 1000. It is sometimes used in symbols to indicate a thousand, as in Mcf, a traditional symbol for 1000 cu ft. This use of the letter M should be avoided.

M An abbreviation for absolute magnitude.

M A symbol for kilogram-molecule.

M An abbreviation for Mach (number).

M An abbreviation for maxwell.

M An abbreviation for metric prefix mega (=1,000,000).

M An abbreviation for mil.

M An informal abbreviation for million in expressions in which the base unit is understood, as in "500M hard drive" (500 megabytes or mebibytes).

M An abbreviation for molar.

M An abbreviation for month.

M An informal abbreviation for MΩ (megaohm).

M» A symbol for kilogram-molecule.

$M_\oplus$ A symbol for earth mass.

m An abbreviation for apparent magnitude.

m An abbreviation for metre.

m An abbreviation for metric prefix milli.

[551] [JONE2].

[552] [FORB, p. 44] and [GOOS, p. 113].

[553] See also: [BLAU, p. 57].

[554] According to [MONA].

[555] [MELA, p. 160].

[556] See also: [DAVI, p. 25].

m An abbreviation, particulary in business literature in North America, for thousand, then mm = million and so on, e.g., mFBM for 1000 FBM of sawn wood and mm.c.f. for 1,000,000 cubic feet of natural gas.

m^{-1} An abbreviation for dioptrie = 1/metre.

m^2 An abbreviation for square metre.

m^3 An abbreviation for cubic metre.

m^3gas An abbreviation for cubic metre of natural gas, nominally representing content of about 37.26 MJ.[557]

m^3/kg An abbreviation for cubic metre per kilogram.

m^3/s An abbreviation for cubic metre per second.

ma An abbreviation for myria.

Ma An abbreviation for Mach (number).

Ma An abbreviation for megaare = 1,000,000 are = 100 km^2.

Ma [mega-annum] A symbol for one million years, often used in astronomy, paleontology, celestial mechanics and geology.

mA An abbreviation for milliampere.

mab An abbreviation for "metres above bottom" (bottom of the sea), a unit used in oceanography.

Mach, **mach**, or **Mach number** (**M** or **Ma**) [usually pronounced "mock" in English] A unit, used, e.g., to express the velocity of aircraft, of the ratio (v/w) of the velocity (v) of an object or fluid to the velocity of sound (w) in the same medium and under the same conditions.[558] The name of the unit is placed before the measurement, thus M1 = the velocity of sound, M2 = twice the velocity of sound, etc.[559] The actual speed of sound varies, depending on the density and temperature of the atmosphere. At 0°C and a pressure of 1 atmosphere, the speed of sound in dry air is about 331.6 m/s. The unit is named after the Austrian physicist Ernst Mach (1838–1916), who first used it in 1887.[560]

Mache, **mache**, or **mache unit** An obsolete, arbitrary unit, in use before 1985, of radioactive concentration = 3.64 Eman = $3.64 \cdot 10^{-7}$ Ci/m^3 = about $13.454\ 5 \cdot 10^{-3}$ Bq/cm^3. The unit was defined in 1930[561] by the International Radium Standards Committee as that quantity of emanation from radon which sets up an ionization saturation current of 0.001 CGS electrostatic units of current in air. The unit is named after the Austrian scientist Heinrich Mache (1876–1954).

MacLeod or **McLeod** An arbitrary unit of gas pressure on a logarithmic scale, proposed in 1945.[562] Pressure P in MacLeods equal $P = -\log_{10} p$, in which p = pressure in mm of mercury. 1 MacLeod = a pressure of 0.1 mm of mercury = about 13.332 24 Pa. The unit is named after the British scientist Herbert MacLeod (1841–1932).

MacMichael degree See *degree MacMichael*.

macro A vernacular term meaning large in size.

macron An alternative name in the early 1900s for the *parsec*. See also *astrometer*, *astron*, and *parsec*.

Madelung constants (**M_3** or **α**) A constant used in calculating Coulomb energy.[563] If one considers the cubic lattice in three-dimensional space with unit charges located at integer lattice points (i,j,k) not = (0,0,0) and of sign $(-1)^{i+j+k}$, the electrostatic potential at the origin due to the charge at (i,j,k) is: $(-1)^{i+j+k}/(i^2 + j^2 + k^2)^{-1/2}$. Hence, the total electrostatic potential at the origin due to all charges is:

$$M_3 = \sum_{n=-\infty}^{\infty} \sum_{j=-\infty}^{\infty} \sum_{k=-\infty}^{\infty} \frac{(-1)^{i+j+k}}{\sqrt[2]{(i^2 + j^2 + k^2)}}$$

M_3 is called Madelung's constant for a 3-dimensional NaCl crystal.[564] Glasser &

[557] See also "Energy" in *Science & Technology*. Gale Research Inc., 1993.

[558] [ISO3112].

[559] [MACK].

[560] [ACAD, p. 17].

[561] [RMP2].

[562] [NATUR6].

[563] [TAYL3] and [MADE].

[564] See also: [CRAN].

Zucker[565] called -2M_3 the Madelung's constant.[566]

MAF or **maf** A symbol for one million acre feet. This symbol, commonly used in reservoir management in the U.S., should be written Maf. 1 maf = about 1.233 5 billion (10^9) m^3.

magic number A name given to numbers[567] that signify the number of electrons in atoms of unusual stability or the number of protons and/or neutrons in very stable nuclei.[568] They have atomic number *N* or atomic mass number *Z* of 2, 8, 20, 28, 50, 82, and 126.[569] The semi-empirical mass formula (SEMF)[570] is used to approximate the mass and various other properties of an atomic nucleus. The mass of an atomic nucleus is given by: $m = Zm_p + Nm_n - (E_B/c^2)$, in which m_p and m_n are the mass of a proton and a neutron, respectively, E_B is the binding energy of the nucleus, A is the total number of nucleons, *Z* the number of protons, and *N* the number of neutrons. The semi-empirical mass formula states that the binding energy will take the following form:

$$E_B = a_v A - a_S A^{2/3} - ac\frac{z^2}{A^{2/3}} - a_A\frac{(A - sZ)^2}{A} + \delta(A, Z)$$

The formula was first formulated in 1935 by German physicist Carl von Weizsäcker (1912–2007), and although refinements have been made to the coefficients over the years, the form of the formula remains the same today.

magnetic constant or **permeability-of-vacuum** (**μ_0**) The SI name of the adopted value for the magnetic permeability of a vacuum = $4\pi \cdot 10^{-7}$ H/m = about 1.256 637 061 4 · 10^{-6} N/A^2.[571]

magnetic flux quantum (**Φ_0**) The ration of the Planck constant to twice the elementary charge = 2.067 833 831 (13) · 10^{-15} Wb.[572]

magnetic ohm A name sometimes used for *gilbert per maxwell*.

Magnetic Reynolds' number (**Mr_e** or **R_m**) A number, used in magneto-fluid mechanics, = the ratio of the mass transport diffusivity to magnetic diffusivity: $Mr_e \equiv \frac{|\nabla\times(vx\mathbf{B})|}{|\lambda\nabla^2\mathbf{B}|} = \frac{vr}{\lambda}$, in which **v** = velocity, **B** = magnetic field, r = disk radius, and λ = magnetic diffusivity.[573] See also *Reynolds number*.

magnum A traditional unit of capacity for wine, generally = 2 standard bottles ("fifths") = about 1.6 L. Since the international standardization of the wine bottle in 1979 at 750 mL, the **metric magnum** = 1.5 L and the **double metric-magnum** = 3 L.[574]

makeweight A weight added to the scale to reach a required weight.

manpower During the eighteenth–nineteenth centuries, an informal unit of power = 0.1 horsepower = 211,168.775 Imp drams = about 74.57 W.[575] The unit seems to have been invented by American engineers. In the early days of the steam engine, used to describe the power of small engines, defined as 1/12 horsepower.[576]

Marangoni number (***Ma***) A dimensionless number used to indicate the interdependence of temperature, surface tension and convection in regulating the flow of heat through thin surface layers of fluid. It is defined as: $(L_s \rho c_p \delta_\gamma)/(\lambda\eta)$, in which L_s = characteristic length, ρ = density, c_p = specific heat, δ_γ = difference in surface

565 [GLAS2].

566 See also: [BUHL] and [CRAN2].

567 Professor Dr. Maria Göppert-Mayer (1906–1972) was awarded the Nobel Prize in 1963 for discovering the reasons as to why if there are either 2,8,20,28,50,82,126, nucleons in the nucleus of an atom, then the atom is extremely stable.

568 Nuclei which have both neutron number and proton number = one of the magic numbers are even more stable. For example, Helium 4 is especially stable because it has both 2 protons and 2 neutrons. They are called *doubly magic*.

569 The term was first used in this type of context in: [HAXE].

570 Also called the Weizsäcker formula or the Bethe-Weizsäcker formula.

571 [AIEE, p. 62].

572 See also: [HUAN, p. 214].

573 [DWIV, p. 343]. See also: [SHER, pp. 52–54].

574 [ATFB, p. 6].

575 [ZUPK6, p. 219].

576 See also: [FERG, p. 243] and [HODG, p. 2].

tension along L_s, λ = thermal conductivity and η = viscosity. The number is named after the Italian physicist Carlo Giuseppe Matteo Marangoni (1840–1925).

marathon [name of Grecian city] A unit of length used in athletics, exactly 26 miles 385 yards = 42,194.988 m. The actual distance from Marathon to Athens is only about 36.75 km. The 1896 run was exactly 40,000 m from the Marathon Bridge to the Olympic Stadium. At the 1908 Olympics in London, King Edward VII and Queen Alexandria wanted the marathon race to begin at Windsor Castle outside the city so that the Royal family could view the start. The distance between the castle and the Olympic Stadium in London proved to be 26 miles, but organizers added 385 yards to the finish around a track, so the runners would finish in front of the king and queen's royal box. In 1921, that distance was adopted as the "official" Marathon distance by the IAAF, and in 1924, it was adopted by the International Olympic Committee.

Margules number A dimensionless number, used in heat transfer calculations, = the Nusselt number divided by the Peclet number. The number is named after the Austrian meteorologist Max Margules (1856–1920), one of the founders of dynamical meteorology.[577]

Marie-Jeanne A large wine bottle holding about 2.25 L (= 3 bottles).

mas A symbol for milliarcsecond, a unit of angular measure commonly used in astronomy.

masl A common abbreviation for "metres above sea level" used in geology and geography.

mass energy conversion factor An energy equivalent of the Dalton = about 931.501 6 MeV.

mass transfer factor (j_M) A dimensionless constant, used in heat transfer, defined as: $(k_c (\mu/(\rho D_v)^{2/3})/v$, in which k_c = diffusion rate, μ = viscosity, ρ = density, D_v = diffuscivity, and v = velocity.

Mastic Turbidity Unit (MTU) A unit formerly used in measuring water quality. It is defined as the turbidity of water when 0.02 mL of mastic solution is mixed in 50 mL of distilled water. The unit is equivalent to 0.125 JTU = 0.125 KTU = 0.0125 FTU.[578]

material measure Device intended to reproduce or supply, in a permanent manner during its use, one or more known values of a given quantity.

Matthiesen's unit of resistance During the nineteenth century, a unit of electric resistance, "equal to the resistance of a copper wire 1/16th of an inch in diameter and 1 statute mile long, at a temperature of 60°F. This unit is sometimes confused with Varley's unit of resistance."[579] See also *Varley unit*.

mAU An abbreviation for the milli-absorbance unit. An increase in absorbance of 1 mAU corresponds to a reduction in transmittance of about 0.2305%.

Max An abbreviation for maxima and maximum.

maxwell (Mx or M) The CGSm, emu, CGS-Gaussian, and metric unit of magnetic flux = the magnetic flux which, linking a circuit of 1 turn, produces in it an electromotive force of 1 abvolt as it is reduced to zero in 1 s = about 10^{-8} Wb (Mx and Wb are not strictly comparable because CGS has three dimensions and SI has four).[580] In a magnetic field of strength one gauss, one maxwell is the total flux across a surface of 1 cm^2 perpendicular to the field.[581] This unit was formerly called a **line** or **abweber**. The unit was adopted by the Fifth International Electrical Congress in 1900.[582] It was confirmed again when the Advisory Committee on Nomenclature of the International Electrotechnical Commission adopted the name maxwell for the unit of magnetic flux at its meeting in 1930. The unit is named after the British physicist James Clerk

577 See: [KUTZ2].

578 [BHUY, p. 141].

579 Sizes.com

580 The corresponding practical unit is the pramaxwell = 10^8 maxwell.

581 [IEC64. p. 27].

582 [NATUR7].

Maxwell (1831–1879), who presented the unified theory of electromagnetism in 1864.

maxwell per square centimetre (Mx/cm^2) See *gauss*.

mayer A unit for measuring heat capacities, proposed in 1925[583] by T. W. Richards and F. T. Glucker. The mayer equals 1 J/ °C temperature change in 1 g of substance = 1 kJ/(kg K) = 1000 $m^2/(K\ s^2)$. The unit is named after the German therodynamicist, physiologist, and physician Julius Robert von Mayer (1814–1878).

mazzo or **mazo** In Italy, a name for a bunch, bale, or bundle of merchandise, such as wool or yarn.

MB An abbreviation for 1000 BTU.

Mb An abbreviation for megabyte.

mb A improper abbreviation for millibar.

MB/h An abbreviation for 1000 BTU per hour.

mbar An abbreviation for millibar.

MBF or **MBM** Obsolete symbols for 1000 board feet, a unit of volume for timber = 250/3 ft^3 = 2.360 m^3. "BM" stands for "board measure."

Mbps An abbreviation for megabits per second.

mbsl A common abbreviation for "metres below sea level" used in geology and oceanography.

MBtuh A symbol for 1000 Btu (British thermal units) per hour, a unit traditionally used in the U.S. heating and air conditioning industry to state rates of heating or cooling. One MBtuh = about 0.293 071 kW.

mc- An alternate symbol for micro-. This prefix is often seen in the symbol mcg for the microgram. Occasionally, mc has been used as a symbol for the micron.

mc An abbreviation for megacycle (per second) = megahertz.

mc A Italian abbreviation for the cubic metre (*metro cubo*). This is a non-standard symbol; the proper symbol is m^3.

Mc An abbreviation for megacycle (per second) = megahertz.

M.C. An abbreviation for Moisture Content.

[583] [RICH3].

mc.d. or **mcd** An abbreviation in France for millicuries-destroyed.

MCF or **m.c.f.** [Roman numeral m (=1000), then cubic feet] A traditional symbol for 1000 cubic feet, a unit of volume = 28.316 85 m^2. Also used with the multiplicative prefix m (for thousand) and mm (for million). See also *b.c.f.* and *t.c.f.*

Mcfd A symbol for 1000 cubic feet per day, a unit of water flow used by many U.S. water supply companies and agencies. 1 Mcfd = 19.665 L/min.

mcg A common abbreviation for microgram.

mcL A common abbreviation for microlitre.

McLeod See *MacLeod*.

MCM An abbreviation for thousand circular mils.

mcm An abbreviation for million cubic metre.

mcg/dl An informal abbreviation for microgram per decilitre.

Mc/s An abbreviation for megacycles per second.

MCOPS An abbreviation for Millions of Complex Operations Per Second.

MCU A symbol for milk clotting unit, used for measuring dosage of bromelain, an enzyme used as a digestive aid and for reduction of pain and inflammation. This unit cannot be converted to a weight unit, because different preparations of the enzyme differ in activity. Bromelain is also measured in gelatin digesting units (GDU); 1 MCU equals about 2/3 GDU.

M_E A symbol for earth mass.

ME A German abbreviation for *Masseinheit* (= unit of weight) used for *Masseinheit* = atomic mass unit.

ME A German abbreviation for *Masseinheit* (= unit of weight) used for *technische Masseinheit* = metric technical unit of weight.

M. E. An abbreviation for Mache unit.

meas An occasionally used abbreviation for measure and measurement.

measure A metric unit, of two, three else four beats usually, defined by vertical lines across the staves.

measuring instrument Device intended to be used to make measurements, alone or in conjunction with supplementary device(s).

measurement The process of assigning numbers or other symbols to the things in such a way that relationships of the numbers or symbols reflect relationships of the attribute being measured.[584]

measurement theory Name of a branch of applied mathematics that is the base of measurement and data analysis. If you want to draw conclusions about the attribute, you must take into account the nature of the correspondence between the attribute and the measurements.

mebi- (Mi-) [contraction of "megabinary"] Binary prefix, meaning $2^{20} = 1{,}048{,}576$, adopted by the International Electrotechnical Commission in 1998, and intended to replace mega- for binary applications in computer science.

mechanic abohm, **mechanic ohm** See *mechanical ohm.*

mechanical equivalent An alternative name somethimes given for heat = cal_{15}.

mechanical ohm or **mechanic abohm** Name sometimes given in cgs-system to dyn/(s cm) = 1 mNs/m.

mechanical ohm or **mechanic ohm** Deprecated unit of mechanical impedence to sound waves in the MKS = 10^{-3} Ns/m.

median Middle or central value in a distribution of data ranked in order of magnitude. If the list has an odd number of entries, the median is the middle entry in the list after sorting the list into increasing order. If the list has an even number of entries, the median is = the sum of the two middle (after sorting) numbers divided by two.

meg An informal contraction of "megabyte," used in computer science.

meg- An informal metric contraction of "mega-," e.g., megohm = MΩ.

mega- (M-) [< Gr: *megas* = "large"] The SI and metric prefix denoting 10^6, or one million. (The form meg- is used before a vowel, as in *megohm* for one million ohms.) It was recommended by the British Assn. Committee for the Selection and Nomenclature of Dynamical and Electrical Units in its Report of 1873.[585] The prefix has also become common in ordinary language, meaning "very large," as in *megabucks* or *megadose*. See also *meg*.

mega- (M-) [<Gr: *megas* = "large"] In measuring the storage capacity of a computer, the prefix mega- formerly meant $2^{20} = 1{,}048{,}576$ instead of an even one million. By a 1998 resolution of the International Electrotechnical Commission, the new prefix mebi- (Mi) replaces mega- for 2^{20}.

megabar (Mbar) A metric unit of pressure = 1 million bars = 100 GPa = about 14.503 million pounds per square inch. Such intense pressures are found inside the earth or in various advanced scientific experiments.

megabarrel (Mbbl, **Mbo**, **MMb**, or **Mb)** A unit of volume, used in the energy industry, = 1 million barrels of oil = about 42 million U.S. gal = about 158.987 ML.

megabase (Mb) A unit of genetic information = the information carried by 1 million pairs of the base units in the double-helix of DNA; also used as a unit of relative distance = the length of a strand of DNA containing 1 million base pairs. In humans, one megabase corresponds approximately to a gene separation of one centimorgan.

megabecquerel (MBq) A unit of radioactivity = one million atomic disintegrations per second = about 27.027 μCi.

megabyte (MB) Term used in the world of computing to describe data storage space and system memory. When referring to a megabyte for disk storage, hard drive manufacturers usually use the standard that a megabyte is 1,000,000 bytes. When the term megabyte is used for real and virtual storage, 2^{20} = 1,048,576 bytes is the appropriate notation.

megacycle (Mc) Term sometimes used as an informal name for the megahertz = 1 million cycles.

megagram (Mg) A rarely used unit of weight = 1000 kg = 1 tonne.

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[584] A particular way of assigning numbers or symbols to measure something is called a scale of measurement.

[585] First Report of the B. A. Committee for the Selection and Nomenclature of Dynamical and Electrical Units.

megahertz (MHz) A common unit of frequency = one million per second. Frequencies of radio waves are commonly stated in megahertz.

megajoule (MJ) A common metric unit of work or energy. The megajoule equals one million joules, which is about 737,562 ft lb = 947.8170 Btu = 238.846 (kilogram) Calories = 0.277 778 kWh.

megalerg The CGS unit of energy = 10^6 ergs = 0.1 J. The "l" was added to "mega-erg" to make the unit pronounceable.

megaline A metric unit of magnetic flux = 10^6 lines of electrostatic induction = 10^6 maxwell = 0.01 weber.

megaliter or **megalitre (Ml** or **ML)** A metric unit of volume = 1000 m^3. Commonly used in reservoir and water system management.

megameter or **megametre (Mm)** A metric unit of length = 1000 km = about 621.371 miles. Although it seems that this would be an appropriate unit for longer distances on the earth, the megametre is seldom used.

meganewton (MN) A metric unit of force = one million newtons. One meganewton equals about 101,972 kg of force = 224,809 lb of force.

megaparsec (Mpc) A unit of distance, used by astronomers studying the most distant quasars and galaxies, = 2.36 million light years = about $30.857 \cdot 10^{18}$ km.

megapascal (MPa) A common metric unit of pressure = 10 bars = about 145.038 lbf/in^2.

megaphone A jocular unit of perceived loudness = 10^{12} microphones. Phone is a paronomasia for the real unit phon. See *phon*.

megapixel A unit used to describe the size or resolution of an image or of a digital camera. One megapixel is one million pixels; thus, a rectangular image 1000 pixels by 1000 pixels is comprised of one megapixel.

megapond (Mp) A metric unit of force, sometimes used by engineers in Germany, = 1000 kg of force (kgf) = 9806.65 N = 2204.622 6 lb of force.

megastandardkubikmeter (MSm^3) In Norway, during the twentieth century, a unit of volume used by the oiltrading business = the volume, in millions of cubic metres, at 15°C and 1 01325 bar, = 1000 000 Sm^3 = 0.001 GSm^3.

megaton (Mton or **Mt)** A unit of energy used for measuring the energy of an explosion, especially a nuclear explosion. The unit came into use in the early 1950s. One megaton is the amount of energy released by the explosion of one million (short) tons of TNT (trinitrotoluene) = about $4.18 \cdot 10^{15}$ J = 1.16 billion kWh = roughly 4 trillion Btu = roughly 1 Tcal.

megatonne (Mt) A metric unit of weight = 1 million tonnes = about 2.204 6 billion lb.

megawatt (MW) A metric unit of power = 1 million W = about 1341.02 horsepower = about 947.817 Btu/s.

megawatt hour (MW·h) A metric unit of energy, especially electrical energy, exactly = 3.6 GJ = about 3.412 million Btu = about 2.655 billion ft lb.

megohm [mega + ohm] A common unit of electric resistance = one million ohms.

mel [contraction of melody] A unit of subjectively estimated pitch. The pitch of a 1000 Hz tone at 60 dB (some sources say 40 dB) above threshold is taken to be 1000 mels.[586] The pitch of any sound judged to be double that pitch is taken to be 2000 mels, etc. The unit was initially defined in 1937,[587] approved as an American Standard in 1951,[588] and redefined in 1975.

MENAMET An abbreviation for Middle East and Northern Africa Metrology Organization.

[586] For tones above 1000 Hz, the perceived pitch in mels is lower than the frequency in hertz; for tones lower than 1000 Hz, the perceived pitch is a little higher than the frequency in hertz.

[587] [STEV2].

[588] *Acoustical Terminology*. American Standards Association Z 24.1-1951. p. 22.

Mendenhall order Order, issued as the Survey's *Bulletin No. 26*,[589] that marked a decision to change the USA's weights and measures from the customary system based on that of England to the metric system. It was issued on April 5, 1893 by Thomas Corwin Mendenhall (1841–1924), superintendent of the U.S. Coast and Geodetic Survey and responsible for the national Office of Weights & Measures, with the approval of the United States Secretary of the Treasury, John Griffin Carlisle (1834–1910). The values in the Order was:

1 m = 39.37 in;
1 in = 25.400 051 mm;
1 kg = 2.204 622 34 lb;
1 lb = 453.592 43 g.

Mendenhall's definitions lasted until 1959 when slightly different international definitions became the law:

1 in = 25.4 mm;
1 m = 39.370 078 7 in;
1 lb = 453.592 37 g;
1 kg = 2.204 622 62 lb.

mensem or **per mensem** A traditional unit of frequency = once a month. See also *per diem*.

mEq An abbreviation for milliequivalent.

Mer An abbreviation for meridian.

mercury ohm See *ohm*.

meridian mile [mile along a meridian] See *geographic mile*.

-merous An ending meaning "-parted," added to a number to create an adjective. Thus, "8-merous" means "having 8 parts." The suffix, frequently used by botanists, is derived from the Greek *meros*, "part."

mesh A traditional unit used to measure the fineness of woven products such as fishing nets, fencing fabric, window screening, etc., = the number of strands per inch.

met [metabolism] A unit of metabolism defined in 1941. Metabolism, the sum of all the processes going on in the body to sustain life, is measured in units of power expended per unit of body surface area. One met is the metabolism of a seated, resting person = 50 calories per hour per square metre of the surface area of a human = about 58.15 W/m^2 = about 13.89 cal/m^{2}s regardless of the person's size. Measurements of human metabolism generally fall in the range 0.8–3.0 met (0.8 = lying down; 1.2 = sedentary activity; 1.6 = light activity standing; 2.0 = medium activity standing; 3.0 = high activity), although athletes can achieve 10 met or more.[590]

meter-atmosphere or **metre-atmosphere** Another name for the *atmo-meter*.

metercandle An obsolete unit of intensity of light, almost = 1 lx.

metre − kilogram-force − second system of units (m-kgf-s) A metric technical system used by engineers, who prefer to work in a system with base units of length, force and time instead of length, mass and time. In Germany and Eastern Europe, the kilogram-force is usually called the kilopond. The unit of weight in the m-kgf-s system was once called the *hyl*, but unfortunately, that term has been used in two senses:

1. A mass such that a gram-force acting on it will accelerate it 1 metre per second per second = about 9.806 65 · 10^{-3} kg; or
2. A mass such that a kilogram-force acting on it will accelerate it 1 metre per second per second = about 9.806 65 kg (the term 'kilohyle' always applies to this second sense).

To avoid confusion, it is best to use the term 'metric-technical unit of weight' (symbol, TME), which always has the second meaning. It has also been called the **metric slug**.

metre-kilogram-second system of units (M.K.S. or **mks (in the U. S.))** Systems of units that take the metre, kilogram, and second as their units of length, mass, and time. SI is such a system. Units for these three properties are

[589] It was approved for publication April 5, 1893, under the title, "Fundamental Standards of Length and Mass"; it was republished in 1894 under the same title, as appendix No. 6—Report for 1893 of the Coast and Geodetic Survey.

[590] See also: *Physiological and behavioral temperature regulation*. Ed. by James D. Hardy, Adolf Pharo Gagge and Jan A.J. Stolwijk. International Symposium on Temperature Regulation. 1st 1968. New Haven, Conn. and *Science*, 1941: **94**, 2445, 429.

enough to do Newtonian mechanics, a branch of physics.

meterlambert or **metre-Lambert** Another name, coined by analogy with the footlambert, for the nit. See *nit*.

meters of seawater or **metres of seawater (msw)** A conventional unit of pressure. Underwater pressure gauges are frequently calibrated in this unit. The pressure exerted by seawater varies slightly with temperature and salinity, but for practical purposes, the convention is that each metre imposes a pressure of 10 kPa = 0.101 3 bar. 1 msw = 3.28 feet of seawater (fsw).

meter-tonne-second system (m.t.s. system, M.T.S. system, or **metric-m.t.s.)** A metric system that has its derived constants relating coherently to the metre, the tonne and the second. The system was promulgated officially in France in 1919.

meter or **metre (m)**[591] Spelling of the basic unit of length in metric systems in most of the English-speaking world. The American spelling is due to Noah Webster (1758–1843), who condemned the "-re" ending in his influential speller and dictionary. The American Society for Testing and Materials and the U.S. Metric Association prefer "metre" and "litre."[592]

Methuselah A large wine bottle, used for sparkling wine in a Burgundy-shaped bottle, traditionally holding about 6.4 L, but now exactly 6.0 L, same size as the Imperial.[593] In the U.S., the Methuselah is traditionally said to equal 6 magnums = 12 standard bottles = 9.6 US qt = about 9.085 L, and the **metric Methuselah** = 9 L.

metre cubed (m^3) See *cubic metre*.

[591] Abbreviated, strictly lower-case form, though conspicuously used in upper-case, in contrast to the traditional m for mile, on British road-signs.

[592] American Society for Testing and Materials. *Standard for Metric Practice*. (ASTM E 380-82) American Society for Testing and Materials: Philadelphia, 1982.

[593] The bottle size is named after Methuselah, a Biblical patriarch described in the book of Genesis as having lived for 969 years.

metre hour degree Celsius per kilocalorie (m h °C/kcal$_{IT}$) A unit of thermal resistivity = 1.488 16 ft·h·°F/Btu = about 0.859 845 m·K/W.

metre kelvin (m·K) The SI unit of second radiation constant.

metre kelvin per watt (m·K/W) The SI unit of thermal resistvity = 1.730 73 ft·h·°F/Btu = about 1.163 m·h·°C/kcal$_{IT}$.

metre of water (mH$_2$O) A unit of pressure = 9.806 65 kPa.

metre per kilogram (m/kg) The SI unit of specific length = 1.488 16 ft/lb.

metre per second (m/s) The SI unit of velocity = 3.6 km/h = about 3.280 84 ft/s = about 2.236 94 mile/h.

metre per second cubed (m/s^3) The SI unit of jerk = 3.280 84 ft/s^3.

metre per second squared (m/s^2) The SI unit of acceleration = 3.280 84 ft/s^2.

metre second per kilogram (m·s/kg) See *reciprocal pascal reciprocal second*.

metre squared (m^2) The SI unit of slowing-down area, diffusion area and migration area.

metre squared per hour (m^2/h) A unit of kinematic viscosity = 277.778 cSt.

metre squared per newton second (m^2/(Ns)) See *reciprocal pascal reciprocal second*.

metre squared per second (m^2/s) The SI unit of kinematic viscosity, thermal diffusivity, diffusion coefficient and thermal dissusion coefficient = 1,000,000 cSt = about 10.763 9 ft^2/s.

metre to the fourth power (m^4) The SI unit of second moment of area = 115.862 ft^4.

metre-tonne-second system of units (mts-system) A system of physical units, invented in France and only adopted by the Soviet Union in 1933. It was abolished in 1955. The units of mts are as follows:

length: metre (m)
mass: tonne (t). 1 t = 10^3 kg
time: second (s)
force: sthene (sn). 1 sn = t·m/s^2 = 10^3 N
energy: kilojoule (kJ). 1 kJ = t·m^2/s^2 = 10^3 J
power: kilowatt (kW). 1 kW = t·m^2/s^3 = 10^3 W
pressure: pieze (pz). 1 pz = t/m·s^2 = 10^3 Pa.

metric . . . A general qualifier distinguishing a metric measure close to some traditional measure, e.g., metric horsepower.

metric carat A unit of weight = exactly 200 mg. It was adopted by the fourth CGPM in 1907 for diamonds, fine pearls and precious stones.

metric c.g.s. system See *c.g.s. system.*

metric c.g.s. e.m.u. system See *e.m.u. system.*

metric c.g.s. e.s.u. system se See *e.s.u. system.*

metric c.g.s. Gaussian system See *Gaussian system.*

metric-d.k.s. See *d.k.s. system.*

metric grain A unit of weight, sometimes used by jewelers, = 50 mg = 1/4 carat.

metric horsepower A unit of power, defined to be the power required to raise a mass of 75 kg at a velocity of 1 m/s. This is about 735.499 W = 0.986 32 horsepower. The unit is also known by its French name *cheval vapeur* or its German name *pferdestärke*.

metric hundredweight An informal unit of weight = 50 kg = about 110.231 lb. This is quite close to the traditional British hundredweight of 112 lb. The unit is also known by its German name, the zentner, or (in English) the centner.

metric inch An informal unit of length, during the twentieth century, used in some Soviet computers built from American blueprints, = 25 mm.

metric mile An informal unit of length, used mostly in athletics. The metric mile is = 1500 m. In U.S. high school competition, the term is sometimes used for a race of 1600 m.

metric mou In Iran, an obsolete metric unit of length = 1 mm.

metric quintal A metric unit of weight = 1 decitonne = 100 kg.

metric slug See *TME.*

metric stere Imaginary rick (or stack) of bolts of dimensions 1 m × 1 m × 1 m, sometimes used in Australia as a stack measurement.

metric system Name of any system used to measure things, but the term usually refers to various systems of units that include the metre or centimetre as the unit of length, the kilogram as the unit of weight, and the second as the unit of time, and that employ only decimal multiples and subdivisions of those units, which are identified by attaching prefixes to the names of the unit. The centimetre-gram-second and metre-kilogram-second systems are examples of obsolete metric systems used in scientific work.

metric technical unit of weight See *kilohyl.*

metric ton (t or **MT)** or **tonne** A alternate name for the tonne. By the original concept for defining masses in the metric system, a metric ton would be the mass of a cubic metre of water. In the U.S., the Department of Commerce recommends that the tonne be called the metric ton to distinguish it clearly from the traditional American ton. The proper symbol for the unit is simply t.

metric ton unit (mtu) A unit of weight used in mining to measure the mass of the valuable metal in an ore. Customarily, the metric ton unit is defined as being one metric ton of ore containing 1% metal, but it is the metal, not the ore, that is being measured. Thus, the unit is really a unit of weight = 10 kg.

metrification or **metrication** Name of the process of converting from the various other systems of units used throughout the world to that of metric or SI.

metrologist According to The Dictionary of Occupational Titles (4th ed., Rev. 1991), an official guidebook produced by the Employment and Training Administration of the US Department of Labor: "Develops and evaluates calibration systems that measure characteristics of objects, substances, or phenomena, such as length, mass, time, temperature, electric current, luminous intensity and derived units of physical or chemical measure. Identifies magnitude of error sources contributing to uncertainty of results to determine reliability of measurement process in quantitative terms. Redesigns or adjusts measurement capability to minimize errors. Develops calibration methods and techniques based on principles of measurement science, technical analysis of measurement problems and accuracy and precision requirements. Directs engineering, quality and laboratory personnel in design, manufacture, evaluation and calibration of measurement standards, instruments and test systems to insure selection of approved instrumentation. Advises others on methods of resolving measurement problems and exchanges information with other metrologist personnel through participation in government and industrial standardization committees and professional societies."

metrology Name for the science that covers three main tasks: the definition of internationally accepted units of measurement, the realisation of units by scientific methods, and the establishment of traceability chains in documenting the accuracy of a measurement. Categories of metrology: scientific metrology—units, fundamental constants, measurement standards, methods; industrial metrology—ensuring adequate functioning of measurement instruments in industry as well as in production and testing processes; legal metrology—concerned with the accuracy of measurements where these have influence on the transparency of economical transactions, health and safety; and Historical metrology—dealing with historical weights and measures.

Metropolitan Gas Referees Notification candle A unit of luminous intensity, defined in 1898[594] by the Metropolitan Gas Referees Notification in London as = $1/10^{th}$ of the output of a Harcourt pentane lamp.[595]

mev or **MeV** An abbreviation for megaelectronvolt = 10^6 electron volts = about 1.602 06 · 10^{-13} J.

meyer During the eighteenth century, a unit of acoustic pressure of unknown size.[596]

MF Deprecated abbreviation for microfarad.

M.F. [Medium Frequency] Radio frequency or radio-frequency band[597] in the range 300–3000 kHz. The standard AM broadcast band is 525–1715 kHz in North America, but remains only up to 1615 kHz elsewhere.

mf Deprecated abbreviation for microfarad.

mf or **mF** An abbreviation for millifarad.

mF.B.M. An abbreviation for 1000 FBM of sawn wood.

mfd Deprecated abbreviation for microfarad.

MFLOPS An abbreviation for Million of Floating Points Operations Per Second.

. . .**mg** An abbreviation for milligrade.

mg An abbreviation for milligram.

M.G. An abbreviation for miglio geographico.

MG Improper abbreviation for milligram, usually seen in contexts of upper-case-only printing.

mg.% A French abbreviation for milligram per 100 cc.

mg/dl An abbreviation for milligrams per decilitre.

mgal or **mGal** An abbreviation for milligal.

Mgd or **MGD** An abbreviation for millions of gallons per day (Mgal/d), a unit used in reservoir management to express the rate at which water is withdrawn, or could be withdrawn, for drinking or for some other purpose. 1 Mgd equals about 3.785 43 megalitres per day = 3785.43 cubic metres per day = 133,681 cubic feet per day.

mg/dL An abbreviation for milligram per decilitres, a unit used in medicine to measure the concentration of cholesterol and other substances in the blood. 1 mg/dL = 0.01 g/L.

mg-eq An obsolete abbreviation for "milligram equivalent", an equally obsolete name for the milliequivalent (mEq).

mg/kg Symbol for milligram per kilogram, a unit used in medicine to measure dosage rates. 1 mg/kg is equivalent to 10^{-6} g/g = 1 part per million based on the patient's body weight.

mH An abbreviation for millihenry.

MHa An abbreviation for million hectare.

mho ["ohm" spelt backwards] (℧, or sometimes $\mathbf{\Omega^{-1}}$) An obsolete[598] unit of electric conductance = 1 divided by the impedance of a

[594] The Metropolitan Gas Referees, who set British illumination standards, adopted the Vernon Harcourt standard lamp in 1898, in place of the old spermaceti candle.

[595] 1911: *Phys. Rev*. (Series I) **32**, 241–242.

[596] According to sizes.com: "Mentioned by Sacerdote in Giorgi.".

[597] Sometimes called mediumwave.

[598] It was deprecated in 1971, when the 14th General Conference on Weights and Measures approved the addition of the siemens.

circuit as measured in ohms.[599] This makes the mho the same as the siemens, except that the mho is used in circuits in which current is retarded by self-inductance as well as by resistance.

MHz An abbreviation for megahertz.

mi In the U.S., an abbreviation for mile.

mǐ In China, a metric unit of length = 1 m.

mi² In the U.S., an abbreviation for square mile.

mi³ In the U.S., an abbreviation for cubic mile.

miao [< Mandarin: = "ten-thousandth"] An early term that became si. See *si*.

mic An informal name for the microgram, pronounced "mike."

mic A unit of electric inductance, during the twentieth century, mainly used by the British Royal Navy 1920–1938, = 10^{-6} H.

Michaelis constant, **Michaelis concentration**, or **Michaelis-Menten constant** (**K_m**) Substance concentration of substrate at which the rate of reaction is = one half of the maximum rate. K_m could be expressed as: c(V − v)/v, in which c = substrate concentration, v = observed rate at substrate, and V = rate at saturation. The constant is named after the Canadian physician and biochemist Maude Leonora Menten (1879–1960) and the German–American biochemist Leonor Michaelis (1875–1949).

mickey A unit used in computer science in programming mice and similar input devices. One mickey is the length of the smallest detectable movement of the cursor on the screen. This depends on the equipment. Typical values are in the range 1/200 to 1/300 in = about 0.1 mm. The name comes from the Disney cartoon character Mickey Mouse.[600]

mickey A vernacular name for a half bottle of liquor = 1/10 U.S. gal = about 378.5 mL. As a metric unit = 375 mL.

micri-erg A unit of energy, used for describing the surface energy of molecules, = 10^{-14} erg = 10^{-21} J. The unit was proposed by the American chemist William D. Harkins (1873–1951) in 1922.[601]

micril Name suggested, by the American mathematician Professor Arthur William Conway (1875–1950), for unit of concentration = gammil. See also *gammil* and *microgammil*.

micro- (**μ-** or **mc-**) [< Gr: *mikro* = "small"] A metric and SI prefix denoting 10^{-6} (one millionth). The prefix is abbreviated as mc- or u- when the Greek letter mu (μ) is not available. Prefixed to "farad," it was often abbreviated as "m," as in "mmf," for micromicrofarad. In Chinese, the micro- is wei.

micro [<Gr: *mikro* = "small"] A vernacular term meaning small.

microampere (**μA**) A unit of electric current = 10^{-6} A.

microangstroem or **microångström** (**μÅ**) A linear measure = 10^{-6} Å.

microbar (**μbar**) The CGS unit of pressure, used in acoustics and sound engineering, = 0.001 mbar = 0.1 Pa = 1 barye = about 0.002 089 lb/ft².

microcentury A weird unit, invented by the American physicist and television personality Professor Julius Sumner Miller (1909–1987), who once was asked how long he wanted to speak to a group. He replied, "about a microcentury". A microcentury is about 52.5 min, close to a "standard" lecture period of 50 min.[602]

microcurie (**μCi**) A common unit of radioactivity. The microcurie equals 10^{-6} curie or 37 kilobecquerels; this corresponds to a radioactivity of 37,000 atomic disintegrations per second.

microdegree (**μdeg**) A unit of angle measure = a millionth of a degree = exactly 36 milliarcseconds.

[599] The name mho was used by Lord Kelvin at a meeting of Civil Engineers on May 3, 1883, according to: *Electrical Units of Measurements: Kelvin's Collected Papers*, Vol. V, Cambridge, 1910, p. 446.

[600] See www.mickey-mouse.com for more information about the cartoon figure.

[601] [HARK].

[602] harts.net/reece/humor/fun-with-units

microeinstein (μE) A unit of light energy concentration used in measuring the flux or density of light or any form of electromagnetic radiation $= 10^{-6}$ einstein = one micromole of photons. The density of photosynthetically active radiation, for example, is reported as μE/s·m^2.

microequivalent (μEq or **μeq)** A unit of relative amount of substance $= 10^{-6}$ equivalent weight. This unit is used, for example, in stating the concentration of ions in drinking water. See also *milliequivalent*.

microfarad (μF) A common unit of electric capacitance $= 10^{-6}$ farad.

microflick (μf) A unit of spectral radiance, used in optical and communications engineering, $= 10^{-6}$ flick = 1 microwatt per steradian per square centimetre of surface per micrometre of span in wavelength = 10 milliwatts per steradian per cubic metre.

microgammil Name suggested by Professor Arthur W. Conway (1875–1950) for a unit of concentration = gammil. See also *gammil* and *micril*.

microgram (μg or **mcg** (North American practice)) A metric unit of weight = 0.001 mg. Ingredients of drugs and vitamins are often stated in micrograms.

microinch or **micro-inch (μin)** A vernacular term for 10^{-6} in = 0.001 mil = 25.4 nm. The microinch is used rather widely to state the roughness of optical surfaces, precise tolerances in machining, and for other industrial purposes.

microkatal (μkat) A unit of enzyme activity = 1 μmol/s.

microlenat See *lenat*.

microliter, microlitre (μl, **μL**, **mcl**, or **mcL)** or **lambda** A metric unit of volume, = 0.001 mL = 1 mm^3. Microlitres are used in chemistry and medicine to measure very small quantities of liquid.

micrometer or **micrometre (μm)** A common metric unit of length = 0.001 mm = about 0.039 370 mil.

micromicro- (μμ-) An obsolete metric prefix denoting 10^{-12}. The prefix has been replaced by *pico-* (p-).

micromicron (μμ) A former name for a millionth of a micron $= 10^{-12}$ m. The name bicron was also used for this unit, which is now called the *picometre* (pm).

micromillimetre (μm) A metric unit of length = 0.000 001 m.

micromole (μmol) A unit of amount of substance = a millionth of a mole. This unit is very commonly used in biochemistry, since a mole of a large organic molecule can be quite a large amount.

micron (μ) [shorter name for the micrometre; the symbol μ was adopted in the 1890s.] An obsolete metric unit of length $= 10^{-6}$ m = about 39.370 08 μin.[603] It was adopted in 1879 by the CIPM[604] and again in Resolution 7 of the 9th CGPM in 1948. In 1968,[605] the thirteenth CGPM abolished the micron (Resolution 7) and recommended that micrometres be used instead. See also *millimicron*.

micron of mercury (μHg) An obsolete unit of fluid pressure $= 10^{-3}$ mmHg = about 0.133 322 4 Pa.

microrad (μrad) A unit of radiation dose = a millionth of a rad or 10 nanograys.

microradian (μrad) A unit of angle measure $= 10^{-6}$ radian = about 0.208 533 milliarc seconds (mas).

microrem (μrem) A unit of effective radiation dose = a millionth of a rem = 10 nanosieverts. Doses in this range are much smaller than those provided by natural sources of radioactivity in the environment.

microsievert (μSv) A unit of radiation dose $= 10^{-6}$ Sv = 0.1 millirem. The radiation doses resulting from exposure to natural sources such as radon gas in the atmosphere are often measured in this unit.

microstrain A common engineering unit measuring strain. An object under strain is typically deformed (extended or compressed), and the strain is measured by the amount of this deformation relative to the same object in an undeformed state. One microstrain is the strain

[603] Also an SI-deprecated name for the micrometre.

[604] BIPM. Proc.-Verbeaux Com. Int. Poids et Mesures. p. 41.

[605] *Nature*, 1968: **220**, 651.

producing a deformation of one part per million (10^{-6}).

microtesla (μT or mcT) A common unit of magnetic field intensity = 10^{-6} tesla. The unit is widely used to measure the strength of electromagnetic fields generated by powerlines or electronic equipment. By comparison, the strength of the Earth's own magnetic field at the surface is about 50 microteslas. One microtesla equals 0.01 gauss.

microtorr (μTorr) An obsolete unit of fluid pressure = $1.333\,22 \cdot 10^{-4}$ Pa.

microwatt (μW) A unit of work = 10 ergs/s.

midi A vernacular term meaning intermediate in size.

midrange Halfway point or midpoint in a set of observations. For most types of data, it is calculated as the sum of the smallest observation and the largest observation, divided by two. For age data, one is added to the numerator. The midrange is usually calculated as an intermediate step in determining other measures.

mijle In the Netherlands, a metric unit of length = 1 km.

mikrotuki or **mikrotukihenkilö** [Finnish: = "microcomputers systems support person"] A jocular unit of PC systems support = one workday of one competent PC systems support person. Originally coined at the Nokia Research Center in Helsinki, Finland. See also *pikotukihenkilö*.

mil, **milia**, **mill**, **mille**, **millia**, or **miliare** During **the** twelfth–nineteenth centuries, an expression for a thousand times. Occasionally abbreviated as M or m.

mil ["milli-inch"] A unit of length = 0.001 in = exactly 25.4 microns. It was primarily used in the U.S. to express small distances and tolerances in engineering work. The thickness of plastic trash bags, for example, is usually given in mils. In Britain, this unit is usually called the thou (thousandth of an inch).

mil or **artillery mil (‰)** A unit of angle used in the military for artillery settings. One artillery mil = the angle subtended by an arc of 1/6400 circumference = exactly 0.056 25°= about 0.000 981 747 704 radian. During World War II, the U. S. Army often used a mil, the old infantery mil, = 1/1 000 of a right angle = 0.1 grad = 0.09° = 5.4 arcminutes (often written as 5.4 moa). More recently, various NATO armies have used a mil = 1/1600 right angle = 0.056 25° = 3.375 moa. In target shooting, the mil is often understood to mean 0.001 radian = 1 milliradian = about 0.057 3° = 3.437 75 moa. In Britain, the term angular mil generally refers to the milliradian, which corresponds to a target size of 10 cm at a range of 10 m. See also *millième*.

mil In Britain, during the twentieth century, an abbreviation mainly used in pharmacies, for the millilitre.[606]

mil An alternate spelling of the *mill*.

mile of line A unit of length, used by railway navvies, = 5 miles of track.

mile of track A unit of length, used by railway navvies, = 1/5 mile of line = 1 mile.

mile ohm or **mile-ohm** A unit of weight of a one mile wire that has a resistance of 1 Ω at 60°F. For aluminium = about 384 lbs; soft copper = about 859 lbs; hard copper = about 880 lbs and iron = about 4600 lbs.

mile per gallon (mile/UKgal) In Britain, a unit of reciprocal fuel consumption rate of motor vehicles. λ miles per British imperial gallon is = $282.481/\lambda$ litres per 100 km. One mile/Imp gal = 0.832 674 mile/U.S. gal = 0.354 006 km/L.

mile per gallon (mi/gal, mile/USgal, or mpg) In the U.S., a unit of reciprocal fuel consumption rate of motor vehicles. δ miles per U.S. gallon is = $235.215/\delta$ litres per 100 km, and 1 mi/gal = 1.200 95 mile/UKgal = 0.425 144 km/L.

mile per hour (mi/h, mile/h, or mph) In Britain and the U.S., a unit of velocity = exactly 22/15 ft/s = exactly 1.609 344 km/h = exactly 0.447 04 m/s.

mile pound or **mile-pound** A unit of work, used in mechanics, = 5280 foot-pounds = about 7158.7 J.

[606] Authorized by the Board of Trade in: *Weights and Measures Regulation*, No. 698. London: HMSO, 1905.

mile, **standard cable (m. s. c.)** A unit of power ratio used for telephone transmissions by the British Post Office until 1923, defined as the ratio between the powers of an 800-Hz signal at the two ends of a loop of cable one mile in length having a weight of 20 lb, a resistance of 88 Ω, an inductance of 1.0 mH, a capacitance of 1.054 μF, and a leakance of 1.0 μmho. In the U.S., the m. s. c. had the same values, except that weight, inductance and leakance were not defined. Because the mile of standard cable is frequency-dependent, it cannot actually be converted to units of power ratio that are not, such as the decibel. Nonetheless, 1 m.s.c. is about 0.922 1 dB.[607]

mil-foot or **circular mil-foot** A mil-foot is a section of wire one foot long and one mil in diameter; this would be a unit of volume = 0.037 7 in^3 = 0.617 8 cm^3. However, the unit is used primarily in statements of resistivity in ohms per mil-foot or of density in pounds per mil-foot.

milipulgada circular See *mil circular*.

military pace Another name for a step. In the U.S. Army, the military pace is defined as being exactly 30 in = 76.2 cm for ordinary "quick time" marching and 36 in = 91.44 cm for double time marching. The same definitions are generally used by marching bands.

mill A unit of quantity or of proportion = 0.001. For example, when the Congress established the U. S. monetary system in 1791, it provided for 10 mills to the cent and 100 cents to the dollar; thus, the mill was an amount of money = $0.001.

mill Slang for one million.

mille The Latin word for 1000, sometimes used in English in very learned or literary contexts. See also *mil* and *mile*.

millenary A unit of quantity = 1000.

Miller indices A symbolic vector representation, proposed in 1839 by the British mineralogist William Hallowes Miller (1801–1880), for the orientation of an atomic plane in a crystal lattice and defined as the reciprocals of the fractional intercepts which the plane makes with the crystallographic axes.[608]

millerium See *mil*.

millesimal With divisor/multiplier steps of 1000, in contrast with the steps of 10 for decimal and of 100 for centesimal.

millesimal fineness A system of denoting the purity of platinum, gold and silver alloys by parts per thousand of pure metal in the alloy.[609]

millesimo [*pl.* millesimi] The Italian name for a 1/1000 part of any unit = 1/10 centesimo.

millesimo [*pl.* millesimi] In Italy, during the eighteenth–nineteenth centuries (before 1840), a prefix signifying the thousandth part of any weight or measure.

milli- (m-) [coined from the Latin number *mille* = "one thousand"] The metric and SI prefix denoting 0.001 (one thousandth). In Chinese, the milli- is hao.

millia See *mil*.

milliampere (mA) A common unit of electric current = 0.001 A.

milliar A metric unit of area = 0.001 a.

milliare See *mil*.

milliampere hour (mA·h) A common unit of electric charge, used (for example) in stating the capacity of batteries for cell phones and other electronic equipment. One milliampere hour is the charge accumulated by a current of 1 mA/h = 3.6 C.

milliangstroem or **milliångström** See *X-unit*.

milliarcsecond (mas) A unit of angular measure commonly used in astronomy. One milliarcsecond is = 0.001 arcsecond = 16 2/3 microdegrees.

milliard A unit of quantity = 10^9, which is what Americans call a billion.

milliard A unit of volume, used by engineers to describe a large quantity of water, = 1 km^3 = 10^9 m^3 = about 810,767 acre feet.

millibar (mbar or **mb)** A metric unit of atmospheric pressure, used in meteorological barometry, = 0.001 bar = 100 Pa = 1000 dynes/cm^2

[607] See also: [HERB].

[608] For more information, see: [GIAC].

[609] It is an extension of the older carat system of denoting the purity of gold by fractions of 24, such as "18 carat" for an alloy with 75% (18 parts per 24) pure gold.

= about 0.029 5 in = 0.750 2 mm of mercury = about 0.014 504 lb/in^2. The most appropriate SI unit for atmospheric pressure is probably the kilopascal (= 10 mbar).

millibarn A unit used in nuclear physics to measure cross-sections of subatomic particles. One millibarn equals 10^{21} sheds = 10^3 outhouses = 10^{-3} barn = 10^{-28} m^2.

millicron See *millimicron*.

millicurie (mCi) A common unit of radioactivity, representing radioactivity at the rate of 37 million atomic disintegrations per second = 37 megabequerels.

millicuries—destroyed (mcd or **mc.d.)** A unit of X-ray dosage, used during the twentieth century and mainly in regards to radon in France. It was defined as a dose equivalent to that emitted from a radioactive source during the time its radioactiy falls by a millicurie.[610]

millidegree (mdeg) A unit of angle measure = 0.001° = exactly 36 arcseconds.

millidegree (mdeg) A unit of temperature = 0.001°, usually meaning 0.001 °C.

millième In France, a unit of plane angle used in artillery = 0.000 999 996 6 radian.

milliequivalent (mEq or **meq)** A unit of relative amount of substance commonly used in chemistry and the biological sciences. One mEq equals 0.001 equivalent weight.

millier [Fr: = "thousand"] A former name for the metric unit = 1000 kg, the metric tonne. It was used in Britain[611] to avoid confusion with the British long ton. In the U.S., use of the millier was authorized by the Act of July 28, 1866, but was delegalized in 1982.[612] See also *bar*.

millifarad (mF) A common unit of electric capacitance = 0.001 farad.

millig In France, a unit of nuclear activity = 10^{-5}.

milligal (mGal or **mgal)** A unit of acceleration used in geology to measure subtle changes in gravitational acceleration = 10 μm/s^2 = 10^{-5} m/s^2. The unit should be called the **milligalileo**.

milligauss (mG) A unit of magnetic flux density = 0.001 gauss = 0.1 μT.

milligrade (...$^{\mathbf{mg}}$) A unit of plane angle = 0.001 grade.

milligram or **milligramme (mg)** A metric and SI unit of weight equal to 1/1000 g = about 0.015 432 grain = 35.274 · 10^{-6} ounce.

milligram per litre (mg/l or **mg/L)** A metric unit of (mass) density = 10^{-3} kg/m^3.

millihelen A proposed jocular unit of beauty. As the astonishingly beautiful Helen of Troy had 'a face that launched a thousand ships,' a millihelen is = the ability to launch one ship.

millihenry (mH) A metric unit of electric inductance = 0.001 henry.

millihg An informal name (pronounced "millig") for the millimetre of mercury.

milli-inch (min) A unit of length = 10^{-3} in = exactly 2.54 · 10^{-5} m. See also *mil*.

millijoule (mJ) A metric unit of work or energy = 0.001 J = 10^4 ergs.

milli-k or **millik** [The origin of the name is that *k* is a common symbol for reactivity] A unit used in nuclear engineering to describe the "reactivity" of a nuclear reactor = a reactivity of 0.001 or 0.1%. This unit was introduced into the Canadian nuclear power industry. See also *inhour*.

millilambert (mLb) A common metric unit of illumination = 10 lux.

milliliter or **millilitre (ml** or **mL)** The metric and SI unit of capacity = 1/1000 L = 1 cm^3 = about 0.061 023 7 in^3 = 16.231 U.S. minims.

millimass unit (mu or **mmu)** A unit of weight = 0.001 atomic mass unit, used in physics and chemistry. This unit is also called the **millidalton**. The millimass unit is an SI unit, but its proper SI symbol is mu, not the older symbol mmu.

millimeter or **millimetre (mm)** The metric and SI unit of length = 0.001 m = 0.039 370 08 in.

millimeter-milligram-second system of units A system used in the 1850s by the German physicist Wilhem Eduard Weber (1804–1891) in the first experiments defining electrical units in absolute terms.

[610] *Glossary of terms used in radiology*, British Standard 2597:1955, p. 59.

[611] Defined in the 1878 Weights and Measures Act.

[612] 47 Federal Register 8399–8400.

millimetre of mercury (mm Hg) [Hg is the chemical symbol for mercury] A unit of pressure = the pressure exerted at the Earth's surface by a column of mercury 1 mm high. When a traditional mercury barometer is used, the pressure is read directly as the height of the mercury column in millimetres. One millimetre of pressure is equivalent to about 0.0393 7 in Hg = 0.019 33 lb/in^2 = 1.333 22 mbar = 133.322 Pa.

millimetre of water (mm H_2O, mm WC, mm CE, or mm WS) [H_2O is the chemical symbol for water] A unit of pressure = the pressure exerted at the Earth's surface by a column of water 1 mm high = about 9.806 65 Pa = 0.098 066 5 mbar = 0.039 37 inch of water = 0.204 lbs/ft^2. The French symbol is mm CE (*colonne d'eau*), and the German symbol is mm WS (*Wassersäule*).

millimicro- (mμ-) An obsolete (introduced in 1960, but no longer acceptable) metric prefix denoting 10^{-9} = one billionth. This prefix has been replaced by *nano-* (n-).

millimicrofarad See *nanofarad*.

millimicron (mμ) or **millicron** An obsolete metric unit of length = 10 ångstrom = 0.001 micron = 10^{-9} m. The millimicron has been replaced by the nanometre (nm).

millimillimillion Name, devised by the number-theorist Rudolf Ondrejka (1928–2001), for the number $10^{6\ 000\ 000\ 000}$.[613]

millimole (mmol) A unit of amount of substance = 0.001 mole.

milline A traditional British unit of advertising = the width of a line of "agate" type (5.5 points, or about 2 mm) times the width of a column times one million copies of a publication.

millinewton (mN) A metric unit of force = 0.001 N = 100 dynes = about 0.101 972 gram of force (gf).

millinile A unit used in British nuclear engineering to describe the "reactivity" of a nuclear reactor. One millinile is a reactivity of 10^{-5}. See also *inhour*.

[613] [CROS3].

millioersted (mOe) Name sometimes used for the milligauss as a unit of magnetic flux density.

million floating-point operations per second (MFLOPS) A measure of the numeric calculating power of a computer, especially in fields of scientific calculations that make heavy use of floating point calculations. Technically, the number of such operations that can be executed in a second, but this varies considerably with the mixture of instructions that a particular program has. The practical reality is usually measured by standardized programs like dhrystone, livermore loops and linpack.

million instructions per minute (MIM) A unit used in computer science = number of instructions computed per unit of time. 1 MIM = $6 \cdot 10^6$ instructions/s.

milliosmole (mOsm) A unit of osmotic pressure = 0.001 osmole, commonly used in biology and medicine.

millipascal second (mPa·s) The SI unit of dynamic viscosity = the centipoise (cP). This unit is gradually replacing the centipoise in many contexts.

millipoise (mP, mPs, or mPo) A metric unit of dynamic viscosity = 0.001 poise = 0.1 mPa·s.

millirad (mrad) A unit of radiation dose = 0.001 rad = 10 micrograys.

milliradian (mrad) A unit of angle measure = 0.001 radian = about 0.057 296° = 3.437 75 arcminutes = 3″ 26.265′.

millirem (mrem) A common unit of radiation dose = 10 microsieverts (μSv). A millirem is roughly the radiation dose you would receive from wearing a luminous dial watch for a year.

millirubbia (mR) A jocular unit of speaking rate, usually for a technical talk. It is said to be derived from the Italian physician and Nobel laureate Carlo Rubbia (b. 1934), who was reported as always speaking at 1 R, while a normal person might be measured at about 100 mR.

millisiemens (mS) A common unit of conductance = 0.001 S = 1 mA/V of potential difference. The millisiemens is often used to measure the salinity of seawater or brackish water, since adding salt to water makes it much more conductive of electricity.

millisievert (mSv) A unit commonly used to measure radiation dose = 0.001 Sv = 0.1 rem.

millistere A metric unit of volume = 0.001 m^3.

millitorr (mTorr) An obsolete unit of fluid pressure = $1.333\ 22 \cdot 10^{-1}$ Pa.

millivolt (mV) A common unit of electric potential = 0.001 V.

milliwatt (mW) A common unit of power = 0.001 W.

MIM An abbreviation for million instructions per minute.

min An abbreviation for milli-inch.

min An abbreviation for minim (U.K. or U.S.) and minimum.

min An abbreviation for minute.

-minex A suffix, proposed by the Japanese mathematician Tadashi Tokieda (b. 1968), used to create small numbers. The number n-minex is 10^{-n}, which is 0.000. . .0001 with a total of $n - 1$ zeros between the decimal marker and the 1. Thus, one is zerominex or 0-minex, and one millionth (0.000001) is 6-minex. See also *-dex* and *-plex*.

mini A vernacular term meaning small.

minimal erythema dose (MED) or **skin erythema dose (SED)** A unit that refers to the reddening of the skin in sunburn. The skin's reaction to sun exposure varies according to the individual. Each skin type is able to accept a specific amount of UV rays before burning. The amount of time an individual can stay in the sun before burning reflects the minimal erythema dose (MED).[614] The MED and expected sun exposure, in turn, determines the proper SPF[615] for a skin type.

minute (min or ′) [< L: *minutus* = "small"] A unit of time = 60 s = 1/60 h. The SI specifies min as the symbol for the time unit and ′ as the symbol for the arcminute. The symbol mn was formerly used in France.

minute (′, m, or **moa)** A unit of plane angle = 60 arcseconds = 1/60 degree = π/10,800 rad = 400/21,600 grade. This unit is often called the arcminute to distinguish it from the minute of time. The SI defines min as the symbol for the time unit and recommends ′ as the symbol for the arcminute. The symbol moa ("minute of angle") is often used in target shooting. ISO 31 recommends that angles be stated in degrees and decimal fractions of the degree, without use of arcminutes and arcseconds.

minute (′ or m) A unit of longitude used in astronomy. Astronomers measure longitude (or "right ascension," as they call it) in time units by dividing the equator into 24 h instead of 360 degrees. This makes one minute of longitude or right ascension = 15 arcminutes.

minute See *centesimal minute*.

minute difference A change in the elements of the nautical almanac caused by a 1-minute step of time.

MIPS or **mips** An unit of computing power = one million instructions per second. An "instruction" is a single program command to the computer's central processor. In a particular computer, there is a definite relationship between the rate at which instructions are processed, in mips, and the "clock speed" of the processor, measured in MHz.

mired [micro-reciprocal degree; pronounced *my-red*] or **micro-reciprocal megakelvin (MK^{-1})** A unit, used in colorimetry and photography to measure the wavelength of light, especially for selecting filters to adjust the "color temperature," defined as one millionth of the reciprocal of the color temperature expressed in kelvin.[616] Thus, a temperature of 4000 K corresponds to a reciprocal degree of $250 \cdot 10^{-6}$ and is = 250 mired, while 80,000 K is equivalent to 12.5 mired. The unit was suggested, as micro-reciprocal-degree absolute

[614] It is considered that 600 MED/yr over a period of 30 years will produce skin cancer.

[615] The Sun Protection Factor (SPF) tells you the relative length of time you can stay in the sun before you burn, compared to using no sunscreen. SPF only applies to UVB radiation.

[616] See also: *Measurement of the Color Temperature of the More Efficient Artificial Light Sources by the Method of Rotatory Dispersion*, US Bureau of Standards Scientific Papers 443.

centigrade, by the American physicist Irwin G. Priest (b. 1886) in 1933.[617]

MIRS An abbreviation for Metrology Institute of the Republic of Slovenia.

Missy Elliot A jocular unit of length, used by the Scottish writer James Docherty (b. 1956), to describe the distances the artist would cover in various situations, = 157.48 cm.

MIU A symbol for one million international units. Dosages of certain drugs, such as various forms of interferon, are commonly stated in this unit.

MJ An abbreviation for megajoule.

mKB A symbol for metres below the kelly bushing, a unit used in the oil industry to express the length of the drillstring, the total length of an oil well. The kelly bushing is the device at the top of the drillstring that turns the entire string. The length of the drillstring is usually less than the vertical depth of the well, since the drilling is usually at more or less of a slant away from the vertical. The vertical depth of the well is recorded as metres subsurface (mSS).

mkp A common symbol for the metre kilopond, a metric unit of torque, = 9.806 65 Nm.

MKS An abbreviation for the measurement system metre-kilogram-second.

MKSA An abbreviation for the measurement system metre-kilogram-second-Ampere.

ml An abbreviation for millilitre.

mL An abbreviation for millilitre.

m/m An abbreviation for "by mass," used in chemistry and pharmacology to describe the concentration of a substance in a mixture or solution. 2% m/m means that the mass of the substance is 2% of the total mass of the solution or mixture.

mm An abbreviation for millimetre.

mm/Hg An abbreviation for millimetre of Mercury.

MM An abbreviation for one million, seen in a few obsolete units such as those listed below. The abbreviation is meant to indicate one thousand thousand, M being the Roman numeral 1000. However, MM actually means 2000, not one million, in Roman numeration.

MMb, MMbo Symbols for one million barrels of oil. See *megabarrel*.

MMBF or **MMBM** Symbols sometimes used in U.S. forestry for one million board feet. One MMBF represents a volume of 83,333 cu ft = 2360 m^3. "BM" stands for "board measure."

MMBTU, **MM Btu**, or **dekatherm** An obsolete symbol for one million Btu, = 1.055 057 GJ, a unit used widely in the energy industry.

MMCF A symbol for one million cubic feet = 28,316.85 m^3.

mmf An abbreviation for magnetomotive force.

mmHg An abbreviation for conventional millimetre of mercury.

mmH$_2$O An abbreviation for conventional millimetre of water.

mmQS A German abbreviation for *Millimeter Quecksilbersäule* = conventional millimetre of mercury.

MM scfd A symbol for one million standard cubic feet per day, the customary unit for measuring the production and flow of natural gas. "Standard" means that the measurement is adjusted to standard temperature (60 °F or 15.6 °C) and pressure (1 atmosphere).

mmscmd An abbreviation for million metric standard cubic metre per day.

mmWS A German abbreviation for *Millimeter Wassersäule* = conventional millimetre of water.

M/N value A pre-WWII unit, used in radiation chemistry, = the number M of molecules converted from N ion-pairs which are formed in a gas by radiation.

MO A French abbreviation for mégaoctet.

-mo A "unit" traditionally used in printing to describe the page size of a book or other publication. In traditional printing, large sheets are printed, folded, and then cut to manufacture the book. After the cut is made, the sheet has been divided into a certain number of "leaves." Each leaf, folded at the spine of the book, comprises two pages front and back. When sheets were cut to form 4, 8, or 12 leaves, the resulting pages were described as quarto (4to), octavo (8vo) or

[617] [PRIE2].

duodecimo (12mo), respectively. Later, the suffix -mo from *duodecimo* was made into a suffix which can be attached to any number to indicate the number of leaves per sheet; thus, 16mo indicates 16 leaves per sheet.

moa An abbreviation for "minute of angle," that is, for the arcminute. This unit is commonly used in target shooting to express the angular size of targets or the spacing between marks on a reticle. By coincidence, 1 moa is very nearly a target size of 1 inch at 100 yards. In metric units: 1 moa = 2.908 9 cm at 100 m.

mob [<L: *mobile* = "excitable crowd"] A large number of people, particulary acting together in an unruly manner.

mob [<L: *mobile* = "excitable crowd"] In Australia, a name used for a grouping of several hundred animals being moved to market or other location, possibly thousands of cattle, tens of thousands of sheep.

Modern Galactic Light Time (MGLT) A standard measurement for subspace velocity in the movie Star Wars, approximately = 10 km/h.

module [<L: *modus* = "measure"] A measurement set within an industry, for instance, 8 in has been widely used in the building industry, for bricks, door-frames, panelling, etc., these having integer multiples of the said module for all their gross dimensions.

module [<L: *modus* = "measure"] In the U. S., a unit of volume used for raw cotton. When cotton is harvested, machinery is used to compact it into bundles, called modules, for transportation to the gin. A cotton module is 8 f. by 8 f. by 20 ft = 1280 ft^3 = about 36.25 m^3.

mohm [derived from mobile ohm] A CGS and MKS unit of mechanical mobility for sound waves = the reciprocal of the mechanical ohm unit of impedance. 1 $mohm_{MKS}$ = 1 m/(N s) (s/kg in base MKS-terms); 1 $mohm_{CGS}$ = 1 cm/(dyn s) (s/g in base CGS-terms). The name was devised by Leo L. Beranek (b. 1914) in 1954.[618]

Mohr cubic centimetre or **Mohrs cm^3 (cc)** During the nineteenth century, a unit of volume used in saccharimetry when defining the litre = the volume occupied by 1 g of H_2O at 17.5 °C = about 1.002 38 cm^3. At the time, this temperature made calibration easy in central European laboratories, which were poorly heated. Later, the standard temperature was taken to be 3.98 °C, at which water has its maximum density. The unit is named after the German pharmacist[619] Karl Friedrich Mohr (1806–1879).[620]

moiety [<Fr: *moitié*] Another name for a half.

Moisture Content (M.C.) The weight of water contained in wood expressed as a percentage of the weight of the oven dry wood.

mol An abbreviation for mole.

molal (m) and **molar (M)** These notations, traditionally used by chemists to describe the concentration of chemical solutions, often appear to be units of measurement.[621] It is easy to get them confused. The term "molal" describes the concentration of a solution in moles per kilogram of solvent (mol/kg), while "molar" describes a concentration in moles per litre (mol/L). A solution described as 1.0 μM has a concentration of 1.0 μmol/L.

molality (m) Number of moles of a solute per kilograms of solvent.[622]

molar fraction Ratio of the number of molecules or gram molecules of a specific constituent to the total number of molecules or gram molecules in the mixture.

molar volume or **mole volume** A unit used by chemists and physicists to measure the volumes of gases. The Ideal Gas Law says that the volume V of a gas is related to its temperature T and pressure P by the formula PV = nRT, in which n is the number of moles of gas present

[618] [BERA].

[619] [SCHÜ2].

[620] [LAIT].

[621] These units are not approved by the General Conference on Weights and Measures; their use is declining, but still substantial.

[622] For aqueous solutions, since water has a density of 1.00 g/cm^3 at 20 °C, 1.00 L of water weighs 1000 g. Thus, for diluted aqueous solutions, the molality and molarity have essentially the same value. For other solutions or for concentrated aqueous solutions, this is no longer the case.

and the gas constant R equals 8.314 joules per mole per kelvin. The molar volume is the volume one mole of gas occupies at 0 °C and 101.325 kPa = about 22.414 L.[623]

molarity (**M** or ***M***) Number of moles of solute dissolved into one litre of solution. The unit, therefore, of moles per litre, specifically moles of solute per litre of solution.

mole (mol), **gram mole**, **gram molecule**, or **gram molecular weight (gmol** or **gmole)** [molecule] Fundamental SI unit of the amount of a substance. Moles measure the actual number of atoms or molecules in an object. When the mole is used, the user must specify what elementary entity is meant, which may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles. The mole was defined by the CIPM in 1967 and adopted in 1971 by the 14th CGPM (Resolution 3) as the amount of substance of a system that contains as many elementary entities as there are atoms in 12 g of carbon-12. In 1980, the CIPM added that it is understood that the atoms of carbon-12 referred to are at rest and in their ground state. The actual number of "elementary entities" in a mole is called Avogadro's number, after the Italian chemist and physicist Amedeo Avogadro (1776–1856).[624] Careful measurement determines Avogadro's number to be about $6.022\,140\,857(74) \cdot 10^{23}$ entities per mole. One mole of a perfect gas at a temperature of 0°C and a pressure of 101 325 Pa has a volume of about 22.414 L.

molecular mass (formerly also **molecular weight) (MW)** A name for the mass of one molecule of that substance, relative to the unified atomic mass unit. Sometimes referred to as the relative molecular mass.

mole per cubic metre (mol/m^3) The SI unit of concentration.

mole per kilogram (mol/kg) The SI unit of molality and ionic strength.

mole per litre (mol/l or mol/L) A unit of concentration = 1000 mol/m^3 = 1 mol/dm^3.

mole per second (mol/s) The SI unit of molar flow rate.

mole volume See *molar volume*.

mol.wt. An abbreviation for molecular weight.

momme or **monme** [匁] In the U.S., a premetric unit indicating the quality of silk cloth, used in trade with Japan in silk cloth, = the weight in lb of 100 yd of silk cloth 45 inches wide.

momme A unit used to measure the density per unit area of silk. The measure is the weight in momme of a standard strip of silk 25 yd long by 1.49 in wide = 1 341 in^2 = about 0.865 2 m^2. This makes the silk momme = 4.33 g/m^2.

mon A unit, proposed in 1964,[625] used for describing the flatness of rolled steel plates. A surface has a flatness of 1 mon if no part of it is more than 25 μm above or below a straight line drawn between any two points 1 m apart on the surface.

monad [<Gr: *mónas* = "single", "unique")] A indivisible, impenetrable unit of substance viewed as the basic constituent element of physical reality in the metaphysics of Gottfried W. von Leibnitz (1646–1716).

monad [<Gr: *mónas* = "single", "unique")] In chemistry, an atom or radical with valence 1.

mooney A unit of plasticity, especially of pre-vulcanized rubber or comparable synthetics. It is determined by a specific procedure in which the material under test is rotated 2 revolutions per minute at a temperature of 100°C. The resulting torque on a disk is measured on a scale calibrated between 0 and 200 in relation to the length of time that the measured twisting has been going on.[626] The unit is named after the American chemist and rheologist Dr. Melvin Mooney (1893–1968).

MOPS An abbreviation for million operations per second.

[623] Occasionally, the term "molar volume" is used for the volume occupied by a mole of a substance which is not a gas; in such cases, the molar volume will be different for each substance.

[624] See [MORS2].

[625] [PEAR].

[626] *Methods of Testing of Raw Rubber*, British Standards 1763, Pt. 3, 1951. The method was first devised in [MOON2].

morgan (M) A unit of genetic separation, used in genetics and biotechnology. If two locations on a chromosome have a 100% probability of being separated during recombination in a single generation, then the distance between those locations, estimated to be about 300 μm, is one morgan. In practice, measurements are made in centimorgans. The unit is named after the American geneticist Thomas Hunt Morgan (1866–1945), who received the Nobel Prize for Medicine in 1933 for his pioneering work in studying the genetics of the fruit fly *Drosophila*.

Moszkowski unit (Mu) A unit of magnetic transition probability used in nuclear physics, 16 times bigger than the Weisskopf unit. It was suggested in 1955.[627] See also *Weisskopf unit*.

Motzkin number Name of the number that describes the number of paths from the southwest corner of a grid to the southeast corner, using only steps northeast, east, and southeast. The Motzkin number is also defined as the number of ways of drawing any number of nonintersecting chords among n points on a circle. It is named after the Israeli-American mathematician Theodore Motzkin (1908–1970). The first 30 numbers are: 1, 1, 2, 4, 9, 21, 51, 127, 323, 835, 2,188, 5,798, 15,511, 41,835, 113, 634, 310,572, 853,467, 2,356,779, 6,536,382, 18,199,284, 50,852,019, 142,547, 559, 400, 763,223, 1,129,760,415, 3,192,727,797, 9,043, 402,501, 25,669,818,476, 73,007,772,802, 208, 023,278,209 and 593,742,784,829.[628] See also *Delannoy number*.

mouse unit (MU or **U)** An unofficial unit of toxicity used in pharmacology. A mouse unit is the dose of a toxin that kills 50% of mice (that is, the LD_{50} dose for mice). Typically, the mice are assumed to have a mass of 20 g, the toxin is administered by intraperitoneal injection, and mortality is measured over a standard period that may vary according to the toxin. The size of the mouse unit (in mL or international units) depends on the specific toxin.

mp An abbreviation for melting point.

MPa An abbreviation for megapascal.

mPa An abbreviation for millipascal.

MPc An abbreviation for megaparsec.

mpc An abbreviation for milliparsec.

MPG or **m.p.g.** An abbreviation for miles per gallon.

mph An abbreviation for milliphot.

MPH, m.p.h., or **mph** An abbreviation for miles per hour.

mq An Italian abbreviation for the square metre (*metro quadrato*). Similarly, cmq is a square centimetre and kmq is a square kilometre. These are non-standard symbols; the correct symbol for the square metre is m^2.

Mr An abbreviation for relative molecular mass.

mrem An abbreviation for millirem.

Ms An abbreviation for Margoulis number.

ms An abbreviation for millisecond.

m/s An abbreviation for metre per second.

MSL An abbreviation for mean sea level.

msw An abbreviation for metres of seawater.

MT A common U.S. abbreviation for the metric ton or tonne (1000 kg).

MT An abbreviation for megatonne.

MT An abbreviation for million tonne.

M/T A French abbreviation for metric tonne.

mt An abbreviation in the US, particulary in business litterature, for metric tonne.

MTOPS An abbreviation for million theoretical operations per second.

m.t.s. system An abbreviation for metre-tonne-second system.

M.T.S. system An abbreviation for metre-tonne-second system.

MTU An abbreviation for Mastic Turbidity Unit.

mu A romanized name of the Greek letter μ, pronounced "mew" in English.

mu An abbreviation for micro and for micron.

Mu An abbreviation for micron.

mug An informal contraction of "metric slug," suggested in 1960.[629] See *TME*.

627 [SIEG3].

628 See also: [AIGN] and [KUZN2].

629 [SEAR].

Munich candle In Germany, a premetric unit of luminous intensity. It was based on a standardized tapered candle made of stearin, 20.5 mm in diameter at the top and 23 mm at the base, with a 50-strand wick. Normal consumption rate was 10.2–10.6 g/h, with a flame height of 56 mm. One Munich candle = about 0.153 carcel = about 1.17 British standard candles = about 1.06 international candles. The Munich candle was replaced by the *Vereinskerze*.

mV An abbreviation for millivolt.

MV An abbreviation for mean variation.

mW An abbreviation for milliwatt.

MW An abbreviation for megawatt.

MW An abbreviation for molecular weight.

mwe An abbreviation for metre of water equivalent, a unit used in nuclear physics to describe the shielding around a reactor, accelerator, or detector. One mwe of any material is a thickness of that material providing shielding equivalent to 1 m of water.

MWe (mégawatt électrique), **MWt** Symbols used in the electric power industry to describe the size of generating plants. MWe is the symbol for the actual output of a generating station in megawatts of electricity, and is used for the thermal output required to operate the generators. Thermal output is typically about three times the electric output.

MWh An abbreviation for megawatt hours.

MWIR An abbreviation for medium wavelength infrared.

Mx An abbreviation for maxwell.

My An abbreviation for myria-.

Mya or **mya** A common abbreviation for "million years ago." The form "Mya" is recommended, since the capital M, taken from the metric prefix mega- (M-) is the appropriate symbol for a million.

myria- (**M**, **my-**, or **ma-**) [<Gr. *myrios* = "countless"] During the nineteenth–twentieth centuries (1879–1935), a decimal multiplier prefix in the metric system, used to indicate 10^4 of the unit.[630] The myria as a prefix was part of the original metric system of 1795. In 1905, the CIPM assigned it the symbol M.[631] In the first part of the twentieth century, electrical engineers began to use capital M for the prefix mega-, to mean one million.[632] In 1935, the CIPM adopted the prefix "mega-" with "M" as a symbol for it, dropping the myria- entirely.[633] In 1982, the U.S., having authorized use of the myriameter and myriagram in the Act of July 28, 1866, declared the terms no longer acceptable.[634]

myriad A number that is not readily countable. It constitutes a very large, indefinite number; innumerable, as in: "the myriad fish in the ocean."

myriar (Mya) During the nineteenth–twentieth centuries, a metric unit of area = 100 ha.

myriagram (Myg) During the nineteenth–twentieth centuries, a metric unit of weight = 10 kg.

myriagramme In Belgium and France, an obsolete metric unit of weight = 10 kg.

myrialiter or **myrialitre (Myl)** During the nineteenth–twentieth centuries, a metric unit of capacity = 10,000 L.

myriameter or **myriametre (Mym)** During the nineteenth–twentieth centuries, a metric unit of distance = 10,000 m.

myriamètre In Belgium and France, an obsolete metric unit of distance = 10,000 m.

myriamètre carré In Belgium and France, an obsolete metric unit of area = 100,000,000 mètres carrés = 100,000,000 m^2.

myriare In France, an obsolete metric unit of area = 100 ha = 10,000 ares.

14 N

N A symbol for Eddington number.

N An abbreviation for newton.

[630] [SCHW5, p. 142].

[631] Benoît, J. René. Annex to the *Proces Verbaux*. 1905.

[632] American Institute of Electrical Engineers. *Transactions of the American Institute of Electrical Engineers*. The Society, 1913, p. 418.
1935: *Proces Verbaux* **17**, 76.

[633] 1935: *Proces Verbaux* **17**, 76.

[634] Federal Register 8399–8400, February 26, 1982.

N See *normal solution*.

n- An abbreviation for prefix nano-, e.g. ng = nanogram.

***n*₀** A symbol for Loschmidt constant.

N solution See *normal solution*.

N unit In radiation physics and radiobiology, during the mid-twentieth century, a unit of ionizing fast neutrons = the quantity of fast neutrons that has the same ionizing effect in a Victoreen R meter equipped with a 25-r chamber as 1 röntgen of x-rays would.[635]

n unit In radiation physics and radiobiology, during the mid-twentieth century, a unit of ionizing fast neutrons = the quantity of fast neutrons that has the same ionizing effect in a Victoreen R meter equipped with a 100-r chamber as 1 röntgen of x-rays would, = ½ e unit.[636]

nA An abbreviation for nanoampere.

N_A A symbol for Avogradro's number.

N.A.C.A. [National Advisory Committee for Aeronautics] atmosphere A standard atmosphere defined by the U.S. National Advisory Committee for Aeronautics in 1922: "The atmospheric pressure registering 760 mm (29.9213 in. of head on a mercury barometer at mean sea level with gravitational acceleration at 9.8066 $m s^{-2}$, assuming the air to be a perfect gas at 15°C (59°F) and the mercury having a density of 13.595 · 103 kg m^{-3}, = 101.3250 kPa (14.691 p.s.i.)".[637]

nad A jocular unit of length in concept = the "distance between a driver's outstretched fingertips and the ticket machine in an automatic car-park," or about 18.4 cm.[638]

nail, **naile**, **naill**, **naille**, **nall**, **nayle**, **nayll**, **neayle**, or **neyle** In England, during the thirteenth–twentieth centuries, a unit of length, used for measuring cloth, in concept = the length of the last two joints of the middle finger, traditionally said to equal 1/20 ell. The nail is usually said to equal 1/16 yd = 1/8 cubit = ¼ span = ½ finger = 2.25 in = exactly 5.715 cm; but it also occurs as a synonym for the clove[639] = 7 lb = 1/16 hundredweight = about 50.80 kg, or as 1/16 acre.[640] The ratio probably comes from the Roman digitus, having been 1/16th of a pes.

nano- (n-) [<Gr: *nanos* = "dwarf"] The SI and metric prefix denoting 10^{-9}. The nano-'s progress toward official acceptance began in 1940 with a draft proposal made by technical committee ISA-9 d 2 of the International Federation of National Standardizing Associations, the predecessor of the ISO. The nano-'s legalization was delayed by the war, but in 1948, the General Assembly of the International Union for Pure and Applied Physics approved it on the recommendation of its Commission on Symbols, Units and Nomenclature. The prefix was widely used, but not actually approved until the adoption of SI by the 11th CGPM in 1960. In Chinese, the nano- is haowei.

nanoacre A jocular unit of area on a computer chip = one billionth of an acre = about 4.047 mm^2.

nanocurie (nCi) A common unit of radioactivity. The nanocurie equals 10^{-9} curie = 37 becquerels; this corresponds to a radioactivity of 37 atomic disintegrations per second.

nanofarad (nF) A common metric unit of electric capacitance = 10^{-9} farad. This unit was previously called the millimicrofarad (mμF).

nanogram (ng) A metric unit of weight = 10^{-9} g.

nanogram per pascal second square metre (ng/(Pa s m²)) A unit used in calculations of moisture transport in buildings.

nanolitre (nl or nL) A metric unit of volume = 10^{-9} L = 0.001 mm^3.

nanometer or **nanometre (nm)** A metric unit of length = 10^{-9} m = 0.001 μm = 10 ångstroms. Introduced in 1951, the nanometre replaced the millimicron.

nanometrology A metrology concerned with dimensional measurements of very small objects in micro, semi-conductor and nano technologies. The dimensions are typically given in nanometres, and the measurement uncertainty is

[635] [NATI, p. 114].
[636] [POLL, p. 165].
[637] [DIEH, p. 10].
[638] [ADAM, p. 97].

[639] In that case, sometimes abbreviated as na.
[640] [NICH].

often less than 1 nm. All the techniques employed are essentially microscope techniques used in conjunction with nano-positioning systems and high-precision position measurements.[641]

nanon An informal and undesirable name, sometimes used by spectroscopists, for the nanometre (10^{-9} m).

nanosievert (nSv) A unit of radiation dose = 10^{-9} sievert = 0.1 μrem.[642]

nanotesla (nT) A unit of magnetic field strength = 10^{-9} tesla = 10^{-5} gauss. The unit is used in geology to measure small changes in the Earth's magnetic field.

Napier or **napier** See *neper*.

napierian logarithm The original definition of a logarithm L of N, given in terms of the modern logarithm as:

$$L(N) = -\frac{\log\left(\frac{n}{10^7}\right)}{\log\left(\frac{10^7}{10^7-1}\right)}.$$

The term has also been used as a synonym for **natural logarithm** and **hyperbolic logarithm**,[643] in the false belief that the Scottish mathematician John Napier (1550–1617) used that number as the base in his work pioneering logarithms.

Napier's constant See *e*.

nat or **natural unit** A unit of information content used in information and communications theory. The nat is similar to the shannon, but uses the natural logarithm instead of the logarithm to the base 2. If the probability of receiving a particular message is p, then the information content of the message is $-\log_e p$ nats. For example, if a message is a string of five letters or numerals, with all combinations being equally likely, then a particular message has probability $1/36^5$ and the information content of a message is $5(\log_e 36) = 17.917\ 6$ nats. One nat equals $\log_2 e = 1.442\ 695$ shannons or $\log_{10} e = 0.434\ 294$ hartleys.

[641] See also: [WHIT4].

[642] Often used to describe low doses of radiation, *c.f.* [HUNT8, p. 217].

[643] See also: [MARS3, p. 28] and [GIBS3, p. 128].

National Institute of Standards and Technology A non-regulatory agency of the United States Department of Commerce's Technology Administration that develops and promotes measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life. NIST was originally called the National Bureau of Standards (NBS), a name that it had from 1901 until 1988. NIST's headquarters are located in Gaithersburg, Maryland

natural number (N) Name of any positive integer, 1, 2, 3, . . . Unfortunately, there is no general agreement about whether to include 0 or not.[644]

natural units A system of units for length, time and mass, independent of human existence, proposed at a meeting in Belfast in 1874[645] by the Irish physicist George Johnstone Stoney (1826–1911). By suitable combinations of Newton's gravitation constant, the velocity of light and an electric unit for charge, which Stoney had himself proposed and calculated, he could construct a length, a time and a mass. Stoney found the following values: length = 10^{-37} m, time = $0.3 \cdot 10^{-45}$ s and mass = 10^{-7} g. It should be noted that Stoney's units were introduced purely ad hoc without connection to any theory.[646]

natural unit systems A systems of physical units of measurement defined in terms of universal physical constants.[647]

nautical mile (nmi, naut mi, n mile, or **NM)** A unit of length used primarily at sea. The nautical mile is defined to be the average distance on

[644] See also: [BOUR] and [HALM].

[645] [STON2].

[646] www2.dk-online.dk

[647] "Natural units are intended to elegantly simplify particular algebraic expressions appearing in physical law or to normalize some chosen physical quantities that are properties of universal elementary particles and that may be reasonably believed to be constant. However, what may be believed and forced to be constant in one system of natural units can very well be allowed or even assumed to vary in another natural unit system." en.wikipedia.org

the Earth's surface represented by one minute of latitude (1/60 degree). The actual degrees of latitude vary from about 59.7 to 60.3 nautical miles. The British nautical mile (also called **the Admirality mile**) was traditionally set at 6080 ft = 1853.184 m. Until 1954, **the U.S. nautical mile** was = 6080.20 ft = 1853.24 m. In 1929, the International Hydrographic Conference in Monaco redefined the nautical mile to be exactly 1852 m = 6076.115 49 ft, since then, a distance known as the international nautical mile.

naut An informal abbreviation for nautical mile.

NBS or **N.B.S.** An abbreviation for National Bureau of Standards.

Ncm Symbol for the newton centimetre, a metric unit of torque = 0.01 Nm = about 1.416 12 in·oz.

NCV An abbreviation for net calorific value.

$\mathbf{N_E}$ Symbol for Ekman number.

$\mathbf{Ne_C}$, **Ne**, or **ECC (English cotton yarn number)** A unit for expressing thinness of cotton yarn, being the hanks of 840 yd/lb = 100/84 typp = about 590.5 divided by the international tex figure for thickness.

neck A unit of length, used in horseracing, = the distance from the tip of the outstretched head to the base of the neck of a horse = about 1 m.

Nederlands Meetinstituut (NMi) Name of the National Institute for Standards and Metrology in the Netherlands.

$\mathbf{Ne_K}$ A unit for expressing the thinness of worsted wool yarn = the number of 560 yards strands per lb.

$\mathbf{Ne_L}$ or **lea** A unit for expressing the thinness of linen yarn, being the leas of 300 yd/lb. One Ne_L = 10/3 typp = about 1654 divided by the international tex figure for thickness.

neper (Np) A unit of dimensionless quantities, used in telecommunications, expressing the ratio of two numbers as a natural logarithm. The value in nepers is given by $Np = \ln(x_1/x_2)$, in which x_1 and x_2 are the values of interest, and ln is the natural logarithm. Quantities differ by 1 neper if one is e^2 = 7.389 056 times the other. One neper is = 8.685 890 dB, and in general, n nepers equal $20n/(\ln 10)$ dB. The neper came into use in 1928,[648] replacing the mile of standard cable (m.s.c.), and is now accepted for use with SI units. The neper is often used to express voltage and current ratios, whereas the decibel is usually used to express power ratios. The unit is named after the Scottish mathematician John Napier[649] (1550–1617), who, in 1614, invented the logarithm.

neper per second (Np/s) A unit of damping coefficient or the Neper frequency, = 1 s^{-1}.

nephalometric unit (NTU or **ntu)** or **Nephelometric Turbidity Unit** A standard unit of measurement used to measure turbidity in water.[650] Other methods used less frequently are the comparator tube determination using formazin, called the Formazin Turbidity Unit (FTU), and the Jackson Turbidity Unit (JTU).[651] The NTU has replaced the JTU as the standard of measurement for the drinking water industry.[652]

nepit [name derived from neper + digit] or **nit** A unit of information defined as $I = \ln(P/P_0)$, in which P_0 and P are the probabilities at the receiver before and after reception of the message and I is the quantity of information expressed in nepits.

nest or **neste** In Britain, during the fifteenth–eighteenth centuries, a unit of quantity = 3. This unit was often, but not always, used for items which nest together, such as three bowls, three

648 [MART11].

649 Napier often spelled his name Jhone Neper, and he used the Latin form Ioanne Napero in his writings.

650 "The 1998 EU Drinking Water Directive stated that the turbidity must be acceptable to the consumer. A value of 1 NTU ex water treatment works the desirable maximum. The WHO guideline maximum value is an average 1 NTU for drinking water. " [SYMO, p. 449].

651 "A common standard for potable water is the Standard Method for the Examination of Water and Wastewater by the American Public Health Service, which uses formazin as the standard for producing a known volume of turbidity. The standard color scale to which it is compared is derived from the Platinum Cobalt Unit (PCU)" [FRAN, p. 4.12].

652 The JTU was eliminated from the 17th edition of *Standard Methods for the Examination of Water and Wastewater* ([GREE4]).

hampers, three counters, three coffers and three bits for horses.

net ton (NT) The name "net ton" is used in at least two ways: (1) as another name for the U.S. or short ton of 2000 lb, and (2) as another name for the register ton, a unit of volume = 100 cubic feet, in describing the cargo-carrying capacity of a ship as opposed to the entire interior volume. To avoid confusion, it is better to use "short ton" for use (1) and "net register ton" for use (2).

neutralization number See *acid number*.

new candle See also *candle*.

new candle The CGS and MKS unit of luminous intensity adopted by the CIE in 1937. It was adopted in 1946 by the CIPM to replace the international candle. The new candle is defined by taking the luminous intensity of a square centimetre of a blackbody radiator at the temperature at which molten platinum solidifies as 60 new candles = one lumen per steradian = 58.9 international candles. The new candle was renamed the **candela** by the ninth CGPM in 1948.

newton (N) The SI unit of force. A force of 1 N will accelerate a mass of 1 kg at the rate of 1 m/s^2 = 10^5 dynes = about 0.224 809 lbf = about 7.233 01 pdl = about 0.101 972 kgf or kp. The unit is named after the British mathematician, physicist, and natural philosopher Sir Isaac Newton (1642–1727), who was the first person to understand clearly the relationship between force, mass, and acceleration, expressed by the formula F = ma.[653] This unit was first suggested under the name **large dyne** in 1900.[654] The name newton was first suggested by Robertson in 1904.[655] Initially, the name newton was seldom used, but in 1935,[656] it was revived by Hartshorn and Vigoureux. The International Electrotechnical Commission advisory committee number 24, on electric and magnetic magnitudes and units adopted the name newton for the unit of force of the Giorgi MKS system on June 23–24, 1938, at a meeting in Torquay, England. The vote was ten to three, with one country abstaining; the Germans led the opposition.[657] Prior to the standardization of the symbol for the newton by the ninth CGPM in 1948, the symbol n (lowercase) was sometimes used, and also Nw.[658]

newton metre (N·m) The SI unit of torque and moment of force, defined as the torque exerted by a force of 1 newton acting at a perpendicular distance of 1 m from the specified axis of rotation. One newton metre is = 10,000,000 dyn cm = about 23.730 4 pdl ft = about 0.737 62 lbf ft = about 8.850 75 lbf in.

newton metre per second (Nm/s) See *pascal cubic metre per second*.

newton metre second (Nms) See *kilogram metre squared per second*.

newton metre squared per ampere (Nm^2/A) See *weber metre*.

newton per cubic metre (N/m^3) A unit of specific weight = 0.1 dyn/cm^3.

newton per metre (N/m) The SI-derived unit of surface tension and force per unit length = 1 kg/s^2 = 1000 dyn/cm or erg/cm^2 = about 0.101 972 kgf/m or kp/m.

newton per metre cubed (N/m^3) See *pascal per metre*.

newton per squared metre (N/m^2) See *pascal*.

newton per weber (N/Wb) See *ampere per metre*.

newton second (N · s) See *kilogram metre per second*.

newton second per metre (Ns/m) The SI unit of mechanical impedance = 1 kg/s.

newton second per metre cubed (Ns/m^3) See *pascal second per metre*.

newton second per metre squared (Ns/m^2) See *pascal second*. Formerly called poiseuille in France.

newton second per metre to the fifth power (Ns/m^5) See *pascal second per metre cubed*.

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653 [SWIN5].

654 [ROGE3].

655 [ROBE6].

656 [HART3].

657 [KENN5].

658 [SAS, p. 19].

newton second per squared metre (Ns/m^2) See *newton second per metre squared*.

newton squared metre per ampere (Nm^2/A) See *weber metre*.

newton squared metre per kilogram squared (Nm^2/kg^2) The SI unit of gravitational constant = 1 m^3/(kg · s).

neyle, **neyll** See *nail*.

NF An abbreviation for noise figure.

nF An abbreviation for nanofarad.

nH An abbreviation for nanohenry.

niacin equivalent (NE) A unit used in nutrition. An essential nutrient, niacin is supplied in normal diets from tryptophan, but only a small fraction of tryptophan is converted into niacin in the body, hence one niacin equivalent = 1 mg of actual niacin = 60 mg of tryptophan.

nibble or **nybble** A unit of information, used in computer science, = 4 bits = ½ byte.[659] The spelling nybble, suggested by byte, is sometimes used. In different contexts, a group of 4 bits is sometimes called a **quadbit** or a **hexit**.

nickle [from 'nickel', the common name for the U.S. 5-cent coin] A unit of information, used in computer science, = 5 bits.[660]

nickel bag or **nickel deck** [nickel = slang for American 5-cent coin] Vernacular name in the US for five-dollars' worth of marijuana or similar drug, e.g., "a nickel bag of drugs," "a nickel deck of heroin."

nile or **reactivity unit (A)** A unit of dimensionless quantity used in nuclear engineering (it was invented in the British nuclear power industry during the twentieth century as a joke). One nile is = a reactivity of $100(1-1/k)$, in which k is the effective multiplication factor = 0.01, i.e., the order of magnitude of the ratio of excess production constant to the effective production constant for a live nuclear reactor.[661] Since this is a rather large amount, its sub-multiple millinile, also symbolized as ρ_{mN} or $\rho_{m\Delta} = 10^5\ \rho = 10^{-5}$, is usually used instead.[662]

nines (N) A measure of reliability. For example, a mechanical component has "3N" of reliability if it operates correctly 99.9% of the time, and "4N5" if it operates correctly 99.995% of the time. If the probability of correct operation is p, then the reliability, in nines, is $= -\log_{10}(1-p)$. Another typical area of usage is to express the purity of materials, such as gases and metals.

nip [shortened form of nipperkin] An informal unit of liquid volume. The term "nip" usually means "a small amount," with no precise equivalent. In Britain, a nip of spirits is considered to be 1/6 gill = about 22.95 mL.

NIR An abbreviation for near infrared.

nit An abbreviation for neper bit. See *nepit*.

nit (nt) [<L: *niteo* = "shine"] or **meterlambert** The MKS unit of luminance = 1 cd/m^2 = 10^{-4} stilb.[663] The unit has been approved since 1947[664] by the International Commission on Illumination (CIE) and is still used.

N_{Kn} An abbreviation for *Knudsen number*.

NM An abbreviation, in maritime context, for nautical mile.

Nm or **N·m** An abbreviation for newton metre, a unit of torque.

Nm An abbrevation for normal metric, a symbol for the density of worsted yarns. Yarn is described as a/b Nm if it is a-ply (has a individual strands) and there are b kilometres of yarn per kilogram. An example might be 2/40 Nw, describing a 2-ply yarn having 40 km/kg. If the yarn is single-ply, the a is often omitted, so a single-ply yarn is described as b Nm.

nm The SI abbreviation for nanometre = 10^{-9} m.

nm. An abbreviation sometimes used in maritime context for nautical mile.

Nm^3 A German abbreviation for *Normkubikmeter*.

NMAS An abbreviation for Norwegian Metrology and Accreditation Service.

[659] [GRAN6, p. 14] and [RAYM].

[660] [RAYM].

[661] [LAU, p. 162].

[662] [THEW, p. 236] and [LEWI11, p. 59].

[663] "LCD panels vary from 100 nits on the low end to over 1000 nits or more on the high end. Average LCD panels are around 300 nits,...". [MEYE6, p. 741].

[664] 1948: *CIE Proc.*, **11**, 145.

NMi An abbreviation for Nederlands Meetinstituut.

n mile An abbreviation for international nautical mile.

No. or **N<u>o</u>** In the U.S., an abbreviation used for denoting the size of cans in a sequence: N<u>o</u> 1, N<u>o</u> 2, . . .approximately with the corresponding multiples of 10.6 US liq oz = about 200 mL.

nodical . . . In astronomy, a term used to refer to the intersections of a celestial orbit with a plane.[665] See *nodical* (or *draconic*) *month*.

noessel See *oessel*.

noeud The French word for the knot (1.852 km/h), the traditional unit of velocity at sea. This non-metric unit is still officially used in France.

noeud de loch [Fr: = "ship's knot"] The French word for a knot, the length of log line between succesive physical knots, = about 15.43 m.

non [<L: = "nine"] e.g., nonagon = having nine angles.

nonet A unit of quantity = 9, used mostly in music to describe an ensemble of nine instruments.

normal cubic metre (Nm^3) or **standard cubic metre** A unit of weight for gases = the mass of 1 m^3 (= 35.3147 ft^3) at a pressure of 1 atmosphere and at a standard temperature, often 0 °C (32 °F) or 20 °C (68 °F). Because industry practice varies, pressure and temperature should always be defined wherever the unit is used. The symbol Nm^3 is not permissible in the SI, as Nm^3 means "newton cubic metre." See also *sccm*.

normal solution (N or **N solution)** A solution containing 1 g equivalent weight (gEW) of solute per litre of solution.[666] The gEW is = the molecular weight expressed as a gram divided by the valency of the solute. The valencies are determined by the number of replaceable hydrogen ions.[667]

normal worsted (Nw) A unit measuring the density of worsted yarns. Worsted yarn is described as *a*/*b* Nw if it is *a*-ply (has *a* individual strands) and there are *b* 560-yard hanks of yarn per pound. An example might be 2/40 Nw, describing a 2-ply yarn having 40 hanks (= 22,400 yd) per pound. If the yarn is single-ply, the *a* is often omitted, so a single-ply worsted yarn is described as *b* Nw.

Normkubikmeter (Nm^3) An obsolete German unit = 1 m^3 of gas under standard reference conditions.

Normlitre (l_n) An obsolete German unit = one litre of gas under standard reference conditions.

Norwegian Metrology and Accreditation Service (NMAS) Name of the National Institute for Standards and Metrology in Norway.

nose A unit of length used in horseracing = minor fraction of the distance from the tip of the outstretched head to the base of the neck of a horse, of no minimum but less than the 30 mm or so of a half-head.

nox (nx) [<L: *nox* = "night"] An obsolete unit of scotopic illuminance = 0.001 lux. This unit was used in Germany during World War II to describe permitted levels of lighting during air raids.

noy A unit of perceived noisiness, introduced by the American acoustics engineer Karl D. Kryter in 1959.[668] One noy is defined as being the perceived noisiness within the frequency band from 910 to 1090 Hz of random noise at a sound pressure level of 40 dB above $2 \cdot 10^{-4}$ barye. $10 \log_2(N') = (N'' - 40)$, in which N' is the perceived noise level in noy and N'' is the sound pressure level in phons. The name noy is derived from the first syllable of the word noise.

nm An abbreviation for nanometre.

Nmi An abbreviation for nautical mile.

Np abbreviation for neper.

[665] Notably, those of the Moon's orbit with Earth's orbital plane—the ecliptic.

[666] Since normal solutions are a bit confusing, these days, the practice is to quote the strength of solutions in molar terms.

[667] For example: for HCL, the valecny = 1, MW = 36.5, EW = 36.5/1, and therefore 1 N corresponds to 36.5 g/L, and for $Ca(OH)_2$, the valency = 2, MW = 74, EW = 74/2 = 37, and 1 N corresponds to 37 g/L.

[668] [KRYT].

Ns An abbreviation for Newton second.

Nt An obsolete abbreviation, used in the MKS-system, for newton.

Nt An abbreviation for typp.

nt An abbreviation for nit.

NTU An abbreviation for nephelometric turbidity unit, a unit used in measuring water quality. Turbidity is an optical property: the scattering and absorbtion of light by solids suspended in water. An instrument called a nephelometer measures turbidity directly by comparing the amount of light transmitted straight through a water sample with the amount scattered at an angle of 90° to one side.

Nu An abbreviation for Nusselt number.

Nu* An abbreviation for Nusselt number for mass transfer. See also *Sherwood number*.

nu See *Abbe constant*.

number density (N) Term used to indicate the number of moles of substance (or molecules) per unit of volume.

Nusselt number (*Nu*) A dimensionless number that represents the temperature gradient at a surface where heat transfer by convection is taking place. $Nu = (h \cdot L)/k_f$, in which h = convection heat transfer coefficient, L = characteristic length, and k_f = thermal conductivity of the fluid.[669] It was proposed in 1933[670] and named after the German engineer Ernst Kraft Wilhelm Nusselt (1882–1957), who derived the number in 1905.[671] See also *Biot number* and *Sherwood number*.

Nusselt number for mass transfer (*Nu)** An alternative name for the Sherwood number. See *Sherwood number*.

nu value See *Abbe constant*.

nW An abbreviation for nanowatt.

Nw Am abbrevation for normal worsted.

nx An abbreviation for nox.

NZ The German abbreviation for Neutralixation Zahl. See *acid number*.

[669] It was approved in 1941 by the American Standards Association in ASA, Sub-committee Z 10 C, March 1941.

[670] [GROB, p. 185].

[671] See also [WHIT6].

15 O

o [abbreviation for the Latin: *omnis* = "every other day"] A unit of frequency, traditionally used in medical prescriptions.

OASM units A system of units, proposed in 1945[672], in which the ohm, ampere, second and metre are the fundamental quantities.

oblate In mathematics, a term describing something that is wider than it is long.

obrometer An instrument used to measure the quantity of rain that falls.

obtuse angle Angle of between 90° and 180° exclusively.

ocean An informal name for a great number or quantity, usually an immeasurable amount. It is often used in the plural, e.g., oceans of time.

Öchsle hydrometer scale A German hydrometer scale used in the making of wine. It is simply specific gravity (with water = 1.000) in thousandths, minus 1000. Thus, a specific gravity of 1.072 translates to 72 on the Öchsle scale, which is the average minimum reading required if a Kabinett wine is to be made. Other average minimums are: 86 for Spätlese, 95 for Auslese, 123 for Beerenaus-lese, and 150 for Trockenbeerenauslese.

o′ clock An informal angular measure that works by describing an angle in terms of the face of a standard (12-h) clock. Each hour "o′ clock" spans an angle of 30°, so "4 o′ clock" means an angle of 120° measured from dead ahead or some other agreed-upon point of reference.

octa... e.g., *octagon* = having eight angles.

octad A unit of quantity = 8.

octal, **octonal**, or **octonary** An expression used to specify that divisor or multiplier steps of 8 is in use, in contrast with the steps of 2 for binary, 10 for decimal, etc.

octal notation or **octal numeral system** A numeral system is the base-8 number system,

[672] Tarbouriech, M. , *C. R. Acad. Sci.*, 1945: **221**, 745.

and uses the digits 0 to 7, e.g., the octal representation for decimal 74 is 112.[673]

octant A unit of plane angle = 1/8 circle = 45° = π/4 radians.

octant A unit of solid angle measure = 1/8 sphere = π/2 steradians = about 5156.6 square degrees.

octave [<L: *octo* = "eight"] A dimensionless quantity used to describe a group of eight objects in sequence.

octave [<L: *octo* = "eight"] A unit of frequency interval, mainly used in music, a ratio of 2:1 (= two notes differ by one octave if the higher note has exactly twice the frequency of the lower one). It is = 301 savarts = 1200 cents.

octet or **octette** [<L: *octo* = "eight"] A unit of quantity = 8.

octet [<L: *octo* = "eight"] Another name for a byte, used primarily in telecommunications. The name refers to the definition of a byte as 8 bits. Also, a group of 8 bits is called an octet, rather than a byte, in computers in which the byte size is different from the usual 8.

octogenarian Person who has passed their eightieth birthday, but has not yet reached their ninetieth.

octogesimal division See *degree Réaumur*.

octonal See *octal*.

octonary See *octal*.

octuple or **octuplet** A group of eight items, especially eight identical items; the word octuplet is also used for one member of the group.

o.d. [L: *omni die* = "every day"] An expression used in medicine for "once per day."

odds Statement of the probabilities that an event will or will not happen. If an event has $a - b$ (or *a to b*) odds in its favor, then the probability is being divided into $a + b$ parts; the probability is $a/(a + b)$ that the event will happen and $b/(a + b)$ that it will not happen. In sports, however, the odds quoted are odds that a contestant will *not* win. Thus, 3−1 odds on a horse in a horse race indicate that the probability of the horse's winning is 1/4.

Oe An abbreviation for oersted.

Oechsle See *degree Oechsle*.

oersted (Oe) A metric, CGSm, emu and Gaussian unit of magnetic field strength. The oersted was defined to be the magnetic field intensity in a vacuum at a distance of 1 cm from a straight conductor of infinite length and negligible circular cross-section which carries a current of 0.5 abamperes. Later, it was redefined as the magnetic field strength. A field of one oersted generates a magnetomotive force of 1 Gb/cm of conductor. There is no named MKS unit of field intensity, but the oersted is equivalent in MKS units to 1000/(4π) A-turns/m = about 79.577 472 ampere-turns per metre (equivalence between a unit in a 3-dimensional CGS system and one in the 4-dimensional SI is not possible). In 1927,[674] the IEC set up a subcommittee to unravel the conflicting uses of the term gauss. The subcommittee decided that flux density should be measured in gauss and magnetizing force should be measured in oersted. The committee's recommendation was adopted by the IEC plenary convention in 1930,[675] and subsequently endorsed by the IUPAP.[676] The unit is named after the Danish physicist Hans Christian Ørsted (1777–1851), who discovered electromagnetism in 1820.

oersted (Oe) Another name for the gauss as a unit of magnetic flux density.

oerstedt An alternative name for the ampere, used by the Indian Telegraph Department in the nineteenth century.[677]

[673] According to en.wikipedia.org: "The Yuki language in California and the Pamean languages in Mexico have octal systems because the speakers count using the spaces between their fingers rather than the fingers themselves".

[674] I.E.C. report on meetings held at Bellagio, Italy, Advisory Committee No. 1., 1927.

[675] Resume of plenary meeting of IEC in Scandinavia, 1930. Magnetic Units, document R.M. 77.

[676] International Electrotechnical Commission. *Recommendations in the field of quantities and units used in electricity*. 1st ed. Geneva: IEC, 1964. *Series*: IEC Publication no. 164, p. 27.

[677] [EVER, p. 139].

ogdoad Another name for an octad.[678]

Oh An abbreviation for Ohnesorge number.

oh Onomatopœia of zero, as cypher and value.

ohm (Ω) The SI unit of electric resistance, impedance, modulus of impedance and reactance. One ohm is the "electrical resistance between two points on a conductor when a constant potential difference of 1 volt, applied to these points, produces in the conductor a current of 1 ampere, the conductor not being the seat of any electromotive force."[679] This is a small resistance; in practical circuits, resistance is often measured in megohms. The dimensions of the ohm are $[(m^2 \times kg)/(s^3 \times A^2)]$. The unit is named[680] after the German physicist Georg Simon Ohm (1787–1854).

ohm, international A unit of electric resistance in the international system of electric and magnetic units. It was established by the International Electrical Congress in 1893. First known as the *reproducible ohm*, but later called the *international ohm*. It was defined as the resistance of a column of mercury of constant cross-section at the temperature of melting ice, 106.3 cm long and with a mass of 14.452 1 g. Public Bill 105, passed by Congress on July 12, 1894, made this the legal definition of the ohm in the United States. It was later confirmed by the International Conference in 1908. In German-speaking areas, the international ohm was also called the *Reichanstalt ohm*, the result of its having been adopted by the Physikalisch-Technische Reichanstalt in Charlottenburg. The international ohm became obsolete when a new, absolute, definition of the ohm was stated by the 1946 CIPM, Resolution 2, and approved by the ninth CGPM in 1948.

ohm circular mil per foot (Ω circ mil/ft) An obsolete unit of resistivity = about $1.662\,43 \cdot 10^{-9}$ Ωm.

ohm metre (Ωm) The SI unit of resistivity = 10^6 Ω mm^2/m.

ohm per square A unit of resistivity for surface films and other materials whose thicknesses are considered to be negligible. The resistivity of a very thin conductor is defined to be its resistance in ohm multiplied by its width and divided by its length. If the conductor is square in shape, then its length and width are the same and its resistivity is numerically = the resistance of the square, which is actually the same no matter what the size of the square is. Therefore, the resistivity could be stated in ohms, but it is conventional to state it in "ohms per square."

ohm second (Ωs) See *henry*.

ohm squared millimetre per metre (Ω mm^2/m) A unit of resistivity = 10^{-6} Ωm.

ohma Name suggested by Bright and Clark in 1861[681] for the practical unit of potential.

ohmad Name proposed in 1865[682] for the practical unit of resistance.

Ohnesorge number (*Z* or *Oh*) A dimensionless number used in momentum transfer in general and atomization calculations in particular. It is normally defined as $\mu/(g_c\ \rho\ L\ \sigma)^{1/2}$, in which μ = viscosity, g_c = dimensional constant, ρ = density, L = characteristic length and σ = surface tension.[683]

[678] In Egyptian mythology, the Ogdoad are the eight deities worshipped in Hermopolis. They were arranged in four male-female pairs, with the males associated with frogs, and the females with snakes. Each pair represents the male and female aspect of one of four concepts, namely water (Nu/Naunet), air (Amun/Amunet), darkness (Kuk/Kauket), and eternity (Huh/Hauhet).

[679] According to CIPM, Resolution 2, 1946.

[680] Ohm's name was first used as an electrical unit in 1861, when Charles Bright and Latimer Clark proposed the **ohma** be a unit of electromotive force, according to The First Report of the B. A. Committee for the Selection and Nomenclature of Dynamical and Electrical Units, 1873.

[681] [BRIG] and *Rep. Brit. Ass.*, 1861, p. 37.

[682] *Rep. Brit. Ass.*, 1865, p. 310.

[683] This number first appeared in:[WEBE3]. See also: [FINL2, p. 181].

OID A unit of frequency traditionally, used in medical prescriptions, = "once a day".

OIML An abbreviation for Organization Internationale de Metrologie Legale.[684]

okta [<Gr.: *okto* = "eight"] A unit of proportion = 1/8, used in meteorology to record the fraction of the sky covered by clouds. For example, if half the sky is cloud-covered, the coverage is reported to be 4 oktas.

olf [<L: *olfacere*: "to smell"] An empirical unit of indoor air pollution, introduced by the Danish environmental scientist Professor Povl Ole Fanger (1934–2006) in 1988. One olf is defined as the air pollution produced by one "standard person," and one deciolf is the perceived air pollution level in a space having a pollution source of strength one olf and ventilation at the rate of 1 L/s with unpolluted air.

omega Romanized name of Ω, sometimes used for ohm.

OMH An abbreviation for National Office of Measures.

omn. bih. A traditional abbreviation for the Latin *omni bihorio*, once every 2 h, a unit of frequency sometimes used in medical prescriptions. The abbreviation alt. h. (*alternis horis*, every other hour) is equivalent.

omn. hor. A traditional abbreviation for the Latin *omni hora*, once every hour, a unit of frequency sometimes used in medical prescriptions. The abbreviation q. h. (*quaque hora*, each hour) is equivalent.

once In Rome, an obsolete unit used for measuring water supply = a day's flow through a specific orifice, reckoned to amount to about 20 kL = about 230 mL/s.[685]

open window unit (owu or **o.w.u.)** Original name of the unit of sound absorption, now called the *sabin* since 1937. It was first used by U.S. physicist Wallace Clement Sabine (1868–1919) in 1911.[686]

optillion See *zillion*.

order of magnitude A logarithmic unit used to compare the sizes of quantities. Two quantities differ by one order of magnitude if one is 10 times the other, by two orders of magnitude if one is $10 \cdot 10 = 100$ times the other, and so on. Thus, a difference of n orders of magnitude means the larger quantity is 10^n times the smaller one.

Organization Internationale de Metrologie Legale (OIML) Name of the international organization of legal metrology.

orgobyte See *geobyte*.

osmolal, **osmolar** Notations used by chemists to describe the concentration of ions in chemical solutions. The term "osmolal" describes an ion concentration of a solution in mol/kg, while "osmolar" describes an ion concentration in mol/L.

osmole (Osm) A unit of osmotic pressure used in physical chemistry, cell biology, and medicine. If chemical solutions are separated by a semipermeable membrane, then the solvent will diffuse across the membrane to equalize the concentrations. This process is called *osmosis*. Solutions with higher concentrations of dissolved substances are said to have higher *osmotic pressure* than solutions having lower concentrations. One osmole is the osmotic pressure of a one molar solution of a substance that does not dissociate. Typical values range from 20 mOsm for fresh water to 1010 mOsm for salt water from the open ocean.

ounce In Britain, a premetric unit of thickness used in grading thin, flexible leathers = ¹⁄₆₄ inch = about 0.397 mm.

ounce In the U.S., a premetric unit used to measure the thickness of shoe leather. For the sole of the shoe, the iron unit is used. One ounce equals exactly 0.015 625 in = about 0.396 875 8 mm.

ounce inch squared ($oz \cdot in^2$) A unit of moment of inertia = $1.829\,00 \cdot 10^{-5}$ kg · m^2.

ounce mole (ozmol) A unit of amount of substance. One ounce mole of a chemical compound is the same number of ounces as the molecular weight of a molecule of that compound measured in atomic mass units. Thus, the ounce mole is = 28.349 52 moles.

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684 See also www.oiml.org

685 [FENN, p. 347].

686 [SABI].

ounce of force (ozf or **oz)** A traditional unit of force = the force experienced at the earth's surface by a mass of one ounce. One ounce of force equals 1/16 pound of force = about 0.278 014 N.

ounce per cubic inch (oz/in^3) A unit of weight density = 1729.99 kg/m^3.

ounce per gallon (oz/gal) A traditional unit of weight concentration and mass density. One ounce per US gallon equals 7.489 152 g/L. In Britain, 1 ounce per imperial gallon is = 6.236 023 g/L.

ounce per inch (oz/in) A traditional unit of linear density = 1.116 12 kg/m.

ounce per square foot (oz/ft^2) In the U.S., a traditional unit of surface density, still used widely for stating the density of coatings, the "weight" of leather, the rates of application for lawn chemicals, and many other applications. One ounce per square foot is = 9 oz/yd^2 = about 2722.5 lb/acre = about 0.305 152 kg/m^2.

ounce per square yard (oz/yd^2) In the U.S., a traditional unit of surface density = 1⅑ oz/ft^2 = about 302.5 lb/acre.

ounce per yard (oz/yd) In the U.S., a traditional unit of linear density = 0.031 003 4 kg/m.

ounce-force (ozf) In the U.S., a unit of force = 6 ¼ lbf.

ounce-force inch (ozf in) In the U.S., a unit of moment of force and torque = $7.061\,55 \cdot 10^{-3}$ N·m.

ounce-force per square inch (ozf/in^2) In the U.S., a unit of pressure = $4.309\,22 \cdot 10^2$ Pa.

ounce weight (oz) In the U.S., a traditional unit for measuring the density of a fabric. For example, for a bolt of wool having a standard width of 50 in (1.27 m), a density of 1 oz/yd^2 corresponds to 43.060 g/m.

ouncedal In the U.S., a premetric unit of force = the force required to accelerate one ounce by one foot per second per second.

out In the English-speaking world, during the late nineteenth century, a unit of length used in surveying = a distance of 500 ft. "By this time surveying with a chain had practically vanished. In the uses for which it survived, a chain 50 f. long with 1 f. links was employed, together with a set of 11 pins. The pins were made of steel wire, about a foot and a half long, with a point on one end and a loop on the other. Every time the front chainman advances the chain, he forces a pin into the ground to mark the position he is leaving, and the back chainman removes the pin when he places his pole at that point. When the front chainman places the 11th pin, a distance of 500 f. has been measured. The front chainman then calls 'out!' and records 1 out, while the back chainman comes forward and gives the front chainman the 10 pins he has picked up. This process is repeated until the point to which the measurement is to be made is reached. The total distance traversed, in feet, is then the number of outs times 500; plus 10 minus the number of pins the front chainman is holding, times 50; plus the number of links up the final point times 1 ft."[687]

owu or **o.w.u.** An abbreviation for open window unit.

oyster basket In Louisiana, during the nineteenth–twentieth centuries, a legal measure for oysters = 1.5 US bu. This measure was used for oysters landed at ports with more than 50,000 inhabitants.[688] In New York, during the late nineteenth century, reported as holding 2 US bu.[689] In the early 1930s, a regular oyster basket was reported to hold 150 box oysters (= an oyster from 7 to 10 years old, not less than 3 in wide and 5 in long).[690]

oz An abbreviation for ounce (avoirdupois).

oz ap or **oz apoth** An abbreviation for apothecaries' ounce.

ozf An abbreviation for ounce-force.

oz t or **oz tr** An abbreviation for troy ounce.

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687 Cited from Sizes.com. See also [ZERN, p. 410].

688 1920: *Statutes* **2**, 1403.

689 [INGE, p. 245]. It was also called **oestermand** by the Dutch people. See: [BOMH2, p. 580].

690 [CASS3, p. 358].

16 P

P The SI prefix for peta-.

P The CGS prefix for poise.

p The SI and metric prefix for pico-.

p An abbreviation for pond.

P4 An abbreviation for perfect fourth.

pA An abbreviation for picoampere.

Pa The SI abbreviation for pascal.

pace or **passus** A military term often used as an alternate name for the step. See *military pace*.

pack (pk) A commercial unit specifying the number of items per package. In retail trade, packages containing, for example, four items are often described as a "4 pack" or "4pk." [691]

pack In North America, during the twentieth century, a unit of retail size, typically the minimal unit, less than a carton. See also *packet*.

packet In Australia, Britain, South Africa, etc., during the twentieth century, a unit of retail size, meaning a small pack less than a pack or carton. In North America, simply refered to as a pack.

pack year A unit of quantity for cigarettes, used in medicine, to measure a patient's smoking history. One pack year is = smoking one 20-cigarette pack per day for one year = 7300 cigarettes.

page One face of a leaf of paper.[692]

pair royal A unit of quantity = 3, used in cribbage to describe three cards of the same rank. This usage recalls the original meaning of "pair" as a group of equivalent objects, not necessarily two in number. Four cards of the same rank form a "double pair royal."

pantometer An instrument for measuring all sorts of elevations, angles and distances.

par [<Fr: *paresseux* = "sluggish"] Name suggested in 1940[693] for the metric slug. See *kilohyl*.

parker Name sometimes used for the Roentgen equivalent physical, after H. M. Parker (1910–), who proposed the unit in 1950. See *Roentgen equivalent physical*.

parsec [parallax of one second of arc] or **parallax second (pc, PC** or **psc)** A non-metric unit of length, used in astronomy, to describe stellar distances. One parsec equals 206,264.8 au = 3.261 631 ly = 1/5 Siriusweit = 30.856 78 · 10^{12} km. The unit was proposed[694] by Professor Herbert Hall Turner (1861–1930), Savilian Professor of Astronomy at the University of Oxford and also an important seismologist, and approved by the 1st International Astronomical Union Meeting in 1922.

part A unit used in informal statements of proportion or in prescriptions for mixtures. The fraction of an ingredient present is the number of parts of that ingredient divided by the total number of parts present.

particle flux unit (pfu, **p.f.u.**, or **PFU)** A unit used to measure the rate at which energetic particles, such as protons, are received by spacecraft. One pfu is a rate of one particle per square centimetre of detector area per steradian of solid angle scanned per second of time, = 10^{-4} $m^{-2}sr^{-1}s^{-1}$. There is also a definition that includes the energy of the particles: 1 pfu = 1 particle/(cm^2 s sr keV).

particle flux unit An informal unit used by geologists in the study of settling particles in the ocean = 1 mg/m^2 per day.[695]

part per billion (ppb) A unit of proportion = 10^{-9}.

part per million (ppm) A unit of proportion = 10^{-6}.

part per quadrillion (ppq) A unit of proportion = 10^{-15}.

part per thousand (ppth or **ppt)** or **per mill** A unit of proportion = 0.001.

part per trillion (ppt) A unit of proportion = 10^{-12}.

Pa/s An abbreviation for pascal-seconde.

pascal (Pa) The SI unit of pressure, fugacity, bulk modulus, modulus of elasticity, shear modulus, and stress. The pascal is the standard

[691] The symbol pk is also used for the peck.

[692] Hence, it is not possible to "tear a page out of a book."

[693] [SPIK].

[694] According to: www.servizi-globali.it

[695] [HONJ].

pressure unit in the MKS metric system, = 1 N/m^2. The unit, added to the SI by the 14th CGPM in 1971, is named after the French philosopher and mathematician Blaise Pascal (1623 – 1662).[696]

pascal cubic metre (Pa m³) The SI unit of quantity of gas = 1 Nm.

pascal cubic metre per second (Pa m³/s) The SI unit of throughput and leak rate = 1 J/s = 1 W.

pascal litre (Pa l or Pa L) A unit of quantity of gas = 1000 Pa m^3.

pascal litre per second (Pa l/s or Pa L/s) A unit of throughput = 1000 Pa m^3/s.

pascal per kelvin (Pa/K) The SI unit of pressure coefficient.

pascal per metre (Pa/m) The SI unit of pressure gradient.

pascal second (Pa·s) or **poiseuille (Pl)** The SI unit of dynamic viscosity = 10 poise = 1000 centipoise. Some scientists want to call this unit the poiseuille, but that name has not been accepted by the General Conference on Weights and Measures.

pascal second per metre (Pa s/m) The SI unit of characteristic impedance of a medium and specific acoustic impedance = 1 Ns/m^3.

pascal second per metre cubed (Pa s/m³) The SI unit of acoustic impedance = 1 Ns/m^5.

pastille dose or **B dose** An obsolete name, used in radiation physics, for the dose of radiation required to change the colour of a barium platinocyanide pastille from a specified apple-green colour (Tint "A") to a specified reddish-brown colour (Tint "B"). The unit, introduced in the early 1920s, was = 500 roentgens.

pat Individual serving of butter. In the U.S. food industry, restaurant servings of butter are usually packaged at 48 pats per pound, making each pat 1/3 oz = about 9.45 g. In recipes, a pat of butter is typically 2 teaspoons = 1/3 f. oz = about 10 mL.

P.at. A French abbreviation for *Poids Atomique*.

pc. An abbreviation for parsec.

pc An abbreviation for per cent.

pcf, pci Symbols for pound per cubic foot and per cubic inch, obsolete engineering units of density. 1 pcf = 16.018 46 kg/m^3 and 1 pci = 1 728 pcf = 27,679.90 kg/m^3.

pcm or **p.c.m.** An abbreviation for pour cent milli.

p/ct An abbreviation for per cent.

Pcu An abbreviation for pound centigrade unit.

PD An abbreviation for potential difference.

pdl An abbreviation for poundal.

Pe*, *Pe* An abbreviation for Péclet number.

pea Name of the sliding weight used in a steelyard, of size appropriate of the particular instrument.

pea A unit of volume, used to express the size of small things in everyday life.[697] An ordinary pea has a volume of about 0.5 cm^3. See also *walnut*.

pebbles A synonym of "gravel."

pebi- (Pi-) [name is a contraction of "petabinary"] A binary prefix meaning 2^{50} = 1 125 899 906 842 624. This prefix, adopted by the International Electrotechnical Commission in 1998, replaces peta- for binary applications in computer science. See also *kibi-*.

Peclet number (*Pe*) A dimensionless number relating the forced convection of a system to its heat conduction.[698] It is equivalent to the product of the Reynolds number with the Prandtl number. It is named after the French physicist Jean Claude Eugene Peclet (1793–1857). In mass transfer problems, it is given by (v l)/α, in which v = velocity, l = characteristic length, and α = thermal diffusivity. It is also defined as $(l \cdot v \cdot \rho \cdot c_p)/\lambda$, in which ρ = density, c_p = heat capacity, and λ = thermal conductivity.

penta… [<Gr = "five"] A prefix for "five."

pentad A unit of quantity = 5.

pentane candle An alternative name for the *international candle*.

pepsin unit A unit for measuring the proportion of pepsin in the gastric juice = the quantity

[696] [LOEF].

[697] www.mydesert.com

[698] The number was recognized in March 1941 by the American Standards Association Sub-Committee Z 10 C.

of enzyme that digests 10,000 times its weight of coagulated egg albumin.

per annum (PA) An obsolete unit of frequency = once a year.

percent, **per cent**, or **per centum** (**%** or **pct**) [L = "by the hundred"] A unit of proportion = 0.01. The symbol % can be placed after any number; mathematically, its effect is an immediate division by 100.

perch In Britain, a premetric unit of volume used for stone and other masonry. A perch of masonry is the volume of a stone wall one perch (16 ½ feet) long, 18 inches high, and 12 inches thick = exactly 24 ¾ ft^3 = about 0.700 842 m^3.

perch In some western states of the U.S., a premetric unit of volume used for rubble work = 16 ½ ft^3.[699]

per diem (PD) [L: = "per day" or "for each day"] A unit of frequency = once a day.

perfect number Name of integer which is = the sum of its positive divisors.[700]

perfect ream A unit of quantity for paper = 516 sheets. The additional amount is to allow for sheets which may be spoiled during shipment.

peripheral resistance unit (**PRU**) or **Wood's unit** A conventional unit of vascular resistance, used in physiology and medicine to assess blood flow in the capillaries, = the resistance that produces a pressure difference of 1 mm Hg, corresponding to a blood flow of 1 mL/sec = 1 mmHg·min/mL = 133.3 Pa·min/mL = almost exactly 8 GPa·s/m^3.[701]

perm An obsolete unit of water vapor permeability, that is, the ability of a material to permit the passage of water vapor.

$$\frac{[\text{flow in barrels} \times \text{distance in feet} \times \text{viscosity in centipoises}]}{[\text{days} \times \text{ feet}^2 \times \text{pressure in } (\text{pounds/inch}^2)]}$$

The unit was used by petroleum engineers to express the permeability of a porous, subsurface reservoir. A material has a permeability of one perm if it allows transmission of one grain of water vapor per square foot of area per inch of mercury of pressure difference per hour. At 0 °C, one perm equals about 5.721 35 · 10^{-11} kg/m^2·Pa·s; at 23°C the equivalent is about 5.745 25 · 10^{-11} kg/m^2·Pa·s. The lower the perm value, the better the vapor barrier.

permeability-of-vacuum See *magnetic constant*.

per mensem An obsolete unit of frequency = once a month.

permicron Name proposed in 1951[702] for the number of wavelengths in a micron.

per mill, **per mil**, or **per mille** A unit of proportion = 0.001. Unlike percent, per mill is written as two words. Its symbol, not available to most web browsers, is like the percent symbol but with two zeroes in the denominator (roughly, 0/00). The spelling "per mill" seems to be more common in the U.S., "per mil" being more common in Britain.

perm inch An obsolete unit of water vapor permeance. The perm value does not depend on the thickness of the material used as a water barrier. The permeance is the product of the perm value and the thickness, measured in inches. One perm inch equals about 1.453 · 10^{-12} kg/m·Pa·s at 0 °C or about 1.459 · 10^{-12} kg/m·Pa·s at room temperature.

person hour A gender-nonspecific version of man hour, a unit of labor = the work of one person for 1 h.

per thousand (‰) A unit of proportion = 1/1000.

peta- (P-) The SI and metric prefix denoting 10^{15}.[703] One parsec, for example, equals 30.857 petametres. The prefix is drawn from a Greek root which means "spreading out."

petabecquerel (PBq) A unit of radioactivity = 10^{15} atomic disintegrations per second = 27.027 curies.

petabyte (**P**, **PB**, or **Pbyte**) Term used in the world of computing to describe data storage space and system memory. When referring to a petabyte for disk storage, the hard drive

[699] [MCCL].

[700] There are infinitely many perfect numbers.

[701] www.enacademic.com

[702] [BAYL2].

[703] According to *Metrologia* **11**,1975, pp. 180–181, the 15th CGPM, in resolution 10, added it to the SI.

manufacturers usually use the standard that a petabyte is 1000 terabytes = 10^{15} bytes. When petabyte is used for real and virtual storage, then 1024 terabytes is the appropriate notation.[704]

petaflops (Pflops) A unit of computing power = one quadrillion (10^{15}) floating point operations per second.

petajoule (PJ) A metric unit of energy = 947.817 billion Btu = 277.777 8 gigawatt hours = about 9.48 megatherms.

petameter or **petametre (Pm)** A metric unit of length = 10^{12} km = about 621.371 billion miles = 0.1057 light year. The distance from the earth to the nearest star (other than the sun) is about 40 petametres.

pF An abbreviation for picofarad.

Pfd German abbreviation for Pfund.

Pferdestärke (ps or PS) The German name for *horsepower*. The symbol ps is used for horsepower in both the Japanese and German automotive industies.

pfu A symbol for the particle flux unit.

pg/ml An abbreviation for picogram per millilitre.

ph An abbreviation for per hour.

ph The CGS abbreviation for phot.

phon A unit of dimensionless quantity of loudness level proposed by Barkhausen and adopted in July 1937 by the First International Acoustical Conference in Paris.[705] Phons are used for subjective measurements, that is, measurements made using the ears of a human listener. A sound has loudness p phons if it seems to the listener to be equal in loudness to the sound of a pure tone of frequency 1 kHz and strength p dB[706]. A measurement in phons will be similar to a measurement in decibels, but not identical, since the perceived loudness of a sound depends on the distribution of frequencies in the sound as well as the pressure of the sound waves. In the U. S., sound loudness is frequently measured in sones rather than phons: a sound of loudness s sones has loudness $10 \log_2 s + 40$ phons.

phone See *megaphone*.

phot (ph) [<Gr: *phot* = "light"] The CGS unit of illumination, proposed in 1921, = one lumen per square centimetre = 10,000 lx. The milliphot was used more commonly than the phot. The name is usually pronounced to rhyme with "not" rather than "note."

photo-absorption unit A unit of photo-absorption, used in photoelectric calorimetry, defined as the mass in grams per millimetre of solution required to reduce the light transmitted through one centimetre of solution by 1%.

photographic magnitude An obsolete method for describing the apparent brightness of stars. In July, 1850, the American astronomer William Cranch Bond (1789–1859) took what is believed to be the first astronomical photograph, on a wet collodion plate.[707]

photon A quantum of any form of electromagnetic energy having a single wavelength, direction, and polarization.

photon See *troland*.

phot-second (ph · s) The CGS unit of light exposure = 10,000 lx · s.

Physikalisch-Technische Bundesanstalt (PBT) Name of the National Institute for Standards and Metrology in Germany.

pi (π) A mathematical unit. The circumference of a circle is = pi multiplied by the diameter. It turns out that pi is an irrational number, which means that its decimal expansion is nonterminating and nonrepeating. To ten significant digits, pi equals 3.141 592 653.

pica (pi) A unit of length used by typographers and printers in typesetting. One pica equals 12 points = 4.22 mm. "Pica type" is type that sets six lines to the inch.

pico- (p-) [<Ital: *piccolo* = "small"] The SI and metric prefix denoting 10^{-12}. In 1940, the technical committee ISA-9 d 2 of the International Federation of National Standardizing Associations, the predecessor of the ISO, made a draft proposal of a prefix called pico. In 1948,

[704] www.whatsabyte.com

[705] 1937: The First International Acoustical Conference. *Nature* **140**, 370.

[706] *Quantitities and Units in Acoustics*. (ISO 31/VII) American National Standards Institute, New York, 1978.

[707] [ROSS6].

the General Assembly of the International Union for Pure and Applied Physics approved it, as recommended by its Commission on Symbols, Units and Nomenclature. The prefix became a prefix of the SI through its adoption during the 11th CGPM in 1960. In Chinese, the pico- is weiwei.

picocurie (pCi) A common unit of radioactivity, used to measure radioactivity occurring naturally in the environment, = 10^{-12} curie = 0.037 becquerel. It corresponds to one atomic disintegration about every 27 s.

picofarad (pF) A common unit of electric capacitance = 10^{-12} farad. This unit was formerly called the micromicrofarad (μμF).

picogram (pg) A metric unit of weight = 10^{-12} g.

picoliter or **picolitre (pl** or **pL)** A metric unit of volume = 10^{-12} L.

piece (pc) A unit of quantity = 1. This unit, like count (ct), is used to indicate that a measurement represents an exact count of items.

pièze (pz) [<Gr: *piezein* = to press] The MTS (the metre-ton-second system) unit of pressure. The pieze is a pressure of one sthène per square metre = 1000 N/m^2 = 1 kPa. The unit, spelled *pièze* in French, is pronounced "pee-ezz" in English.

piezometer An instrument for ascertaining the compressibility of water, and the degree of such compressibility under any given weight.

pikotukihenkilö [<Fin: = **"**grossly incompetent person assigned in systems support"] or **pikotuki** A jocular unit of incompetence in systems support = one millionth of a mikrotuki. Originally coined at the Nokia Reseach Center in Helsinki, Finland. See also *mikrotukihenkilö*.

pinch An informal unit of capacity used in food recipes, equal to "the quantity of a powder or similar that can be picked between the tips of fingers, sometimes interpreted as between thumb and two fingers, but in modern recipes, the thumb and one finger."[708] In the U.S., the pinch is usually defined as equalling 2 smidgens = 1/8 teaspoon = 1/48 f. oz = about 0.6 mL; for liquids = 1/6 barspoon = 1/36 US liq oz = about 0.616 mL. See also *pugillus*.

pinhead A measure often used by writers when expressing the size of various objects by comparing it to a pinhead. It is a very inexact quantity; heads of pins (not including pins whose heads are glass or plastic beads) usually fall between 1 mm and 1.9 mm in diameter.

pinhead A unit of measure, used for very powerful ingredients such as camphor in Indian cooking, in concept = the amount that can be held on a pinhead.

pinta A name given to the litre in Milan, when it adopted the metric system in 1803, = 10 coppi = 1/10 mina = 1/100 soma.

pip Name of the smallest measured change in a currency conversion rate. This depends on the relative values of the two currency units. In converting Euros to U.S. dollars, a pip is 0.000 1, but in converting U.S. dollars to Japanese yen, a pip is 0.01. See also *tick*.

Pipeline parameter (ρ^N) A dimensionless number used in momentum transfer in general and hydraulic transients calculations in particular. It is normally defined as (a v_0)/(2g H), in which a = wave velocity, v_0 = initial velocity, g = gravitational acceleration and H = static head.

pitch Measurement of the size of type in units of characters per inch (CPI). The concept was originally invented in the electric typewriter era to represent the size of fonts having monospaced letterforms. CPI = 120/pointsize. The three common sizes were 10, 12, and 15 cpi (called 10 pitch, 12 pitch, and 15 pitch). These were equivalent to 12, 10, and 8 point type.

pixel A unit of screen resolution employed in computer science.

piye A unit of pressure in the metre-ton-second system of units = 1000 Pa.

PJ An abbreviation for petajoule.

Pk A German abbreviation for the unit Parsec = parsec.

pK A measure of the strength of an acid, used for comparison of acids. If K_α = the acid dissociation constant, then pK = −log10 K_α.

pk or **pk.** An abbreviation for peck (U.S.).

Pl An abbreviation for poiseuille.

[708] [FENN, p. 383].

planck The MKS unit of "action" (energy multiplied by duration) or of angular momentum. The planck is = 1 J·s = 1 m of length times a momentum of 1 metre kilogram per second. The unit, proposed in 1949,[709] is named after the German thermodynamicist and physicist Max Planck (1858–1947), the originator of quantum theory.

planck A proposed SI unit of angular momentum.[710]

planck length A unit of distance representing the scale at which gravity, and perhaps space itself, becomes discrete rather than continuous. This is the shortest distance that is meaningful in our understanding of the laws of physics. The planck length is defined as being the square root of Gh/c^3, in which G is the universal gravitational constant, h is Planck's constant, and c is the speed of light. This makes the planck length about $4.051 \cdot 10^{-35}$ m.

planck mass A unit of weight = 10^{-5} g.

planck time A unit of time, equal to the time required for a photon moving at the speed of light to travel the distance of one plank length. This is the shortest time that is meaningful in our understanding of the laws of physics, representing the scale at which time itself may become discrete rather than continuous. The planck time is about $1.351 \cdot 10^{-43}$ s.

platoon A military term for an assembly of troops, generally close to 25 in number, normally the smallest administratively recognized tactical unit, but operationally divided into sections, etc.

playte A unit of information used in computer science = 16 binary digits.[711]

-plex A suffix used to create large numbers. The number n-plex is 10^n, which is 1 followed by n zeros. Thus, a googol is 100-plex, for example. The American mathematician Edward Kasner (1878–1955), who invented the googol in 1938, also defined a "googolplex" to be 1 followed by a googol of zeros, thus suggesting this generalization. See also *dex* and *-minex*.

plf A symbol for pounds per linear foot (lbm/ft), a common unit of load in engineering. 1 plf = 1.488 164 kg/m. The symbol is sometimes used for pounds of force per linear foot (lbf/ft), in which case 1 plf = 14.593 90 N/m.

plf An abbreviation for "per linear foot." In this use, 1 plf = 3.280 840 per metre (/m).

pli An abbreviation for pounds per linear inch or pounds of force per linear inch. For a load, 1 pli = 17.857 97 kg/m, and for a force, 1 pli = 175.126 8 N/m.

plotter unit A unit of distance used in typography. This, the smallest distance addressed by Hewlett Packard plotters, has become a fairly familiar term in digital graphics design.

According to the HP7475A manual, there are about 40.2 plotter units per millimetre = about 1021 plotter units per inch. Hence, one plotter unit = about 24.876 mm.

-ply [<L: *plicare* = "to fold"] A suffix used to indicate the number of folds or layers in an object; thus, 4-ply means having four layers.

P.mol. French abbreviation for *Poids molé culaire* (= molecular mass).

PMPO An abbreviation for "peak music power output" or "Pulse Maximum Power Output," which is often claimed by electronics manufacturers as a unit measuring the effective power output of amplifiers, stereo systems, etc. There is no industry standard for this "unit," so it is impossible to determine just what it means.[712]

PN [symbol for "nominal pressure"] A measure used for rating piping, valves, fittings, etc. Nominal pressure is essentially the pressure rating of the piping system, measured in MPa at a temperature of 20 °C.

PNC An abbreviation for Preferred Noise Criterion.

PNU An abbreviation for protein nitrogen unit, a measure of the potency of the compounds used by doctors in allergy skin tests. One PNU is defined as 0.01 μg of phosphotungstic acid-precipitable protein nitrogen.

point or **point of the compass (pt)** A unit of plane angle, in use since the thirteenth

[709] [BODE2].

[710] [JERR].

[711] [RAYM].

[712] The alternative to PMPO is RMS (Root Mean Square), which is an accurate mathematical representation of a speaker's power output, measured over time rather than a few microseconds.

century, = 1/32 of a circle = 11.25º. One point equals 11°15′ of arc or pi/16 radians.

point (pt), **pica point**, **pointe**, **poynte**, **printers´point**, or **punctum** During the seventeenth–twenty-first centuries, a unit of length used by typographers and printers. When printing was done from hand-set metal type, one point represented the smallest element of type that could be handled, roughly 1/64 inch. The point began as a French measure, when the common pica was divided into 12 points. The system was adopted by the U.S. Type Founders Association in 1886. Eventually, the point was standardized in Britain and America as exactly 0.013 837 in = about 0.351 459 8 mm. In continental Europe, typographers traditionally used a slightly larger point of 0.014 83 in = 0.377 mm, called a **Didot point** after the French typographer Firmin Didot (1764–1836). In the U.S., Adobe software defines the point to be exactly 1/72 inch = 0.352 777 8 mm and TeX software uses a point of 0.351 459 803 5 mm. The German standards agency DIN has proposed that all these units be replaced by multiples of 0.25 mm.

point (pt) or **percentage point** A unit of proportion = 0.01 = 1%.

point (pt) or **jeweller´s point** A unit of weight used for precious stones such as diamonds. One point equals 0.01 carat = exactly 2 mg.

point (pt) A unit of quantity = 1. This unit is used to express changes in an arbitrary score or index, such as the score in an athletic contest. In finance, a change of one point in the Dow Jones average or similar indices represents a change of 1.00 in the index.

point (pt) A unit used to represent the smallest significant change in an arbitrary ratio. This usage is common in sports. Most sports "averages" are actually ratios of successful performances divided by attempted performances.

point (pt) A unit of length used to measure the thickness of card stock in the paper industry. One point = 0.001 in = 25.4 µm.

point (pt) A dimensionless number used as a measure of the specific gravity of a liquid, typically used in brewing and winemaking, defined as the mass of a sample of the liquid divided by the mass of an equal volume of pure water. Each "point" represents an increase of 0.001 above 1. For example, a liquid of specific gravity 1.068 is described as 68 point.

poise (P, **Ps**, or **Po)** The CGS unit of dynamic viscosity. If a force of 1 dyne is needed to move 1 cm^2 of the liquid or gas relative to a second layer 1 cm away at a speed of 1 cm/s, then the viscosity is 1 poise. The unit, originally suggested in 1913[713] as the unit of viscosity, was defined around 1924, and is named after the French physician and physiologist Jean Louis Marie Poiseuille (1799–1869). The SI recognizes no named unit for dynamic viscosity; one poise equals 0.1 Pa·s = $14.503\ 8 \cdot 10^{-6}$ reyn.[714]

poiseuille (Pl) The MKS unit of dynamic or absolute viscosity = 1 pascal second = 10 poise = 1000 centipoise (cP).[715] The poiseuille has been proposed, but not accepted, as an SI-derived unit. The unit is named after the French physician and physiologist Jean Louis Marie Poiseuille (1779–1869).

pole See *unit (magnetic) pole*.

poll An abbreviation for pollex.

pollen count A term used by botanists since the early 1930s to indicate the number of grains of pollen of all kinds per unit of microscope slide; in practice, often taken as one square centimetre.[716]

pollex (poll) [<L: *pollere* = "to be strong"[717]; *pl*. pollices] Latin word for "thumb," sometimes used to mean the inch in botanical descriptions.

polu... Russian prefix for "half", e.g., poluosmin = ½ osmin.

polypin An informal unit of capacity for beer and other alcoholic beverages, used mostly in

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713 [DEEL].

714 In 1977, the British Standards Institution recommended that for the calibration of viscometers, the dynamic viscosity of distilled water at 20°C should be taken to be $100.20 \cdot 10^{-3}$ Pa s.

715 The unit has never been approved by the CGPM. The pascal-second is preferred for dynamic viscosity.

716 [CAIN2].

717 Because in a contest of strength, the thumb wins over the other fingers.

Britain. A polypin of beer is a rectangular cardboard box with a plastic lining, holding 32–36 Imperial pints (18.2–20.5 L) or exactly 20 L.[718]

poncelet An obsolete metric unit of power legalized in 1919 in France. It was defined as the power required to move a 100-kg mass over a distance of 1 m in 1 s, at an acceleration of 1 m/s^2 = about 980.665 W. The unit is named after the French mathematician and natural scientist Jean Victor Poncelet[719] (1788–1867).

pond (p) [<L: *pondus* = "weight"] An obsolete metric unit of force = the gravitational force on a mass of 1 g = 980.665 dynes = 0.002 204 622 6 pounds of force. The kilopond was used more often than the pond.

pontificate Name for the length of time that the position of a Pope lasts.

pontoon [name of a card game with 21 as its target] A British slang word for a 21-month prison sentence.

pony A small glass for liquor. In the U.S., a pony generally holds exactly 1 U.S. fluid ounce = 29.57 mL.

pool of work In England, name for a quantity of construction, used in estimating and billing for labor and materials, = the covering by slate of a area of roof 6 f. across and 14 f. up, or 168 f. across and 1 f. up.[720]

porosity In the paper industry, porosity is generally measured by the time (in seconds) required for 100 cm^3 of air to pass through 1 in^2 of the paper at a standard pressure difference; thus, the porosity unit is s·in^2/dL, sometimes called a **Gurley unit** after the name of a test procedure. In SI units: 1 s·in^2/dl = 6.4516 s/m column of air.

postages (P) A postal weight unit, used between about 1850 and 1890, = one penny per half-ounce. Since four ounces equals eight half-ounces, it was written as 8P or P/8, and similarly two ounces would be written as 4P or P/4. Postal weights marked F referred to foreign postages, which were one penny per quarter-ounce, thus 1P = 2F.

potrzebie A jocular unit of length, presented by the Stanford Professor Emeritus of the Art of Computer Programming Donald Ervin Knuth (b. 1938) in the article "The Potrzebie System of Weights and Measures" (Mad Magazine #33, June 1957) as a basic unit in his own system of weights and measures, = the thickness of issue 26 of the magazine Mad in 1957, = about 2.263 348 517 438 173 216 473 mm.

pouce de fontainier During the eighteenth–nineteenth centuries, a unit of water flow in the area now occupied by the nation of Haiti = the rate at which water flows through a hole 1 pouce (about 2.707 cm) in diameter in a vertical baffle. The head is unspecified, but the flow rate has been estimated[721] at 13 L/min.

poumar An acronym for one pound per million yards, a unit of yarn density formerly used in the U.S. textile industry. One poumar equals about 10^{-6} lb/yd = 0.496 055 tex.

pound (lbf or lb) An obsolete unit of force. See *pound force*.

pound (lb) A traditional unit measuring the weight of paper. See *pound weight*.

pound-calorie (lb.-cal.) A unit of energy, during the late nineteenth–early twentieth centuries, used to express the heating value of coal, equal to the quantity of heat needed to raise the temperature of 1 pound of water from 15°C to 16°C = about 453.6 calories.

pound centigrade unit See *Celsius heat unit*.

pound cut (lb cut) An obsolete unit of concentration for shellac in the U.S. One pound cut means that the shellac was manufactured by dissolving 1 lb of dry, bleached shellac in 1 gal of denatured alcohol (= about 120 g of shellac/L of solvent). The most common concentrations sold are 3, 4, and 5 lb cut.

pound foot (lbf ft or lb ft) An obsolete unit of torque. Torque is the tendency of a force to cause a rotation; it is the product of the force and the distance from the center of rotation to the point where the force is applied. Thus, it can be

[718] The word 'polypin' is actually a registered trademark of Biovision GmbH; it is the name of the polythene plastic used for the lining of the container.

[719] [BERT3].

[720] [WORL].

[721] According to Sizes.com, that refers to [MORE4].

measured in pounds of force times feet of distance. One pound foot is = 1.355 82 N·m.

pound mass (lbm) See *pound*.

pound mole (lbmol) A unit of amount of substance. One pound mole of a chemical compound is the same number of pounds as the molecular weight of a molecule of that compound measured in atomic mass units. Thus, the pound mole is = exactly 453.592 37 moles.

pound foot per second ((lbf · ft)/s) The FPS unit of momentum = 0.138 255 kg · m/s.

pound foot per second squared ((lbf · ft)/s^2) See *poundal*.

pound foot square (lbf · ft^2) The FPS unit of moment of inertia = 0.042 401 km · m^2.

pound foot square per second (lbf · ft^2/s) The FPS unit of moment of momentum = 0.042 401 km · m^2/s.

poundal foot See *foot poundal*.

pound force (lb$_f$, lbf, or Lbf)[722] A unit of force in the British Gravitational System, defined as the weight that a body with a mass of 1 lb would exert at a location where the acceleration due to gravity is exactly 32.174 0 ft/s^2. Later, a standard value of 9.806 65 m/s^2 was adopted for the acceleration due to gravity, which made one pound-force = 4.448 221 615 260 5 N.

pound-force per square foot (lbf/ft^2 or **psf)** An obsolete unit of pressure. 1 psf equals about 47.880 Pa = 0.478 80 mb = 0.192 79 in WC.

pound-force per square inch (lbf/in^2 or **psi)** An obsolete unit of pressure = 144 psf = about 6.894 75 kPa = 68.947 5 mb = about 2.036 in Hg = about 27.7612 in WC.

pound inch square (lbf · in^2) An obsolete unit of moment of inertia = 2.926 40 · 10^{-4} km · m^2.

pound per acre (lb/acre) An obsolete unit of surface density = 3.673 09 · 10^{-4} oz/ft^2 = 1.120 85 · 10^{-4} kg/m^2.

pound per cubic foot (lbf/ft^3) The FPS unit of weight density = 0.160 544 lb/Imp gal = about 16.018 5 kg/m^3.

[722] [SCHM, p. 274]: "the pound-force is abbreviated Lb with capital initial letter."

pound per cubic inch (lbf/in^3) An obsolete unit of weight density = 1728 lb/ft^3 = about 2.767 99 · 10^4 kg/m^3.

pound per foot (lb/ft) The FPS unit of linear density = 3 lb/yd = about 1.488 16 kg/m.

pound per gallon (lb/UKgal) An obsolete unit of weight density in Britain = 6.228 84 lb/ft^3 = about 99.776 4 kg/m^3.

pound per gallon (lb/USgal) In the U.S., a unit of weight density = 7.480 52 lb/ft^3 = about 119.826 kg/m^3.

pound per hour (lb/h) An obsolete unit of weight flow rate = 2.777 78 · 10^{-4} lb/s = about 1.259 98 · 10^{-4} kg/s.

pound per inch (lb/in) An obsolete unit of linear density = 12 lb/ft = about 17.858 kg/m.

pound per second (lb/s) An obsolete unit of weight flow rate = 3600 lb/h = about 0.453 592 kg/s.

pound per square foot Name sometimes incorrectly used for pound-force per square foot.

pound per square foot (lb/ft^2) The FPS unit of surface density = 4.883 43 kg/m^2.

pound per square inch Name sometimes incorrectly used for pound-force per square inch.

pound per square inch (lb/in^2) An obsolete unit of surface density = 703.070 kg/m^2.

pound per square yard (lb/yd^2) An obsolete unit of surface density = 0.542 492 kg/m^2.

pound per thousand square feet (lb/1000 ft^2) An obsolete unit of surface density = 0.144 oz/yd^2 = about 4.882 43 · 10^{-3} kg/m^2.

pound weight (lb wt or **lb)** In the U.S., an obsolete unit measuring the weight or thickness of paper. The metric measure of paper weight is the areal density in grams per square metre (g/m^2). 1 lb wt is equal to 3.76 g/m^2 for bond paper, 1.48 g/m^2 for text stock, and 2.70 g/m^2 for card stock.

pound per yard (lb/yd) An obsolete unit of linear density = 1/3 lb/ft = about 0.496 055 kg/m.

poundal (pdl or **pl)** An obsolete unit of force used in engineering = the force which accelerates a mass of 1 lb at the rate of 1 ft/s, = 0.031 081 pound of force = 0.138 255 N = 13 825 5 dynes. The poundal was invented in the late 1870s[723] by the British engineer James Thomson (1822–1892), who also named the radian.

poundal (pdl) The FPS unit of force = the force that accelerates a mass of 1 pound at a rate of one foot per second per second = about 0.031 081 lbf = exactly 0.138 254 954 376 N.

power (x) A unit expressing the magnifying power of an optical system. The power is defined as being the angular diameter of the image formed by the system divided by the angular diameter of the original object being observed. In simple telescopes, this is = the focal length of the primary objective divided by the focal length of the eyepiece lens.

power (x) A way of indicating that a measurement is a multiple of some standard quantity.

power factor Ratio of the true watts to the apparent watts developed in a component of a circuit through which an alternating current is passing = the cosine of the phase angle. The name was defined by the British electrical engineer Sir John Ambrose Fleming (1849–1945) in 1892.[724]

Power number (N_p) or **Newton number** A dimensionless number in momentum transfer in general and power consumption by agitators, fans, pumps, etc., calculations in particular, relating the resistance force to the inertia force. The Power number has different specifications according to the field of application. e.g., for stirrers, it is defined as: $P/(\rho n^3 d)$, in which P = power, ρ = fluid density, n = rotational speed, and d = diameter of stirrer.

Pp An abbreviation for Paris point.

ppb, **ppm**, **ppM**, **ppq**, **ppt**, **pptr** Abbreviations for units of proportion: ppb = part per U.S. billion (10^{-9}), ppm = part per million (10^{-6}), ppM = parts per milliard, ppq = part per U.S. quadrillion (10^{-15}), and ppt = part per U.S. trillion (10^{-12}), respectively. The abbreviation "ppt" is sometimes also used for part per thousand (10^{-3}). To avoid this confusion, "pptr" is an alternate abbreviation for part per trillion.

ppcm, ppi Abbreviations for pixels per centimetre and pixels per inch, respectively. A pixel is a single "picture element," so these units measure the resolution, or fineness, of an image.

ppi An abbreviation for pages per inch, a measure of paper thickness.

ppm-days An abbreviation for the multiplicative product of parts per million concentration multiplied by the number of days exposure to that concentration. 2 ppm-days = 2 ppm for 1 day or 1 ppm for 2 days. It is used as a unit of total chemical exposure.

ppmv An abbreviation for part per million by volume.

Pr An abbreviations for Prandtl number.

Prandtl number (*Pr*) A dimensionless number, used in fluid mechanics, approximating the ratio of momentum diffusivity and thermal diffusivity. $Pr \equiv \upsilon/\kappa$, in which υ = kinematic viscosity and κ = thermal diffusivity. At 20°C, the Pr lies between 0.67 and 1.0 for gases. For water, it is 6.7.[725] The number was deduced by Nusselt in 1910,[726] but was named after the German engineer Ludwig Prandtl (1875–1953) under the misinformed belief that he had initially derived it in 1922.[727] The number was recognized by the American Standards Association in 1941.[728]

precision Difference between an instrument's reported values during repeated measurments of the same quantity. Typically, this value is determined by statistical analysis of repeated measurement. See also *accuracy*.

preece An obsolete metric unit of electric resistivity. It was based on the resistance, measured in megaohms, of a cube with sides 10^7 m long. The unit is named after the Welsh scientist and former British Post Office Engineer-in-

[723] [THOM7, p. 220].

[724] [FLEM] according to [JERR].

[725] [DIEB].

[726] [NUSS2].

[727] In 1952, Nusselt states: "The author is unwilling to encourage this piece of historic inaccuracy and therefore prefers the equally brief expression υ/K" [PRAN, p. 407].

[728] American Standards Association Sub-Committee Z 10 C, March 1941.

Chief Sir William Henry Preece (1834–1913), who suggested the unit in 1891.[729]

Preferred Noise Criterion (PNC) A unit used in engineering to measure the level of background noise of ventilation and other background broad band noise sources in rooms or other enclosed spaces. PNC was proposed in 1971 by the American acoustics expert Leo Leroy Beranek[730] (1914–2016), as a modification of the older Noise Criterion (NC), due to unacceptable low frequency noise in air-condition systems. PNC ratings below 40 are generally required for residential or classroom spaces. PNC ratings are typically 10–15% lower than raw measurements of the sound level in decibels.

printer's bundle In Britain, a unit of quantity of paper = 4 reams = 1920 sheets.

printer's quire See *commercial quire*.

printer's ream In Britain, a unit of quantity for paper = 10 perfect reams = 5160 sheets. The additional amount is to allow for sheets which may be spoiled in shipment.

prism diopter (PD) A unit, used in optics to measure the deflection of light by a prism, = the angle determined by a deviation of 1 cm at 1 m = 4/7 degrees. Mathematically, the deflection in prism diopters is = 100 times the tangent of the angle through which the path of the light is bent in passing through the prism.

p.r.n. [< L: *pro_ra nata*] In medicine, an expression for "as occasion requires."

prout A unit of nuclear binding energy, suggested in 1947[731] by Enos Eby Witmer, = 1/12 of the binding energy of the deuteron structure = about $1.855 \cdot 10^4$ eV. The unit is named after the Scottish scientist William Prout[732] (1786–1850).

PRU An abbreviation for peripheral resistance unit.

ps or **PS** The German abbreviation for the unit pferdestärke.

[729] [PREE] according to [JERR].

[730] [BARA].

[731] [WITM].

[732] [BROC3].

p.s.f. or **psf** An abbreviation for "pounds per square foot", correctly: poundforce per square foot.

psi, **psia**, **psid**, **psig** An obsolete symbols for pressure units used in hydraulics and plumbing. **psi** is a symbol for *poundforce per square inch*. **psig** is a symbol for *poundforce per square inch gauge*; this means that the pressure has been read from a gauge which actually measures the difference between the pressure of the fluid and the pressure of the atmosphere. **psia** is a symbol for *poundforce per square inch absolute*, which is the total pressure including the pressure of the atmosphere. **psid** is a symbol for *poundforce per square inch differential*, a difference between two pressures, neither of which is atmospheric pressure.

PSU or **psu** An abbreviation for practical salinity unit, a standard measure of the salinity of seawater, actually a dimensionless ratio obtained by measuring the conductivity of a water sample. Seawater typically has a mass salinity of about 35 PSU, or the same conductivity as a standard solution of potassium chloride (KCl) with a concentration of 3.243 56 % by mass, although lower values are typical near coasts.

pt or **pt.** An abbreviation for pint.

PTB An abbreviation for Physikalisch-Technische Bundesanstalt.

pudy See *pood*.

puff A colloquial for a picofarad, from its symbol "pF." It was common among technicians in electronics during the 1940s, '50s, and '60s.

pugillus A unit of capacity in pharmaceutical recipes in the U.S. = as much as can be taken with three fingers, sometimes interpreted as between thumb and two fingers.[733] See also *pinch*.

pull A measure of the angular deflection in an overhead utility line at a pole where the line changes direction. Pull p is related to the angle α of deflection by the formula $p = 100 \cdot \sin(\alpha/2)$.

pulp cord See *cord*.

[733] In modern recipes, interpreted as between the thumb and one finger.

pulsatance Name suggested in 1919 for angular or circular frequency = $2\pi f$, in which f = frequency in Hz.

pulse (p) A very seldom used unit of frequency, proposed in 1947,[734] = the number of oscillations in 2π seconds.

pulviameter An instrument for ascertaining the quantity of water that falls in rain, or in rain and snow, in any particular climate or place.

punnet A small square or rectangular container for fruits or vegetables, such as small berries, bean sprouts, or mushrooms. When used as a measure of capacity, a punnet is generally equal to a dry pint in the U.S. or an Imperial pint in Britain, and as a measure of weight, it usually varies between ¾ lb and 1 lb = about 340 g to 454 g. The unit is named after the British grower of strawberries Reginald Crundall Punnett (1875–1967), who used to sell strawberries in small woodchip baskets at the London market.

puppy A jocular unit of happiness. Character Lucy van Pelt in the syndicated comic stip Peanuts, written by the American cartoonist Charles Monroe Schulz (1922–2000), once discovered the axiom "happiness is a warm puppy." The unit is said to be "derivable as the quantity of happiness which one kilogram beagle puppy whose body temperature is 310 kelvins produces when held in skin contact for one second."[735] See also *happy*.

pwt An abbreviation for pennyweight.

pyrometer A non-contacting instrument for measuring degrees of heat above those indicated by the mercurial thermometer; such as the pyrometer of Wedgewood.

pyron [<Gr: *pyr* = "fire"] A CGS unit used to measure the heat flow delivered by solar radiation = 1 IT calorie/(cm^2 · minute) = 697.633 $J/m^2 \cdot s$.[736] See also *langley*.

pz An abbreviation for pièze.

[734] [SAS, p. 21].

[735] www.en.wikipedia.org

[736] Also about half the average solar radiation rate for Earth.

17 Q

Q A metric unit of length = exactly 0.25 mm. It is used by typographers and page designers in China, Germany, Japan,[737] Korea and Vietnam in preference to the traditional point. One Q is = 0.71 point, a little more or less depending on the exact definition of the point. In Chinese, it is called a *jiíshū*, in Japanese, a *kyūsū*, and in Korean, a *geubsu*.[738]

Q A symbol for quad.

q- or **qq** A symbol for the Latin *quaque*, "every," often used in medical prescriptions and orders. The symbol is used in combinations such as q8h, "every 8 h," or q2d, "every other day."

q- A former German prefix meaning *quadrat-*, "square," seen in combinations such as qm (*Quadratmeter* or square meter) and qkm (*Quadratkilometer* or square kilometer). The SI does not allow use of this symbol.

q An abbreviation for quintal.

q An abbreviation for kwintal.

Q-factor, **quality factor**, or **magnification of the circuit** A unit or factor that describes the overall quality or selectivity of a resonant circuit.[739] It is numerically = $2\pi fL/R = (LC)^{1/2}/RC$, in which f = resonant frequency of the circuit, L = inductance, C = capacitance, and R = resistance. The Q-factor can also be defined as (reactance power)/resistance = Q/P, in which Q = the reactive power and P = the average energy dissipation rate.[740] The letter Q was introduced in 1931.[741] In the early 1930s, the unit was known as the magnification of the circuit (abbreviated *m*).[742]

Q unit See *quad*.

Q unit See *Qunit*.

q.2h., q.3h., . . .An abbreviation used in medicine = "each 2 h", "each 3 h", etc.

[737] The unit is defined in JIS 0207-1979.

[738] [LUND, p. 340].

[739] The reciprocal is called the dissipation factor.

[740] [BIRD, p. 352].

[741] [BAYL].

[742] [BEAT].

qd, **q.d.**, **QD**, or **qqd** [<L: *quaque die* = "once a day"] A unit of frequency traditionally used in medical prescriptions. This notation is often modified for a lesser frequency by imbedding a number of days in the middle, as in q.2d., every two days.

Q.F. or **QF** An abbreviation for quality factor. See *Sievert*.

qh, **q.h.**, **QH**, or **qqh** [<L: *quaque hora* = "once a hour"] A unit of frequency traditionally used in medical prescriptions. This notation is often modified for a lesser frequency by imbedding a number of hours in the middle, as in q.3h., every 3 h.

qhs [<L: *quaque hora somni* = "every night at bedtime"] A symbol often used in medical prescriptions and orders.

q.i.d. or **QID** [<L: *quater in die* = "four times a day"] A unit of frequency traditionally used in medical prescriptions.

qm An obsolete German abbreviation for *Quadratmeter* = square metre.

qod A symbol for "every other day," often used in medical prescriptions and orders.[743]

qq See *q-*.

QR An abbreviation for Quadratrute.

qt An abbreviation for Imperial quart.

quad A unit of information, used in computer science, = 2 bits. See also *crumb* and *tayste*.

quad A proposed unit of length = 10^7 m.[744]

quad [short for quadrillion Btu] or **Q unit (Q)** A unit of heat energy of fuel reserves, used in the U.S. for such purposes as reporting the total annual energy consumption in the American economy.[745] One quad is = 10^{15} Btu = about 1.055 EJ = about 293.07 TWh, which is roughly the amount of energy in 44 million short tons of bituminous coal, 172 million barrels of crude oil, or 980 billion standard cubic feet of dry natural gas.

quadbit A unit of information = 4 bits = ½ byte. This unit is used in telecommunications, in which data is frequently transmitted in quadbits. In other contexts, the same unit is called a tetrad, a nibble, or a hexit.

quadrant (quad) A unit of angle measure = ¼ circle = π/2 radians = 90° = 100 grads.

quadrant (quad) A unit of length = the distance from the North Pole to the Equator. The metric system was originally designed to make this distance exactly 10 million metres. Using the conventional figures of 12,756 km for the equatorial diameter of the earth and 12,714 km for the polar diameter, and assuming the earth to have an elliptic cross-section, the length of the quadrant is about 10,001,300 m = about 5400 international nautical miles (= 10,000,800 m).

quadrant (inductance) An obsolete unit of inductance, the name chosen by the Second International Conference of Electricians in 1889 and renamed the **henry** at the Third Conference in 1893.[746] "Quadrant" was suggested as ". . ., the unit of inductance must be 1000 million centimetres. . .,"[747] which is the approximate length of a quadrant of the earth, measured on the meridian of Paris. See also *henry* and *international henry*.

quadrat- (q-) A German prefix meaning "square." For example, the square kilometer is the Quadratkilometer (km^2) in German.

quadrumvirate A unit of quantity = 4. The word was coined after the model of 'triumvirate.'

quadruplet The name of a group of four items, especially four identical items; the word is also used for one member of the group.

quadword A unit of information = 4 shortwords = 8 bytes = 64 bits. See also *word*.

quantum A unit of relative energy used in physics = the frequency in Hz multiplied by Planck's constant, 6.626 070 040(81) · 10^{-34} J·s.

quarter An adjective, used in words such as quartersection, quarter hour, and quarter note.

quarter A name used for a quarter dollar in the U.S. = 25 cents.

743 [KOWA, p. 229].

744 [CLAR3].

745 It is likely, as the Universe evolves, that virtually all energy will be converted into heat.

746 According to [BAAS3, p. 43].

747 1891: *The Electrical Review* **28**, 59.

quarter (qtr or **Q)** A unit of angle measure = ¼ circle; hence, another name for a *quadrant*.

quarter (qtr or **Q)** A unit of angle measure, sometimes used at sea, = ¼ of a compass point. In this use, a quarter equals $2°48'45'' = 2.8125° = \pi/64 = 0.049\ 087$ radian.

quarter (qtr or **Q)** An informal unit of length = ¼ mile = 2 furlongs = 402.336 m. This unit is used in athletics and horseracing.

quarter (Q) In the U.S., during the twentieth century, a unit of length = 0.25 mm.

quartet A unit of quantity = 4.

quartile A statistical unit = 25 percentiles, or ¼ of a ranked sample. See *percentile*.

quarto In England, a name for a page size. See *-mo*.

quatloo A fictional currency used in the American science fiction entertainment series Star Trek, created by Eugene Wesley "Gene" Roddenberry (1921–1991). Quatloos were used for betting in the episode "The Gamesters of Triskelion."

Quevenne scale See *degree Quevenne*.

quindecagon The name for a polygon that has fifteen sides.

quintet A unit of quantity = 5.

quintile A statistical unit = 20 percentiles, or 1/5 of a ranked sample. See *percentile*.

quintuplet A group of five items, especially five identical items; the word is also used for one member of the group.

Qunit, **Q-unit**, or **Q unit** [short for quintillion Btu] **(Q)** In the U.S., a unit of heat energy used by economic analysts to measure very large amounts of energy = 10^{18} Btu = 1000 quads = about 1.055 zettajoules (ZJ). The unit was proposed by the English nuclear physicist Sir John Douglas Cockcroft (1897–1967) in 1953[748] to express the world's fuel reserves.

[748] [COCK].

18 R

R An abbreviation for resistance, but sometimes used in lieu of the alien Ω as the symbol for ohm.

R An abbreviation for Renard number or röntgen.

R See *R value*.

°R An abbreviation for degree Rankine, degree Réaumur or degree Rømer.

R units (Solomon R unit and **German R unit)** or **r unit** [radiation] Obsolete units of X-ray intensity, used in the 1920s. The Solomon R unit was defined as the intesity of an X-ray that produces the same ionization as that from 1 g of radium placed 2 cm from an ionization chamber when there is a platinum screen ½ mm thick between the source and the chamber = about 2100 r/h. One German R unit = about 2 ½ Solomon R units.

R value or **R** A commercial unit used to measure the effectiveness of thermal insulation.[749] A thermal insulator is a material, manufactured in sheets, which resists conducting heat energy. 1 R value = 1 $\text{hr}\cdot\text{ft}^2\cdot°\text{F}/\text{in}\cdot\text{Btu} = 0.176\ 11\ \text{m}^2\cdot\text{K/W}$. The reciprocal of R-value is known as the U-value.

r An abbreviation for relong or revolution.

$\mathbf{R_0}$ See *galactocentric distance*.

$\boldsymbol{R_a}$ A symbol for Rayleigh number.

°Ra An abbreviation for *degree Rankine*.

ra The name of the flat of the note ray[750] in the movable English tonic sol-fa system.

rack unit or **U (RU** or **U)** An obsolete unit of length, used to measure the height of audio, video, or computer equipment components, as well as that of the standard panels and racks in which these components are mounted.[751] It is

[749] The unit was approved in 1979 by the British Standards Institution.

[750] Pronounced "raw."

[751] "This mounting system originated with the telephone company, who needed a standard for housing the millions of relays at one time used in the telephone system. Its adaptability, and the high quality and ready availability of components lead to the system's use in housing electronic equipment in industry and research, and in the *1980s*." Cited from Sizes.com.

based on the height of the equipment's front panel, which must have a width of 19 in. The nominal height of the panel is a multiple of 1 ¾ in = 44.45 mm.[752]

rad An abbreviation for radian.

rad (rd) [acronym for "radiation absorbed dose"[753]] An obsolete SI, CGS and metric unit measuring radiation dose. In 1918, it was defined as the dose required to kill a mouse.

In 1953, the rad was defined by the International Commission on Radiological Units as the amount of radiation that leads to the absorption of 100 ergs of energy per gram (0.01 joule per kilogram) of whatever substance is being used. The value 0.01 joule was chosen so that absorption of 1 roentgen of X rays or gamma radiation in water or soft tissue would produce an absorbed dose of 1 rad = 1 μJ/kg.

In 1956, the rad was accepted as the general unit of dose.

In 1970, the rad was defined in SI as the number of ergs per hectogram = 10 mJ/kg.

In 1975, the rad was replaced in SI by the gray (Gy). 1 rad equals 0.01 Gy. While the symbol for this unit is the same as the symbol for the radian unit, the symbol 'rd' was sometimes used to avoid confusion.

rad per second (rad/s or rd/s) A unit of absorbed dose rate = 0.01 Gy/s = 100 erg/(g · s).

radar mile The time required for a radar signal to travel a distance of one mile from the transmitter to an object, and then return to the receiver. Both statute and nautical miles are used: the radar statute mile is about 10.8 μs and the radar nautical mile is about 12.4 μs.

radian (rad) An SI supplementary unit of plane angle and phase difference, used in mathematics and science, defined as the plane angle at the center of a circle that cuts off an arc of length = the radius. Since the circumference equals 2π times the radius, one radian equals 1/(2π) of the circle = about 63.662 grade = about 57.295 779 513°. The radian was defined and named by the Professor of mathematics at Queens College in Belfast, James Thomson, in 1873.

radian frequency A name suggested for angular frequency in 1949.[754] It is defined as $2\pi f$, in which f = frequency in hertz.

radian per metre (rad/m) A unit of phase coefficient = 1 m^{-1}.

radian per minute (rad/min) A unit of angular velocity = 0.954 930 °/s = about 0.016 667 rad/s.

radian per second (rad/s) or **strob** The SI unit of angular velocity and circular frequency = 57.295 8 °/s = about 63.662 grade/s = about 9.549 30 rpm.

radian per second squared (rad/s²) The SI unit of angular acceleration = 57.295 8 °/s^2 = about 63.662 grade/s^2.

radiation length See *cascade unit*.

radiation unit (ru) An obsolete name for the becquerel.

radiation unit See *cascade unit*.

radiocarbon year (^{14}C yr, yr BP) A unit used in stating the nominal ages of plant or animal remains dated by radiocarbon testing. Only about 10^{-12} of the carbon in the ecosystem is radioactive carbon-14, which decays to nitrogen-14 with a half life of about 5760 years. After a plant or animal dies, the carbon-14 in its body decays, so the amount remaining is a measure of the age of the remains. The age T of a sample, in radiocarbon years, is computed from the formula T = −8033 ln(R/A), in which R is the measured ratio of carbon-14 to ordinary carbon-12 in the sample and A is the benchmark ratio measured in the atmosphere in 1950. The results are inaccurate, as the formula assumes a half life of 5568 years, which is now known to be too short, and as the ratio of carbon-14 to ordinary carbon-12 in the atmosphere varies slightly over time.

ralte In former Persia and present Iran, a name given to the litre during the country's conversion to the metric system in the early twentieth century.

Ramden's chain During the seventeenth–nineteenth centuries, a unit of length used by

[752] [GIDD, p. 452].

[753] [ROYA, p. 27, footnote 4].

[754] [DARW].

British engineers = 100 Ramden's links = 100 feet = 30.48 m.

Rankine or **Rankine scale of temperature** An absolute temperature scale. See *degree Rankine*.

rasbukniks A fictional currency used in the satirical American comic strip Li'l Abner, written and drawn by Al Capp (1909–1979). It was used in the imaginary nation Lower Slobbovia, and had literally no value.

rasher The name of a slice of bacon, cut transversely to the body line, of several millimetres in thickness.

Rathborn chain During the seventeenth–nineteenth centuries, a unit of length used by British surveyors = 2 perches = 20 primes = 100 Rathborn links = 33 feet = 10.058 4 m.

rationalized electric and magnetic units To prevent π from popping up, when it made no sense, when using the electrical and magnetic units in the centimetre-gram-second and metre-kilogram-second systems, π has to be introduced coherently. In 1950, the IEC decided to increase the value for the permeability of free space by a factor of 4π. The resulting system was called "rationalized MKSA".

rat unit A unit of weight for riboflavin = 4 μg of riboflavin.

rat unit or **International Rat Unit (IRU)** A unit of quantity of vitamin E = the minimum amount of *dl*-alpha-tocopherol acetate that must be given orally to tocopheral-deficient rats to prevent absorption of the fetuses in 50% of the rats.[755]

ray or **ram** During the twentieth century, a unit of acoustic or mechanical resistance, suggested in 1934[756] by McLachlan, = the acoustic ohm. The unit is named after the British physicist and pioneer in acoustic measurement John William Strutt (1842–1919), the second Baron Rayleigh of Terling Place, Witham in the county of Essex.

rayl A unit of sound impedance, representing the ratio between the pressure and the particle velocity it produces. In MKS units, this means 1 rayl equals 1 (Pa·s)/m = 1 (N·s)/m^3 = 1 kg/(m^2 s). The same name, rayl, was also used for the corresponding CGS unit for 1 dyne-second per cubic centimetre (dyn·s/cm^3) = 1 g/(cm^2 s) = 10 Ns/m^3. The CGS rayl equals 10 MKS rayls. The units are named after the British physicist and pioneer in acoustic measurement John William Strutt (1842–1919), the second Baron Rayleigh of Terling Place, Witham in the county of Essex.

rayleigh (R) The CGS unit of luminous flux used in astronomy and physics to measure the brightness of the night sky and the air glow, for example, the aurora. One rayleigh represents the light intensity of 10^6 photons of light/(cm^2 · s) = 10^{10} photons/m^2 = about $5.272 \cdot 10^{-25}$ W/m^2 steradian times the frequency in hertz of the light being measured. A dark night sky has a light intensity of roughly 250 R, while auroras may be measured between 1000 and 1,000,000 R. The unit, first proposed in 1956,[757] is named after Robert John Strutt (1875–1947), the fourth Lord Rayleigh.

Rayleigh number (*Ra*) A dimensionless number used in heat transfer in general and free convection calculations in particular. It is normally defined as $(L^3\ \rho^3\ g\ \beta\ \Delta T\ C_p)/(\mu\ k)$, in which L = characteristic length, ρ = density, g = gravitational acceleration, β = coefficient of expansion, ΔT = temperature differens, C_p = heat capacity, μ = viscosity and k = thernal conductivity.

R.B.E. An abbreviation for relative biological effectiveness. See also *sievert*.

rd An abbreviation for rad.

rd An obsolete abbreviation for radian.

rd or **Rd** An abbreviation for rutherford.

R.E. An abbreviation for retinol equivalent.

Re An abbreviation for Reynold number.

°**Re** An abbreviation for degree Réaumur.

°**Ré** An abbreviation for degree Réaumur.

reactivity unit See *nile*.

[755] [SIEB, p. 664].

[756] [MCLA].

[757] [HUNT].

reactivity unit The name of any unit expressing the reactivity of a nuclear reactor. See *dollar*, *inhour*, *millik*, *nile*, and *pour cent milli*.

Réaumur or **Réamur scale of temperature** A temperature scale. See *degree Réaumur*.

reciprocal angström (**$Å^{-1}$**) A unit of wavenumber = 10^{10} m^{-1}.

reciprocal centimetre (**cm^{-1}**) The CGS unit of wavenumber, used in spectroscopy, = 100 m^{-1}.

reciprocal cubic metre (**m^{-3}**) The SI unit of number density and molecular concentration.

reciprocal cubic metre reciprocal second (**m^{-3} s^{-1}**) The SI unit of volume collision rate.

reciprocal degree Celsius (**$°C^{-1}$**) See *reciprocal kelvin*.

reciprocal electronvolt reciprocal cubic metre (**eV^{-1} m^{-3}**) An obsolete unit of density of states = 6.241 46 · 10^{18} J^{-1} m^{-3}.

reciprocal farad (**F^{-1}**) The SI unit of elastance.

reciprocal henry (**H^{-1}**) The SI unit of reluctance = 1 S/s.

reciprocal joule reciprocal cubic metre (**J^{-1} m^{-3}**) The SI unit of density of states = m^{-5} kg^{-1} s^2.

reciprocal megakelvin (**MK^{-1}**) See *mired*.

reciprocal kelvin (**K^{-1}**) The SI unit of linear expansion coefficient, cubic expansion coefficient and relative pressure coefficient = 0.555 555 $°F^{-1}$.

reciprocal metre (**m^{-1}**) The SI unit of wavenumber and circular wavenumber = 1 dioptre. It is also the SI unit of attenuation coefficient, linear absorption coefficient, linear attenuation coefficient, linear ionization, macroscopic cross section, phase coefficient, propagation coefficient and Rydberg constant.

reciprocal minute (**min^{-1}**) A unit of circular frequency = 1/60 s^{-1}.

reciprocal mole (**mol^{-1}**) The SI unit of Avogadro constant.

reciprocal nanometre (**nm^{-1}**) A unit of wavenumber.

reciprocal ohm (**Ω^{-1}**) See *siemens*.

reciprocal ohm metre (**$(\Omega\ m)^{-1}$**) [correct name is reciprocal ohm reciprocal metre] See *siemens per metre*.

reciprocal pascal (**Pa^{-1}**) The SI unit of compressibility.

reciprocal pascal reciprocal second (**$(Pa\ s)^{-1}$**) The SI unit of dynamic fluidity.

reciprocal poise (**P^{-1}**) The CGS unit of fluidity = 10 $(Pa\ s)^{-1}$.

reciprocal second (**s^{-1}**) The SI unit of circular frequency = 60 min^{-1}. Also, the SI unit of damping coefficient, decay constant and velocity gradient.

reciprocal second reciprocal cubic metre (**s^{-1} m^{-1}**) The SI unit of slowing-down density and total neutron source density.

reciprocal second reciprocal kilogram (**s^{-1} kg^{-1}**) See *becquerel per kilogram*.

reciprocal second reciprocal square metre (**s^{-1} m^{-2}**) See *reciprocal square metre reciprocal second*.

reciprocal second reciprocal tesla (**s^{-1} T^{-1}**) See *ampere square metre per joule second*.

reciprocal square metre (**m^{-2}**) The SI unit of particle fluence.

recommended dietary allowance (**RDA**) A units used in the U.S. to measure the amounts of certain nutrients found in foods or provided by supplements such as vitamin tablets. Each nutrient has its own RDA unit.

Red, **Red I**, and **Red II** See *redwood viscometer*.

red hot A vernacular measure that can be fairly accurate in familiar circumstances, such as, for instance, in the operation of a steelworks.[758]

redshift (**z**) A unit of relative distance used in astronomy. The universe is expanding, so distant galaxies are receding from the earth. The faster the speed of recession, the farther the object. The redshift equals z if the wavelength of light is z + 1 times the normal wavelength; thus, a redshift of

[758] An approximate pattern is: 500°C (redness beginning), 700°C (dark red), 900°C (bright red), 1100°C (yellowish red), 1300°C (whiteness beginning), and 1500°C (white).

0.20 means that the wavelength of the light is 20% longer than normal.

reduced frequency See *Strouhal number*.

redwood viscometer or **Standard British viscometer** A viscometer that determines petroleum oil viscosity by measuring the time it takes for a given amount of liquid to pass through an orifice.[759] The instrument is available in two sizes: Redwood type-I and type-II. When the flow time exceeds 2000 s, type-II must be used.

Reech-Froud number See *Froude number*.

Reech number See *Froude number*.

reel In the motion pictury industry, a unit of running time used to describe the length of films = 10 min.

relative molecular mass See *molecular mass*.

relativistic mass The name for a mass of a body in motion relative to the observer. It is = the rest mass multiplied by a factor that is greater than 1 and that increases as the magnitude of the velocity increases.

rem or **REM** ["roentgen equivalent man" meaning that it measures the biological effects of ionizing radiation in humans] An obsolete unit used for measuring the effective dose of radiation received by a a living organism. The unit was usually encountered as the millirem, **mrem**, and was introduced in 1944 by the American physicist Herbert M. Parker (1910–1984) of the Manhattan Project as the quantity of radiation that would produce the same biological damage in a human being as would result from absorption of 1 rep of X rays. While some forms of radiation are more harmful than others, a factor called *relative biologial effectiveness* (RBE) is used, meaning the ratio of the size in rads of a dose of X rays to the size in rads of a dose of another type of radiation causing the same amount of damage. RBE is determined experimentally. Rems are defined as: dose in rems = dose in rads × RBE. The rem has been replaced by the sievert, 1 rem = 0.01 Sv, but the temporary use of the rem has been sanctioned by the CIPM.[760]

Renard number (*R*) A type of preferred number, named after the French army engineer Charles Renard (1847–1905), who, in 1870, proposed a set of preferred numbers for use with the metric system. Renard Numbers were adopted as ISO standard 3 in 1952. Renard numbers are rounded results of the formula $R(\mathrm{i}, \mathrm{b}) = 10^{\mathrm{i}/\mathrm{b}}$, in which b is the selected series value and i = the *i*-th element of this series. See also *preferred number*.

rep [acronym for röntgen equivalent physical] or **Parker** An obsolete unit of absorbed dose. The value of the rep depends on the amount of energy liberated in the body by X rays producing 1 esu of charge, which is determined experimentally. First, it was defined as equalling the absorption of about 83.8 erg/g = 8.38 mGy, but later changed to about 93 erg/g = 9.3 mGy. Later improved measurements have found that 1 roentgen of air kerma deposits 8.77 mGy in dry air and 9.6 mGy in soft tissue. The unit was proposed in 1950[761] by the American specialist in radiology Herbert M. Parker (1910–1984), and originally called the **reb** (röntgen equivalent biological), but during one of his early presentations of the new unit, Parker was suffering from a cold, which led to difficulty in differentiating it from the rep.[762]

reputed … An adjective applied to some measure to mean a size by reputation, in contrast to that of statute.

res or **RES** A symbol for "resolution," a unit defined to be the number of dots or pixels per millimetre in an image. The unit is often stated before the measurement. RES 1 is = 25.4 dpi.

resolution The term for the smallest increment of change in the measured value that can be determined from the instrument's readout scale. The resolution is often on the same order as the precision.

rest A musical term defined as an interval of silence between tones.

rest mass The mass of a body as measured when the body is at rest relative to an observer, an inherent property of the body.

retinol equivalent (RE) A unit of dosage for retinol (vitamin A) and for related substances

[759] intota.com

[760] A Glossary of Terms in Nuclear Science and Technology. New York: American Society of Mechanical Engineering, 1955, p. 147.

[761] [PARK].

[762] Sizes.com and [KATH].

such as beta carotene. One RE is equivalent to 5 international units (IU), or 1.5 μg, of retinol. U.S. nutritional authorities recommend that an adult diet provide 1000 RE per day.

rev A formerly used abbreviation for revolution.

revenue ton or **tonne (RT)** A unit used for billing in the shipping industry. The size of a shipment in revenue tons is the number of metric tons or cubic metres in the shipment, whichever is larger.

revolution (r or **rev)** A unit of plane angles = a full circle = 4 right angles = 6 hexangles = 360° = 2π rad = 400 grades.[763]

revolution per minute (r/min or **rpm**; **formerly rev/min)** A unit of frequency, used particularly for rotation rates in mechanics. One r/min equals 1/60 Hz = 0.104 720 rad/s. The tachometers on auto dashboards are usually calibrated in units of 1000 r/min.

revolution per second (r/s or **rps**; formerly **rev/s)** A unit of rotational = 6.283 19 rad/s.

reyn [pronounced "ren"] An FPS unit of dynamic and absolute viscosity, used in lubrication. With force measured in pounds of force (lbf), one reyn equals 1 lbf·s/in^2 = about 68.947 57 kilopoise = 6.894 757 kPa s. Together with the centipoise, it was one of two viscosity units endorsed at the 1957 London Conference on Lubrication and Wear. The unit is named after the British scientist Sir Osborne Reynolds (1842–1912).

Reynolds number (*Re*) A dimensionless number used in momentum, heat, and mass transfer to account for dynamic similarity. Normally defined as (L v ρ)/μ, in which L = characteristic length, v = velocity, ρ = density and μ = viscosity. It is named after the British scientist Sir Osborne Reynolds (1842–1912), who proposed it in 1883.[764]

rhe [<Gr.: *reo* = "to flow"] The CGS-unit of dynamic fluidity. The unit was introduced by the American chemists Eugene Cook Bingham (1878–1945) and Theodore R. Thompson (1879–1973) in 1928[765] and defined as the reciprocal of the centipoise.[766] However, rhe came to be used as the reciprocal of the poise itself instead, so the fluidity of a substance in rhes is 1 divided by its dynamic viscosity in poise = 100 (Pa·s)$^{-1}$.

rhe [<Gr.: *reo* = "to flow"] The CGS-unit of kinematic fluidity, defined in 1961 as 1 Ms/m^2.

Rheoboam A large champagne bottle holding six standard bottles = 4.5 L (when it comes to other wine districts, it is called a Jeroboam). See also *Jeroboam*.

rhm [roentgen-hour-metre] A unit used in physics to measure the strength of gamma rays, a form of high-energy radiation emitted by some radioactive substances. A source of strength 1 rhm produces ionization at the rate of 1 roentgen per hour at a distance of 1 m from the source.

Rhode Island The smallest state in the U.S., Rhode Island has long served as an informal unit of area in statements such as "A gigantic iceberg, about 1 times the size of Rhode Island, has drifted a few hundred miles from Antarctica into South Atlantic shipping lanes." or "Alaska is 499.7 times the size of Rhode Island." Rhode Island has a land area of about 2706 km^2. A comparable European unit might be that of Luxembourg (2586 km^2).

Richardson number (*Ri*) A dimensionless number whose values determine whether convection is free or forced, defined by: $F_{\text{bouyancy}}/F_{\text{inertial}} = \left| -g\alpha\Delta T \right| / \left| \mathbf{u} \cdot \mathbf{u} \right| = g\alpha\Delta TL/U^2 = \mathrm{Fr}_{\text{internal}}^{-2}$, in which g is the gravitational acceleration, α is the thermal expansion coefficient, ΔT is the temperature difference, **u** and U are the velocity scale, L is the length scale, and $\mathrm{Fr}_{\text{internal}}$ is the internal Froude number. The number is named after the English phycisist Lewis Fry Richardson (1881–1953), who was the first to apply mathematics, in particular, the method of finite differences, to predicting the weather.

[763] In some senses, also referred to as a turn.

[764] [REYN2]. For more information see also: [ROTT3].

[765] [BING2].

[766] In [VANN], it is defined as the reciprocal of the centistokes!

Richtstrahlwert A German unit of brightness, used in electron-optics, = the current density per unit solid angle.

Riggs constant A number often applied by undergraduates and high school students. The Riggs constant is whatever number can be inserted into your formula to make it work. See also *fudge factor* and *Stradivarius' constant*.

right angle (∟) A common unit of angle measure = 90° = π/2 rad = 100 grads = ¼ circle.

ringing equivalent number (REN) A measurement of power required to ring a POT (Perfectly Ordinary Telephone). The REN value equals a conductance of 1/4 000 Ω^{-1}, because the impedance of telephone ringing circuits was set, by British Telecom in the late 1970s, to a standard value of 4000 Ω.

rippo . . . A Japanese prefix meaning "cubic", e.g.,ripposhaku = cubic shaku.

$\boldsymbol{R_m}$ A symbol for Magnetic Reynolds' number.

RMS An abbreviation for root mean square, a mathematical technique for averaging the values of a changing quantity.

RMSE An abbreviation for root mean square error.

°**Rø** An abbreviation for degree Rømer.

roc [reciprocal ohm centimetre] ($\boldsymbol{\sigma_{roc}}$) The CGS unit of electrical conductivity, proposed in 1964,[767] = 100 σ_{rom}. See also *rom*.

roentgen See *röntgen*.

rom [reciprocal ohm metre] ($\boldsymbol{\sigma_{rom}}$) The CGS unit of electrical conductivity, proposed in 1964,[768] = 1/100 σ_{roc}. See also *roc*.

Roman numerals Name of graphic characters used as numerals in ancient Rome. The system was slightly modified in the Middle Ages to the system we know today.

Rømer scale (°**Rø** or °**R**) A disused temperature scale, named after the Danish astronomer Ole Christensen Rømer (1644–1710), who proposed it in 1701. The boiling point of water was defined as 60°. The freezing point of water was defined at 7 ½°, and used as the other fixed point. Thus, the unit of the scale is 40/21 of a kelvin.

$$[^\circ R\text{ø}] = [^\circ \text{C}] \times {}^{21}\!/_{40} + 7.5 = \left([^\circ \text{F}] - 32\right) \times {}^{7}\!/_{24} + 7.5 = [^\circ \text{R}] - 491.67\big) \times {}^{7}\!/_{24} + 7.5 = ([\text{K}] - 273.15) \times {}^{21}\!/_{40} + 7.5.$$

röntgen or **roentgen** (**R** or **r**) A non-metric unit used to measure the ionizing ability of X-radiation or gamma rays. The roentgen was defined by the 1937 Radiological Congress in Chicago as the amount of X-radiation or gamma radiation that produces ionization = 1 electrostatic unit of charge, either negative or positive, in 1 cm^3 of dry air at 0°C and at standard atmospheric pressure. At a meeting of the BIPM's working group for the measurement of X- and gamma-rays in the mid-1960s, the roentgen was redefined as 258 μC/kg of air.[769] The unit is named after the German physicist Wilhelm Konrad Röntgen (1845–1923).

röntgen equivalent man See *rem*.

röntgen metre squared per curie hour ($\mathbf{R \cdot m^2/(Ci \cdot h)}$) A unit of specific gamma ray constant = 1.936 94 · 10^{-18} C · m^2/kg.

röntgen per second (R/s) A unit of exposure rate = 2.58 · 10^{-4} C/(kg · s).

roon A fictional currency used in the science fiction trilogy Helliconia, written by the English author Brian Wilson Aldiss (b. 1925).

root mean square (RMS) Notation used after various measurements to indicate that the root mean square method has been used to measure or compute an average value for the measurement. In the RMS method, the varying quantity is first squared (S), then a mean (M) or average of the squared values is obtained, and then the square root (R) of this mean value is computed.

root-mean-square error See *standard deviation*.

Rossby number ($\boldsymbol{R_0}$) or **Kibel number** (***Ki***) A non-dimensional number expressing the ratio of inertial to Coriolis forces in the atmosphere or oceans. The Rossby number is defined as U/(*fL*),

[767] [BARK4].
[768] [BARK4].
[769] [TERR2].

in which U = a characteristic velocity scale, f = the Coriolis parameter, and L = characteristic length scale. The number is named after the Swedish meteorologist Carl-Gustav Arvid Rossby (1899–1958).

round Name suggested in 1880, by James Thompson, for an angle of 360°.[770]

rowland A unit of length, used extensively between 1887 and 1907, adopted in 1887[771] by the American physicist Henry Augustus III Rowland (1848–1901), because of a discrepancy in the wavelength of the lines on Ångström's map of the solar spectrum. This error was due to Ångström's assuption that the Uppsala standard of length was 0.999 94 m, whereas it was 0.999 81 m.

r.p.h. or **rph** An abbreviation for revolutions per hour.

r.p.m. or **rpm** An abbreviation for revolutions per minute.

r.p.s. or **rps** An abbreviation for revolutions per second.

RSD An abbreviation for relative standard deviation.

RSI or $\mathbf{R_{SI}}$ A symbol for the R-value of insulation when stated in SI units: $m^2 \cdot K/W$. RSI 1 is equivalent to R 5.678.

rss An abbreviation for root sum square.

rum A unit of pressure = 1 bar = 1 dyne/cm^2 = 0.1 Pa. The unit was suggested in 1934 in the hope that confusion might be avoided between this bar and that which had a value of 10^5 Pa.

run or **American run** In the U.S., a unit of density for woolen yarn, usually called specific length. One American run is = 100 yd/oz = 5/8 typp = 3,225.451 094 891 437 85 m/kg. Yarn is described as *n* run if there are *n* 1,600-yard hanks of the wool per pound.

run or **run system** ($\mathbf{N_{ar}}$) A yarn numbering system, in which the yarn number is the length in yards of 1 lb of the yarn, divided by 1600. So 1 lb of number 1 run yarn is 1600 yds long, 1 lb of number 2 run yarn is 3200 yds long, and so on. Numbers 1 through 3 are coarse, 3½ to 5 are medium, and numbers 6 to 8 runs are fine. Lederer[772] says a run was 1644 yds and quotes a 1734 Connecticut law that speaks of yarn that is "eight runs to the pound."

running foot Another name for a linear foot.

running meter Another name for a linear metre.

running yard Another name for a linear yard.

rutherford (Rd or **rd)** A unit of radioactivity = one megabecquerel (MBq). This means 1 rutherford represents 1 million radioactive disintegrations per second = 1/37 millicurie = 1,000,000 Bq. The unit was proposed in 1946[773] by the American physicists Edward Uhler Condon (1902–1974) and Leon F. Curtiss (b. 1895) of the U. S. Bureau of Standards and approved by the American National Research Council in 1949. The unit is named after the British nuclear physicist Ernest Rutherford (1871–1937), later Lord Rutherford.

rydberg A former name for the kayser, the CGS unit of wave number (reciprocal of wavelength). The unit, suggested in 1951[774] by Candler, is named after the Swedish physicist and spectroscopist Johannes R. Rydberg (1854–1919). See also *Balmer unit*.

rydberg (R) A unit of natural-energy = the energy required to ionize an atom of hydrogen = about 13.605 8 eV = about $2.179\,9 \cdot 10^{-18}$ J. The unit is named after the Swedish physicist and spectroscopist Johannes R. Rydberg (1854–1919).

rydberg constant ($\boldsymbol{R_H}$) [rid'b*u*rg] A physical constant used in studies of the spectrum of a substance. The constant appears in the Balmer formula for spectral lines of the hydrogen atom. For a hydrogen atom, the effective mass must be taken as the reduced mass of the proton and electron. In MKS: $R_H = [(m_e m_p)/(m_e + m_p)]e^4/(8c\varepsilon^2 h^3)$ = about $1.096\,78 \cdot 10^7\ m^{-1}$, in which m_e = electron mass, m_p = proton mass, e = electron charge, c = speed of light, ε = permittivity of free space, and h = Planck's constant. Each

[770] [JERR].

[771] [ROWL].

[772] [LEDE, p. 200].

[773] [CURT2].

[774] [CAND].

chemical element has its own Rydberg constant, but the one most commonly referred to is the "infinity" constant: R_∞ = 10,973,731.568 508 (65) m^{-1}, according to CODATA 2014. The constant is named after the Swedish physicist and spectroscopist Johannes R. Rydberg (1854–1919).

19 S

S An abbreviation for siemens or svedberg.

s An abbreviation for second, shower unit, stere or stat.

sabin, sabine, absorption unit, open window unit (owu or **OWU)** or **square-foot unit of absorption** The FPS unit of acoustic absorption used in acoustical engineering. One sabin is the sound absorption of 1 ft^2 of a reverberation coefficient of 1 (perfectly absorbing surface, such as "an open window"). The total absorption in sabins can be calculated by: $A = S_1\alpha_1 + S_2\alpha_2 + \ldots + S_n\alpha_n$, in which A = the absorption of the room (m^2 sabin), S_n = area of the actual surface (m^2), and α_n = absorption coefficient of the actual surface.[775] The unit was introduced in 1911[776] by the American acoustician and Harvard University Professor Wallace Clement Ware Sabine (1868–1919), who founded the systematic study of acoustics in about 1895. Sabine named the unit "the open window unit." In 1934, it was called "the total absorption unit" by Stanton, Schmid and Brown,[777] and in 1937, the American Acoustical Society[778] gave it the name sabin.

saccharimeter A special-purpose polarimeter having a scale calibrated directly in the concentration of sugar in the test solution.

Sackur–Tetrode constant (*S_0/R*) A dimensionless constant, an absolute entropy constant, $= 5/2 + \ln[(2\pi m_0 kTh^{-2})^{3/2} kT/P_0]$. When T = 1 K and P = 100 kPa, then S_0/R = about −1.151 704 8(44), and when T = 1 K and P = 101.325 kPa, then S_0/R = −1.164 867 8 (44).[779] The constant is named after the Dutch theoretical physicist Hugo Martin Tetrode (1895–1931) and the German physical chemist Otto Sackur (1880–1914), who both independently developed a solution of Boltzmann's gas statistics and entropy equations.

S.A.E. horsepower See *horsepower*.

S.A.G. ft An abbreviation for South African geodetic foot.

sagan A jocular unit of quantity = at least 4 billion, derived from the phrase "billions and billions (of stars)", frequently attributed to the American astrobiologist Carl Sagan (1934–1996).[780]

sagnac interferometer A type of interferometer in which two coils of optical fiber are arranged so that light from a single source travels clockwise in one, and counter-clockwise in the other. Rotation of the coils causes a phase shift in the combined output measured by the detector.

sailmaker ounce (smoz) A traditional unit measuring the weight per unit area of sailcloth. The weight is in avoirdupois ounces of a piece of cloth 36 in by 28.5 in. thus, 1 smoz is = 1.263 oz/yd^2 = about 42.828 g/m^2.

salinity A measure of the quantity of dissolved salts in seawater. Traditionally, salinity is defined as the total amount of dissolved solids in seawater in parts per thousand (0/00) by weight when all the carbonate has been converted to oxide, the bromide and iodide to chloride, and all organic matter is completely oxidized.

salinometer An instrument for determining salinity, especially one based on electrical conductivity methods.

samson A metre-gram-wink-unit of force, proposed in 1957, $= 9 \cdot 10^{13}$ N. See also *einstein*, *simon*, and *wink*.

sandglass See *hourglass*.

sand timer See *hourglass*.

[775] engineeringtoolbox.com

[776] [SABI] and [SABI2].

[777] [STAN3].

[778] [FRED].

[779] [CARD].

[780] Sagan titled his final book *Billions and Billions*. See: [SAGA2].

Saunders theatre cushion Name of an early unit of absorption, used as a standard by Harvard University Professor Wallace Clement Ware Sabine (1868–1919) in his pioneering work on the acoustics of buildings in 1896. The original "unit" was a cushion from the Saunders Theatre at Harvard, Boston; this cushion is now preserved by the Acoustical Society of America.

savart (sav) A unit used in music to describe the ratio in frequency between notes. One octave is about 301.030 savarts. This means two notes differ by one savart if the higher note has a frequency $= 2^{1/301}$ = about 1.002 305 468 times the frequency of the lower note. For frequencies f_1 and f_2, the latter being the higher, the difference in savarts is officially $1000 \times \log_{10}(f_2/f_1)$. The unit is named after a French physicist Félix Savart (1791–1841), who did pioneering research in the physics of sound.

sb The metric and CGS abbreviation for stilb.

Sc An abbreviation for Schmidt number.

scatterometer A microwave radar sensor used to measure the reflection or scattering effect produced while scanning the surface of the earth from an aircraft or a satellite.

sccm, **scfm**, **scfd**, or **scim** Symbols for "standard cubic centimetres per minute," "standard cubic feet per minute," "standard cubic feet per day," and "standard cubic inches per minute." These are units of flow rate for gases, and the term "standard" indicates that the flow rate assumes a standard temperature and a standard pressure of 1 atmosphere. There is some variation in the standard temperature. For natural gas, the petroleum industry uses a standard temperature of 60 °F (15.6 °C). For air flow, the standard temperature is sometimes 32 °F (0 °C) or 68 °F (20 °C), and a standard relative humidity must also be specified. The actual air flow is often designated with an "a" instead of an "s," as in "acfm."

scfh An abbreviation for cubic foot per hour under standard reference conditions.

scfm An abbreviation for cubic foot per minute under standard reference conditions.

Schachtwerk In Altona (now part of the city of Hamburg in Germany), a premetric unit of capacity used for excavations = 6.024 7 m^3.[781]

Schank. . . German prefix for "bar"; e.g., Schankeimer.

Schenk. . . A German prefix for "bar"; e.g., Schenkmass.

Schmidt number (*Sc*) A dimensionless number, used in fluid mechanics, defined as ν/κ_c, in which ν = the kinematic viscosity, and κ_c = the mass transfer diffusion coefficient. It is named after the German engineer Ernst W. H. Schmidt (1892–1975).

schmillion See *zillion*.

school A unit of count, used for marine animals, = 20–30 whales = 10,000–20,000 smaller fishes.

Schuh [G: *Schuh* = "shoe"] An alternative name for *Fuss*, a foot, in Germany.

scintillation counter An instrument designed to measure radiation indirectly through the use of several phosphors and a photomultiplier tube. The absorption of radiation by any phosphors results in light flashes that may be recorded.

sclerometer An instrument used by mineralogists to measure the hardness of various materials. It measures the pressure on a standard point that is necessary to scratch the material. The method was introduced in 1896 by Turner.[782]

scope of cable A length of anchor cable paid-out, measured by counting shackles, = 5 times depth of water, depending on conditions.

scopometer A device used to take turbidimetric or nephelometric measurements by considering the contrast between a constant brightness field and an illuminated line positioned behind the solution being tested.

sd or **s.d.** An abbreviation for standard deviation.

SE or **S.E.** An abbreviation for the Saka Era.

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781 [GIER].

782 The 1924 edition of Machinery's Handbook says, "*The hardness number is the weight in grams required to produce a standard scratch. The scratch selected is one which is just visible to the naked eye as a dark line on a bright reflecting surface. It is also the scratch which can just be felt with the edge of a quill when the latter is drawn over the smooth surface at right angles to a series of such scratches produced by regularly increasing weights.*"

Seasonal Energy Efficiency Ratio (SEER) A measure of efficiency by which the cooling process of air conditioners and heat pumps is rated, used in the U.S. and Canada, defined as the total output of the air conditioner over an entire cooling season, in Btu, divided by the total electrical energy consumed, in watt hours. Since this is a ratio of two energy units, the result is a dimensionless number. The higher the SEER number, the greater the efficiency. See also *EER* and *COP*.

secohm (Ωs) Name sometimes used for ohm second, a practical unit of inductance, = the product of the second and the legal ohm, approximately = the henry. It was introduced in 1887[783] in Great Britain and was mainly used by the British, even after the International Electrical Congress in 1889[784] had adopted the term *quadrant*.

second (s, sec, or ″) A fundamental unit of time in most measuring systems. It is also the SI unit of duration, period, time interval and timeconstant, half-life, mean-life and specific impulse.

second (″, **s** or **sec)** or **arcsecond** A unit of angular measure = 1/60 arcminute = 1/3240 grade. This unit is also called the arcsecond to distinguish it from the second of time. The SI defines s as the symbol for the time unit and recommends ″ as the symbol for the arcsecond. The international standard ISO 31 recommends that angles be stated in degrees and decimal fractions of the degree, without use of arcminutes and arcseconds.

second (″, **s** or **sec)** A unit of longitude used in astronomy. Astronomers measure longitude (or, as they call it, right ascension) in time units by dividing the equator into 24 h instead of 360 degrees. This makes 1 second of longitude = 15 arcseconds.

second (″ or **sec)** A unit of viscosity defined by the time required for a specified amount of a liquid to flow through a particular viscometer. The *Saybolt second* was used in the U.S., the *Redwood second* in Britain, and the *Engler degree* in continental Europe.

second per cubic metre (s/m³) The SI unit of resistance (fluid flow).

second per litre (s/l or **s/L)** A unit of resistance (fluid flow) = 10^3 s/m³.

second per metre squared (s/m²) The SI unit of kinematic fluidity.

second squared per kilogram (s²/kg) See *squared metre per joule*.

section (sec) In the U.S. and the prairie provinces of Canada, during the nineteenth–twentieth centuries, a unit of land area = 640 acres = 6400 sq chains = 1 square mile = about 259 ha.[785] This unit is used by the U.S. Public Land Survey System, which applies to most of the U.S., with the exception of the original 13 states, Alaska, and Hawaii.

SED A symbol for standard erythemal dose, a unit used to measure the amount of skin-reddening ultraviolet radiation received by a person in the sun or in a tanning salon. One SED is = a dose of 100 J/m² of skin surface. A tanning rate of one SED per hour is equivalent to 27.778 mW/m² of skin surface.

seemeile or **sea mile** An alternative name for the nautical mile. *Seemeile* is the customary name in German.

SEER An abbreviation for seasonal energy efficiency rating.

Sek The German abbreviation for *Sekunde* = second.

Sem An abbreviation for semaine.

semester hour (sem hr) A unit of academic credit, supposedly = one semester's study for a period of one "academic hour" (often 50 or 55 min per class) per week.

semi- A common English prefix meaning ½. In adverbs of frequency, *semi-* means "twice every" or "every half." Bells on a ship ring semihourly (every half hour) and the tides usually occur semidiurnally (twice a day); a semiweekly newspaper is published twice in a week; a semimonthly payroll is paid twice every month; and days and nights have the same length

[783] [AYRT].

[784] 1890: *L'Electricien* August , 750.

[785] U. S. Revised Statutes, 2395 (a1877).

semiannually (twice a year). For something that happens once every two time units, use bi-.

semiannually See *semi-*.

semicircle A unit of angle measurement = ½ circle = π radians.

semidiurnally See *semi-*.

semih An abbreviation for semihourly (every half hour), sometimes used in medical prescriptions.

semihourly, **semimonthly** See *semi-*.

semiweekly See *semi-*.

senidenary See *hexadecimal*.

sensation unit (S) A unit of loudness, suggested in 1925.[786] If P_0 = the sound pressure level that can be detected by the ear, then P = the sound pressure under examination, and is S sensation units greater than P_0, where S = 20 log10 (P/P_0). The unit was based on the false assumption that there is a one-for.one relationship between sound pressure and loudness.

sensitometer An instrument used for determining the sensitivity of a photographic film to light.

sensitivity The change of an instrument or transducer's output per unit change in the measured quantity. A more sensitive instrument's reading changes significantly in response to smaller changes in the measured quantity.

septendecimal A unit of quantity = 17.

septet A unit of quantity = 7.

septim A fictional currency used in The Elder Scrolls (abbreviated TES), a computer role-playing game series developed by the American company Bethesda Softworks.

septuple or **septuplet** A group of seven items, especially seven identical items; the word septuplet is also used for one member of the group.

sestet Another name for a sextet, a unit of quantity = 6. This spelling is used in poetry to describe a six-line stanza and is sometimes used in music for an ensemble of six instruments.

sevenpenny nail (7d) Pennysize for nails, representing a length of 2 ¼ in.

786 [STEI7].

sexagenary A unit of quantity = 60.

sextet A unit of quantity = 6.

sextuple or **sextuplet** A group of six items, especially six identical items; the word sextuplet is also used for one member of the group.

SF A common symbol for the square foot (ft^2).

S.F.S. An abbreviation for Saybolt Furol Second.

Sh An abbreviation for Sherwood number.

S.H.A. An abbreviation for sideral hour angle.

Sha A prefix used in Mandarin for hundred-millionth, with a subsequent qualified unit, though also sometimes used without one, in the same manner as "kilos."

shabolubalu See *zillion*.

shade number A unit of light transmission for the protective glasses used in welding. If T is the fraction of visible light transmitted, the shade number is $1 + 7(-\log_{10} T)/3$. For example, if 1% of the light is transmitted, the shade number is 4.

shake An informal and obsolete unit of time, originated in nuclear physics, = the approximate lifetime of an individual neutron with the fission of uranium or plutonium = 10^{-8} s = 10 ns.

shannon (Sh) A unit of information content used in information and communications theory. If a message has probability *p* of being received, then its information content is $-\log_2 p$ shannons. For example, if the message consists of 10 letters, and all strings of 10 letters are equally likely, then the probablity of a particular message is $1/26^{10}$ and the information content of the message is $10(\log_2 26) = 47.004$ shannons. This unit was originally called the bit, because when the message is a bit string and all strings are equally likely, then the information content turns out to equal the number of bits. One shannon equals $\log_{10} 2$ = 0.301 030 hartley = $\log_e 2$ = 0.693 147 nat. The unit is named after the American mathematician Claude Shannon (1916–2001), the founder of information theory.

sh cwt An abbreviation for short hundredweight.

shed A unit of area, during the mid-twentieth century, used in nuclear physics to express the apparent cross-sectional area of a subatomic particle from which other particles are scattered.

One shed equals 10^{-24} barn = 10^{-52} m^2= 0.0001 ym^2. See also *barn* and *fermi*.

sheet Name for a single piece of paper, unfolded, as an isolated entity or the equivalent in a bound pad.

sheppey [<ancient Saxon: *sceapige* = "sheep"] A jocular unit of length, defined as the closest distance at which sheep remain picturesque. The Sheppey was invented in England by author and comic radio dramatist Douglas Noël Adams (1952–2001) and writer and television producer John Hardress Wilfred Lloyd (b. 1951) in 1983, and included in their humorous dictionary *The Meaning of Liff*.

Sherman unit A unit of vitamin C, defined as the minimum amount of vitamin C which, fed daily, will protect a 300-g guinea pig from scurvy for 90 days = about 0.5–0.6 mg of ascorbic acid. The unit is named after the American biochemist Henry Sherman (1875–1955).

Sherman-Bourquin unit of vitamin B2 A unit = the amount of vitamin B2 required in the diet daily to sustain an average weekly gain of 3 g for 8 weeks in standard test rats, = 1–7 ug of riboflavin.[787] The unit is named after the American biochemist Henry Sherman (1875–1955) and the American chemist Anne Bourquin (1872–1947).

Sherman-Munsell unit Name of a rat growth unit, defined as the daily amount of vitamin A which sustains a rate of gain amounting to 3 g a week in standard test rats. The unit is named after the American biochemist Henry Sherman (1875–1955) and the American chemist Hazel E. Munsell (1891–1989).

Sherwood number (*Sh*) A dimensionless number used in mass-transfer calculations. It is the mass-transfer equivalent of the Nusselt number, represents the ratio of lengthscale to the diffusive boundary layer thicknesses, and is normally defined as $(k_c L)/D_v$, in which k_c = diffusion rate, L = characteristic length and D_v = diffusivity.[788] It is named after the American chemical engineer Thomas Kilgore Sherwood (1903–1976). See also *Nusselt number* and *Biot number*.

shì [Mand-PY: = "market"] In China, a prefix used to denote the revised metric-related values introduced in 1929 for traditional units. See also *shih*.

shì [Mand-WG: = "ten-thousandth"] In Japan and Korea, a prefix used with a subsequent qualified unit for a ten-thousandth of a measure. For more traditional expressions also used, like "kilos," without a unit following it.[789]

shih [<Mand-WG: = "market"] In China, a prefix used to denote the revised metric-related values introduced in 1929 for traditional units. See also *shì*.

shipping cubic inch In Britain and the U.S., a unit of volume = a cuboid having a height of 1 in and a base of 1 ft × 1 ft = 144 in^3 = 1 board-foot = about 2359.737 216 cm^3.

shipping ton or **U.S. shipping ton** See *freight ton*.

shire An administrative division, during the seventeenth century, of Australia, Great Britain and Virginia. It never had a defined size.

shortword See *word*.

shot, **shackle**, or **shackle of cable** In Britain, a unit of length used for measuring the lengths of nautical cables and for the anchor chains of ships. Between the sixteenth century and 1949, it was = 12.5 fathoms = 75 ft = about 22.86 m. In 1949, the British Navy changed the length to 15 fathoms = 2 half-shackles = 90 ft = 27.432 m, thus making it the same length as the American shot.

shot, **shotglass**, **jigger**, or **bar glass** In Britain and the U.S., a unit of liquid capacity used for alcoholic drinks, typically whiskey. The term "shot" is often used informally to mean "a small serving." In the U.S., a shot is legally = 1 f. oz = about 29.574 mL. Many bartenders use larger shot glasses holding 1.25 f. oz = about 37.0 mL, and some shot glasses hold the same as a jigger: 1.5 f. oz = about 44.36 mL. A metric equivalent = 40 mL is sometimes used.

[787] 1931: *Journal of the American Chemical Society* **53**, 9, 3501–3505.

[788] [WILL11].

[789] [FENN].

shovel An informal unit of volume. In U.S. building trades, a common rule of thumb is that a cubic yard contains about 150 standard (no. 2) shovels of material. This means that a shovel contains about 5 L and a cubic metre is about 200 shovels.

shower unit or **shower length (s)** During the mid-twentieth century, a unit of length, employed in astrophysics for cosmic-ray measurements, = the thickness of a medium which halves the intensity of an incident beam of charged particles.[790] It corresponds to the half-thickness X_1/2 of the considered medium for a given charged particle of energy E. 1 shower unit = ln2/mu (m**(−1)). Thus, it depends on the material: in air, the shower unit is very long, about 230 m, in water, it is 30 cm, and in lead, only 35 mm.

sh tn An abbreviation for short ton.

SI [French: *Système international d'unités*] This is the modern form of the metric system, introduced in 1799. The Metre Convention in 1875 led to the formation of permanent international bodies (the CGPM, BIPM, and CIPM) with a commitment and a mandate to standardize and improve the world's weights and measures.

SI prefixes SI is a system that dates back to the original Metric system in 1793, when only *kilo*, *hecto*, *deca*, *deci*, *centi*, and *milli* were used.[791] In 1795, *myria* (*ma*) = 10^4 was added, but later became deprecated (no longer officially allowed); *myrio* (*mo*) = 10^{-4} is also deprecated; *mega* dates from the late 1800's and was officially adopted in France in 1919. During the 1900s, *kilomega* and *megamega* were used, but it was eventually decided that these needed their own prefixes; *giga*/*nano* and *tera*/*pico* were adopted in 1960, *femto* and *atto* in 1964, *peta* and *exa* in 1975, and *zetta*/*zepto* and *yotta*/*yocto* in 1991.[792,793] There are also proposals for further harmonization of the capitalisation. Therefore, the symbols for deka, hecto and kilo would be changed from "da", "h" and "k" to "D" or "Da", "H" and "K," respectively. Likewise, some lobby for the removal of prefixes that don't fit the $10^{\pm 3 \cdot n}$ scheme, namely hecto, deka, deci and centi. The CGPM has postponed its decision on both matters for now.

SID [<L: *singular in die* = "once a day"] A unit of frequency, traditionally used in medical prescriptions.

siegbahn or **Siegbahn unit** An alternative name for the *x-unit*.

siemens [same in singular and plural] **(S)**, sometimes called **mho** The SI and MKS-unit of electric conductance, admittance, modulus of admittance and susceptance. A conductor has a conductance of one siemens if it carries one ampere of current per volt of potential. Conductance is the inverse of resistance, and the siemens is the reciprocal of the ohm. The 14th CGPM added the siemens to the SI in 1971. The unit is named after the German electrical engineer E. Werner von Siemens (1816–1892).

siemens, **Siemens' unit**, or **Siemens' mercury** A premetric unit of electrical resistance, introduced in 1860 by the German inventor Werner von Siemens (1816–1892),[794] = 0.953 4 Ω. The standard was defined as the resistance of a column of pure mercury 1 m long with a cross sectional area of 1 mm^2, at a temperature of 0°C. For everyday purposes, the standard was

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790 [JANO, p. 205].

791 Double prefixes, such as those formerly used in micromicrofarads, hectokilometres, micromillimetres, etc., are now obsolete.

792 In 2001, a few unofficial prefixes appeared on the Internet: *hepa* (10^{21}), *ento* (10^{-21}), *otta* (10^{24}), *fito* (10^{-24}), *nea* (10^{27}), *syto* (10^{-27}), *dea* (10^{30}), *tredo* (10^{-30}), *una* (10^{33}) and *revo* (10^{-33}).

The Oxford professor Jeffrey K. Aronson has suggested extending beyond *zetta*/*zepto* and *yotta*/*yocto* with *xenta*/*xenno*, *wekta*/*weko*, *vendeka*/*vendeko*, and *udeka*/*udeko*, based on the idea that the 'Z' and 'Y' prefixes would continue backwards through the English alphabet.

He goes on to list a large number of prefixes, starting with *Xona*-, *Weka*-, *Vunda*-, *Uda*-, *Treda*-, *Sorta*-, . . .

Another proposal for xenta/xona is *novetta*, from the Italian nove.

793 In 1993, Morgan Burke proposed, as a joke, *harpo* for 10^{-27}, *groucho* for 10^{-30} (and therefore *harpi* for 10^{27}, *grouchi* for 10^{30}, zeppi for 10^{33}, gummi for 10^{36}, and chici for 10^{39}) (according to Chemtutor.com).

794 [SIEM].

realized as a German silver wire 3.8 m long and 0.9 mm in diameter.[795] At the 1st International Electrical Congress in Paris, 1881, the ohm was defined and the siemens became obsolete.[796]

siemens metre per square millimetre (S m/mm) A unit of conductivity = 10^6 S/m.

siemens per metre (S/m) A unit of conductivity.

siemens square metre per mole (S m^2/mol) The SI unit of molar conductivity.

Sierpinski number of the second kind A number *k* satisfying Sierpinski's composite number theorem, i.e., a Proth number *k* such that $k \cdot 2^n + 1$ is composite for every $n \geq 1$.[797]

sievert (Sv) An SI unit used by health physicists for measuring the effective dose of radiation, such as X-rays and gamma rays, received by a human or some other living organism.[798] The sievert was recommended by the ICRU and the International Commission on Radiation Protection in 1977, and added to the SI in October 1979 by the 16th CGPM (resolution 5).[799] An effective dose of one sievert requires 1 gray of beta or gamma radiation, but only 0.05 gray of alpha radiation or 0.1 gray of neutron radiation. One sievert equals 100 rem. [800] The unit is named after the Swedish medical physicist Rolf Maximilian Sievert (1898–1966), who worked over many years to measure and standardize the radiation doses used in cancer treatment. Sievert proposed the unit in 1932 with the name **intensity millicurie**, defined as the dose in 1 h at a distance of 1 cm by a point source of 1 mg of radium enclosed in a platinum case 5 mm thick.[801]

sigma (σ) Name proposed for the length 1 pm = $1 \cdot 10^{-12}$ m.

sign An informal unit of angle measure originating in astrology. The Sun's annual path through the sky, called the Zodiac, is divided into 12 parts called signs, each sign corresponding roughly to one of the classic twelve constellations through which the Sun passes. One sign = 1/12 revolution of 360° = 30°.

Sikes See *degree Sikes*.

silver ampere (silver amp) See *international ampere*.

simon A metre-gram-wink-unit of resistance, proposed in 1957, = 30 Ω. See also *einstein*, *samson*, and *wink*.

Singapore Institute of Standards and Industrial Research (SISIR) Name of the National Institute for Standards in Singapore.

SIRIM An abbreviation for Standards and Industrial Research Institute—Malaysia.

siriometer An obsolete unit of length suggested by the Swedish astronomer Professor Carl Vilhelm Ludvig Charlier (1862–1934), who studied celestial mechanics, the calibration of photographic photometry, and the theory of lenses. One siriometer = 10^6 AU.[802]

Siriusweit An obsolete unit of length, used in astronomy, = $1.542\ 838\ 784\ 7 \cdot 10^{17}$ m = 5 parsecs = about the average distance between Sirius and Tellus. The unit was used by the German astronomer Hugo von Seeliger (1849–1924).

795 [GANO2].

796 [SIEM2].

797 [BAIL2].

798 It is intended to be used at the sort of radiation levels encountered in medicine or the workplace, but should not be used in assessing the effects of high-level, accidental exposures.

799 See: International Commission on Radiation Units and Measurements. *Radiation Quantities and Units*, ICRU Report 33. 1980, and CIPM, Recommendation 1 *Procès-Verbaux des Séances du Comite International des Poids et Mesures* **52**, 31.

800 Because of continued confusion over the meaning of the sievert, in 1984, the CIPM voted to add the following explanation to the official SI booklet:

"The quantity dose equivalent *H* is the product of the absorbed dose *D* of ionizing radiation and the dimensionless factors *Q* (quality factor) and *N* (product of any other multiplying factors) stipulated by the International Commission on Radiological Protection:

$H = Q \cdot N \cdot D$

Thus, for a given radiation, the numerical value of *H* in joules per kilogram may differ from that of *D* in joules per kilogram depending on the values of *Q* and *N*. In order to avoid any risk of confusion between the absorbed dose *D* and the dose equivalent *H*, the special names for the respective units should be used, that is, the name gray should be used instead of joules per kilogram for the unit of absorbed dose *D* and the name sievert instead of joules per kilogram for the unit of dose equivalent *H*." See also: *Metrologia*, **21**, 90 (1985).

801 This unit was about a twelfth of the modern unit.

802 See [EDDI2].

SISIR An abbreviation for Singapore Institute of Standards and Industrial Research.

sitio, **sitio de ganado mayor**, **sitio de ganedo mayor**, or **sitio de labor** [= "place for horses"] In Mexico and the southwestern U.S., a traditional unit of land area = 1 league cuadradas = 25 million varas cuadradas = about 1.755 61 ha. The unit was legalized in 1837 by the Mexican Ordinance for Land and Sea.[803] This was the amount of land considered necessary for a cattle ranch. In California, during the nineteenth century, this unit was sometimes referred to as a **California league**, distinguishing it from the league in Texas, which was 4428.4 acres. There was also a sitio de ganado menor = 3333 varas cuadradas = about 1348.933 ha.

six-pack In the U.S., during the twentieth–twenty-first centuries, a colloquial name for a pack of 6 beer cans of 12 liq oz each.

sk An abbreviation for skot.

skajillion See *zillion*.

skein A unit of count, applied to a flight of geese and other wildfowl, usually = a number in the range twenty to a hundred.

skein In the U.S., a unit of length used for yarn or thread. In retail trade, a skein is a highly variable unit, varying from one type of yarn to another and often from one manufacturer to another. In textile manufacturing, however, the skein is a unit of length = the lea. It is usually = 360 ft, but a skein of thrown silk = 1000 yd.

Skewes number or **first Skewes number** (**Sk_1**) Name of value that Stanley Skewes[804] gave to the number above which $\pi(n < \mathrm{Li}(n))$ must fail (assuming that the Riemann Hypothesis is true),[805] in which $\pi(n)$ is the prime counting function and $\mathrm{Li}(n)$ the logarithmic integral. In 1912, J. E. Littlewood proved that Sk_1 exists.[806] It was estimated as being $10^{103.29994322\ldots\times 10963} = e^{eee7.705}$. A more accurate representation is $10^{3.5536897484442191\ldots 1088521421975432706061061004520735038} \sim= e^{ee79} \sim= 10^{101034}$. It was subsequently reduced to $e^{e27/4} \sim= 8.184\,794\,620\,722\,496\,062\,343\,7 \cdot 10^{370}$. The **second Skewes number** (Sk_2) is the number above which $\pi(n < \mathrm{Li}(n))$ must fail (assuming that the Riemann Hypothesis is true), in which $\pi(n)$ is the prime counting function and $\mathrm{Li}(n)$ the logarithmic integral. $Sk_2 = 10^{1010103}$. It is much larger than the Skewes number.

skillion See *zillion*.

skin erythema dose (SED) See *minimal erythema dose*.

skot (sk) [<Gr: *skotos* = "darkness"] An obsolete unit of scotopic luminance = 0.001 apostilb = 1 milliblondel = $(10^{-3}/\pi)$ cd/m^2 = about 3.183 10 · 10^{-4} cd/m^2. One skot is the brightness of a surface produced by 1 nox = 0.001 lux of light. The unit was used in Germany during World War II to describe permitted levels of lighting during air raids.[807]

slinch [The word is a contraction of *slug-inch*] A unit of weight invented by the U.S. National Aeronautics and Space Administration (NASA). The unit is part of a system based on the pound of force and the inch. One slinch is the mass accelerated at one inch per second per second by a force of one pound; thus, the slinch equals exactly 12 slugs = 386.088 lb = 175.126 8 kg.

slm An abbreviation for standard litres per minute. 1 slm = 1000 sccm.

slug, **g pound**, or **gee pound** A unit of weight in the English foot-pound-second system (BI-f.p.s.). One slug is the mass accelerated at 1 ft/s^2 by a force of 1 lb = 32.174 04 lb = 14.593 90 kg. The unit is reputed to have been invented in 1890 by John Perry.[808] During the late nineteenth century, the unit was called the "engineer's mass unit."

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[803] September 15, 1837, Article 20.

[804] [SKEW].

[805] Some numbers, called *prime numbers*, have the special property that they cannot be expressed as the product of two smaller numbers, e.g., 2, 3, 5, 7, etc. The distribution of prime numbers among all natural numbers does not follow any regular pattern, however, the German mathematician Georg Friedrich Bernhard Riemann (1826–1866) observed that the frequency of prime numbers is very closely related to the behavior of an elaborate function z(s), called the Riemann Zeta function. The Riemann hypothesis asserts that all interesting solutions to the equation z(s) = 0 lie on a straight line.

[806] [HARD3].

[807] [BUCK].

[808] [PERR3].

The British physicist Arthur Mason Worthington (1852–1916) first called it a slug in a 1902 textbook.[809]

slug foot squared (slug ft^2) A unit of moment of inertia in the English foot-pound-second system (BI-f.p.s.) equal to 1.355 82 kg m^2.

slug per cubic foot (slug/ft^3) A unit of weight density in the English foot-pound-second system (BI-f.p.s.) equal to 515.379 kg/m^3.

sluice head In Australia, a premetric unit of stream flow used in apportioning water among miners = 1 cubic foot of water per second.

small . . . General qualifier typically distinguishing a smaller form of some ambiguous measure.

smidge or **smidgen** A colloquial unit of capacity, of an indeterminate amount of spices. The unit has later also been used by kitchen supply stores for a spoon designed to hold about 1/32 teaspoon = about 0.15 mL.[810]

smite A old English word for a small amount of something; in recipes, a pinch. Originally, the word probably meant one of the pieces into which something had been smashed.

Smith number Name of a composite integer with the property that the sum of its digits is the same as the sum of the digits of its prime factors.[811] For example, 16,940 is a Smith number, since 2 x 2 x 5 x 7 x 11 x 11 = 16,940 and 1 + 6 + 9 + 4 + 0 = 2 + 2 + 5 + 7 + 1 + 1 + 1 + 1.[812] The numbers are named after mathematician Albert Wilansky's brother-in-law, whose phone number was once a Smith number.[813]

smoot A jocular unit of length, invented in October 1958 as the result of a fraternity prank at the Massachusetts Institute of Technology (MIT). The fraternity brothers of Lambda Chi Alpha measured the length of Harvard Bridge in Boston using pledge Oliver Reed Smoot, Jr. (class of 1962, b. 1940). The bridge turned out to be 364.4 smoots long, plus an ear (the ear stands for epsilon, meaning a very small or negligible distance). Distances on the bridge are indicated with a colored paint mark every Smoot and a number every ten Smoots. Biannually, the pledge class of Lambda Chi Alpha repaints the markings with a new color. Oliver Reed Smoot is a past Chairman of the Board of Directors of ANSI, the American National Standards Institute, and past President of the International Organization for Standardization (ISO). One smoot equals 67 in = about 170.18 cm.

smoz An abbreviation for the sailmaker ounce.

SMY An abbreviation for solar maximum year.

sn An abbreviation for sthène.

snap A unit of length used for woolen yarn = 320 yd. See also *lea*.

snelfu A fictional currency used in Cyberchase, an educational television series for children created by the American non-commercial television station WNET.

SNR An abbreviation for signal to noise ratio.

S.N.U., **snu** An abbreviation for solar neutrino unit.

sol [<L: = "sun"] A unit of time on Mars = the average length of the Martian day as it would appear to an observer on Mars = 24 h 38 min 22 s (in Earth time) = about 1.025 Earth days = about 24.622 9 Earth hours.

solar flux unit or **international solar flux unit (sfu)** A unit used by astronomers to express the flux density of radio energy from the sun as received on the Earth = 10^{-22} watt per square metre-hertz = 10,000 jansky.

solar mass An often-used reference mass for comparative indication of star masses, being the mass of the Sun = about $1.989\,1 \cdot 10^{30}$ kg = about 332,946 times the mass of the Earth.[814]

solar neutrino unit (S.N.U. or **snu)** A unit used by astrophysicists to measure the rate at which neutrinos from the Sun are detected on

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[809] [WORT].

[810] See lotsofhousewares.com and kitchensensation.com.

[811] The first ten Smith numbers are 4, 22, 27, 58, 85, 94, 121, 166, 202, and 265.

[812] There are an infinite number of Smith numbers.

[813] everything2.com

[814] nssdc.gsfc.nasa.gov

Earth. It is defined as being 10^{-36} neutrino capture per target atom per second.

solaris A fictional currency used in the science fiction novels about the Dune universe, created by the American author Frank Herbert (1920–1986).

soma [*pl.* some] In Milan, a name given to the hectolitre in 1803.

-some Suffix added to a number to create a unit of quantity. For example, a foursome is a group of four.

sone [<L: *sonus* = "sound"] A unit of subjective sound loudness. One sone is the loudness of a pure tone of frequency 1 kHz and strength 40 dB. A sound has a loudness of *s* sones if a listener judges it to be *s* times louder than a sound of 1 sone. The phon is another unit of sound loudness; a sound of loudness of *p* phons has a loudness of $2^{(p\ -\ 40)/10}$ sones. The sone is often used in industrial engineering to express the perceived loudness of engines, fans, and other items of industrial equipment. The unit was introduced by the American psychologist Stanley Smith Stevens (1906–1973) in 1936.[815]

sonometer An instrument for measuring the relationship between the frequency of the sound produced by a plucked string and the tension, length and mass per unit length of the string. See also *audiometer*.

South African geodetic foot (S.A.G. ft) In southern Africa, a unit of distance used for surveying and geodetic measurement = 30.479 726 54 cm.

sp An abbreviation for spat.

spade An informal unit of volume, usually = 3 dm^3.

spat (sp) [<L: *spatium* = "space"] A unit of solid angle measure = the sphere = 4π steradians.

spat [acronym for "space-time"] **(S)** An informal unit of length, formerly used by astronomers, = 1 terametre (Tm, or 10^{12} m) = about 6.684 6 AU. The unit was proposed by the French astronomer L. Callou in 1944.[816]

spat [<L: *spatium* = "space"; since a solid angle of 1 spat covers all the space surrounding the vertex of the angle] A unit of solid angle, equal to the solid angle around a point, = 4π steradians.

speck Nontechnical name for a tiny piece of anything or a very small amount.

speck In the U.S., an informal unit of capacity = 0.62 mL.[817]

SPECmark An obsolete measure of the effective speed of a computer workstation, being the geometric mean of ten floating-point and integer SPEC benchmark results.[818]

S.P.F. An abbreviation for Sun Protection Factor.

sphere A traditional unit of solid angle measure, divided into 4π steradians. There are also 129,600/π = 41,252.96 square degrees in a sphere.

spherical degree A unit of relative surface area for spheres = 1/720 the total surface area or $\pi \cdot R^2/180$, in which R is the radius of the sphere. Thinking in terms of the Earth's surface, this is the area of the region in one hemisphere (northern or southern) bounded by the equator and two meridians of longitude one degree apart.

spin A unit of angular momentum, used in particle physics, = Planck's constant *h* divided by 2 π = about $105.457\ 27 \cdot 10^{-36}$ J·s. The spin of an elementary particle is always a simple multiple of this unit.

spoonful An informal unit of volume, sometimes an alternate name for the teaspoon.

spoud A proposed CGS-unit of acceleration = 1 cm/s^2.[819]

sq or **sq.** See *square*.

sq or **sq.** In Britain and the U.S., a deprecated abbreviation for square (e.g., sq ft = ft^2).

square (sq or **sq.)** During the late nineteenth–early twentieth centuries, a unit of area, used for measuring roofing material, finished lumber, roofing materials, and other building materials in England and the U.S. One square equals

815 [STEV5].

816 [CALL].

817 [FENN].

818 See also: ftp://ftp.cdf.toronto.edu

819 [CLAR].

material sufficient to cover 100 ft^2 = 11 1/9 yd^2 = 4 paces = about 9.290 340 6 m^2.[820]

square See *block*.

square centimetre (cm^2) The CGS unit of area = 100 mm^2 = about 0.155 in^2.

square centimetre per erg (cm^2/erg) The CGS unit of spectral cross section = 1000 m^2/J.

square centimetre per kilogram-force (cm^2/kgf) A unit of compressibility = 1.019 72 · 10^{-5} Pa^{-1}.

square centimetre per steradian erg (cm^2/sr erg) A unit of spectral angular cross section = 10^3 m^2/(sr J).

square chain (ch^2 or sq ch) A traditional unit of area in English surveying, defined as the area of a square whose side equals Gunter's chain (4 rods = 22 yards). One square chain equals 10,000 square links = 4356 ft^2 = 484 yd^2 = 16 perches = 0.4 rood = 0.1 acre = about 4.046 872 4 ares. The unit is known as the *ngan* in Thailand.

square degree (π ∘ or sq deg) A deprecated unit of solid angle = $(\pi/180)^2$ = 0.000 304 617 4 steradian. There are $4180^2/\pi$ = 129,600/π = 41 252.961 25 square degrees in a sphere.

square fathom An obsolete unit of area used in the U.S. in the mining industry. One square fathom equals 36 ft^2 = 4 yd^2 = about 3.344 509 44 m^2.

square foot (ft^2 or sq ft) In Britain and the U. S., an obsolete unit of area = 20,736 $lines^2$ = 144 in^2 = 1/9 yd^2 = about 0.033 025 perch = about 0.092 903 04 m^2.

square foot hour degree Fahrenheit per British thermal unit foot (ft^2 h °F/(Btu ft) An obsolete unit of thermal resistivity = 0.577 789 m·K/W.

square foot hour degree Fahrenheit per British thermal unit inch (ft^2 h °F/(Btu in) An obsolete unit of thermal resistivity = 6.933 47 m·K/W.

square foot per hour (ft^2/h) See *foot squared per hour*.

square foot per pound (ft^2/lb) The FPS unit of specific surface = 0.204 816 m^2/kg.

square foot per poundal (ft^2/pdl) The FPS unit of compressibility = 0.671 969 Pa^{-1}.

square foot per pound-force (ft^2/lbf) The ft-lbf-s unit of compressibility = 0.020 885 4 Pa^{-1}.

square foot per second (ft^2/s) The FPS unit of thermal diffusivity = 0.092 903 04 m^2/s.

square foot per ton-force (ft^2/tonf) A unit of compressibility = 9.323 85 · 10^{-6} Pa^{-1}.

square grade ($\square^g$) In Britain, a deprecated unit of solid angle = $(\pi/200)^2$ sr = about 2.467 40 · 10^{-4} sr.

square inch (in^2) An obsolete unit of area, since 1959, exactly 645.16 mm^2.

square inch per pound-force (in^2/lbf) An obsolete unit of compressibility = 1.450 38 · 10^{-4} Pa^{-1}.

square inch per ton-force (in^2/tonf) In Britain, an obsolete unit of compressibility = 6.474 90 · 10^{-8} Pa^{-1}.

square inch square foot (in^2 · ft^2) An obsolete unit of second moment of area = 5.993 73 · 10^{-5} m^4.

square kilometre (km^2) A common metric unit of area = 100 ha = 10^6 m^2 = about 247.105 acres.

square line (sq line) An obsolete unit of area = 0.006 944 in^2 = about 4.480 295 4 mm^2.

square link (sq link) An obsolete unit of area = 0.000 1 sq chain = about 62.726 40 sq in = about 404.687 235 5 cm^2.

square metre (m^2) An SI unit of area = 10^4 cm^2 = 10^{28} barns

square metre kelvin per watt (m^2 · K/W) The SI unit of thermal insulance.

square metre per joule (m^2/J) The SI unit of spectral cross section = 0.001 cm^2/erg.

square metre per kilogram (m^2/kg) The SI unit of weight attenuation coefficient, mass energy transfer coefficient, mass absorption coefficient, mass energy absorption coefficient and specific surface = 4.882 43 ft^2/lb.

square metre per kilogram-force second (m^2/(kgf s) The m-kgf-s unit of fluidity = 0.101 972 Pa^{-1} s^{-1}.

square metre per mole (m^2/mol) The SI unit of molar absorption coefficient and molar attenuation coefficient.

square metre per newton (m^2/N) See *reciprocal pascal*.

[820] [ALEX], [THUR2] and [MCCO2] .

square metre per newton second ($m^2/(N\ s)$) See *reciprocal pascal reciprocal second*.

square metre per second (m^2/s) The SI unit of diffusion coefficient, thermal diffusion coefficient and thermal diffusivity. See also *metre squared per second*.

square metre per steradian (m^2/sr) The SI unit of angular cross section = 10^{28} b/sr.

square metre per steradian joule ($m^2/(sr\ J)$) The SI unit of spectral angular cross section = 10 ^{21} b/(sr erg).

square metre per volt second ($m^2/(V\ s)$) The SI unit of mobility = 1 m^2/Wb.

square metre per weber (m^2/Wb) See *square metre per volt second*.

square micrometre (μm^2) [formerly called **square micron**] A unit of area = 10^{-12} m^2.

square micron (μ^2) See *square micrometre*.

square mil (mil^2) An informal surface unit = 6,451,625,400,025 · 10^8 barns = about 0.000 645 162 mm^2.

square mile per ton ($mile^2/ton$) In Britain, an obsolete unit of specific surface = 2549.08 m^2/kg.

square millimetre (mm^2) A unit of area = 1.550 · 10^{-3} in^2.

square minute (□´) A deprecated unit solid angle area = 8.461 59 · 10^{-8} sr.

square rod (rd^2 or sq rd) An obsolete unit of area = 272.25 ft^2 = 30.25 yd^2 = 25.2929 m^2.

square scottish ell An obsolete unit of area = 1369 in^2 = about 9.506 94 ft^2 = 1/36 fall = about 88.322 752 dm^2.

square second (□″) A deprecated unit solid angle area = 2.350 44 · 10^{-11} sr.

square yard (yd^2 or sq yd) An obsolete unit of area = 9 ft^2 = 1296 in^2 = 0.836 127 36 m^2.

square yard per ton (yd^2/ton) In Britain, an obsolete unit of specific surface = 8.229 22 · 10^{-4} m^2.

squillion See *zillion*.

sr The SI abbreviation for steradian.

ss A traditional abbreviation for ½, from the Latin *semis*. In medieval times, the symbol was often written as the long s, an obsolete character that looks something like *f* without the crossbar.

ST An abbreviation for short ton.

St The CGS and metric abbreviation for stokes.

St A symbol for Stanton number.

st A metric abbreviation for stère.

stand basal area (*G*) The sum of the basal area of all living trees in a stand, expressed in m^2/ha. It can be calculated from measurements of the diameter (D in cm) of all trees in a known area (a in ha):

$$G = \frac{\pi}{40000} * \frac{\sum D^2}{a}$$

Alternatively, *G* can be estimated using a variable probability sampling approach called angle count sampling, point sampling, variable radius plot sampling (VRP sampling), plotless cruising, angle counting, probability proportional to size (PPS) sampling or horizontal point sampling.

standard atmosphere See *atmosphere*.

Standard British viscometer See *redwood viscometer*.

standard deviation (sd) A mathematical unit used to describe the dispersion of a set of data. Each item in the data set has a deviation from the mean of the data. The standard deviation is computed by taking the squares of these individual deviations, adding them, and then taking the square root of the sum.

standard gravity (g) An average acceleration of a freely falling body in a vacuum, defined as being exactly 9.806 65 m/s^2 = 32.174 ft/s^2 at sea level and 45° latitude. The unit is popularly known as the g.

standard temperature and pressure (s.t.p.) Usually, the ice point (0°C) or, less frequently, the temperature of maximum water density (4°C), and a pressure of 101.325 kPa.

standard volume (V_0) A unit sometimes used by chemists and physicists to measure the volumes of gases, equal to the volume one kilomole of gas occupies at standard temperature (273.16 K) and standard pressure (101.325 kPa) = 22.413 83 m^3.

Standards and Industrial Research Institute—Malaysia (SIRIM) Name of the National Institute for Standards in Malaysia.

stanine A statistical unit used in educational testing. Test scores are normalized so that they have a mean of 5 and a standard deviation of 2. This transformation naturally divides the ranked scores into 9 classes called stanines 1–9. The percentage of scores in each stanine is 4, 7, 12, 17, 20, 17, 12, 7, and 4, respectively.

Stanton number (*St*) A dimensionless number proportional to heat transferred divided by thermal capacity of fluid. It is usually used in forced convection calculations, and is = the Nusselt number divided by the product of the Prandtl and Reynolds numbers. Normally, it is defined as h/(Cp ρ v), in which h = heat transfer coefficient, Cp = heat capacity, ρ = density, and v = velocity. In mass transfer problems, it is defined as m/(t A ρ v), in which m = mass transferred across the area A in time t. It is named after Sir Thomas Stanton (1865–1931).

stapp A unit used to express the effects of acceleration or deceleration on the human body. One stapp represents an acceleration of 9.806 65 m/s^2 for 1 s. The unit is named after the U.S. Air Force physician John P. Stapp (1910–1999), a pioneer in research on the human effects of acceleration during the 1940s and 1950s.

stat A rarely used unit of rate of radioactive distintegration. One stat is the rate of disintegration of that quantity of radon that gives rise to a charge of 1 statcoulomb in one second in air = about $3.63 \cdot 10^{-27}$ Ci.

stathm [<Gr: = "weight"] Name suggested by the Italian Professor Giovanni Polvani (1892–1970) in 1951 for the gram.[821] See also *bes* and *brieze*.

Staudinger molecular weight See *Staudinger value*.

Staudinger value Number sometimes used to give a value to the molecular weight of a polymer. The number is not = the actual molecular weight, which is why there are charts available to convert the **Staudinger molecular weight** into the real molecular weight. It is named after the German chemist J. Hermann Staudinger (1881–1965).[822]

std. . . An abbreviation for standard . . .

steelyard [<G: *Stahlhof*] A portable balance, used as a weighing instrument, consisting of a pivoted bar with arms of unequal length. In the Middle Ages, it was the main trading base of the Hanseatic League.

Steinhaus–Moser notation Notation for certain extremely large numbers.

△n (a number *n* in a triangle) means n^n

$\boxed{n}$ (a number *n* in a square) is equivalent to "the number *n* inside *n* triangles, which are all nested"

ⓝ or ⬠n (a number *n* in a circle or a pentagon) is equivalent to "the number *n* inside *n* squares, which are all nested"

. . . etc., why: *n* written in an (*m*+1)-sided polygon is equivalent to "the number *n* inside *n* *m*-sided polygons, which are all nested".

stellar magnitude See *absolute magnitude*.

step A unit used in music to describe the ratio in frequency between notes. Two notes differ by a step if the higher note has a frequency exactly $2^{1/6}$ = 1.122 46 times the frequency of the lower one. This unit is often called **the full step** to distinguish it from the half step.

sterad A deprecated abbreviation for steradian.

steradian (sr) [<Gr.: *stereos* = "solid"] A unit of solid angle in the SI = the solid angle which, having its vertex in the centre of a sphere, cuts off an area of the surface of the sphere = that of a square having sides of length = the radius of the sphere. There are 4π steradians in a sphere, thus one steradian equals about 0.079 577 5 of a sphere. There are 129,600/π = 41,252.96 square degrees in a sphere, so one steradian equals about 3,282.806 square degrees = $1.18 \cdot 10^7$ square minutes = $4.25 \cdot 10^{10}$ square seconds. The unit originated in the 1870s by analogy with the *radian*.

stère (st) [<Gr.: *stereos* = "solid"] An obsolete metric unit of volume = one cubic metre or one kilolitre. Although it dates from the origin of

[821] [POLV].

[822] See also: [STAU], about polymeric substances.

the metric system in 1798, the stère has never been used as much as the litre. In the Cameroons, the décastère ($= 10\ m^3$) and décistère ($= 100\ dm^3$) were in use in the 1960s. The stère was approved for use in the U.S. by Sec. 2 of the Act of July 28, 1866. In Europe, it is used primarily for measuring bundles of firewood. For this purpose, adopted by the CIPM in 1879, the stere equals 1 m^3 of wood = about 0.279 5 cord = 2.207 cord feet. At that time, the symbol was "s." In 1948, the ninth CGPM (Resolution 7) changed the symbol to "st." In 1982,[823] the stère was declared no longer acceptable.

Steven's power law or **Steven's law** In 1957, initiated by the American psychologist Stanley Smith Stevens (1906–1973), a law proposed to describe the psychophysical relationship between sensation magnitude and stimulus intensity.[824] $S = kI^{\alpha}$, in which S = the sensation magnitude, k = arbitrary constant determining the scale unit, I = stimulus intensity, and α = the power exponent dependent on modality.[825] Then, $\log(S) = \alpha \log (I) + \log(k) = \alpha \log (I) + K$.[826]

sthen A metric unit of energy per length = 100 J/m.

sthène (sn) [< Gr: *sthenos* = "strength"] or **funal** A metric unit of force and part of the "metre-tonne-second" system,[827] sometimes used by European engineers, = the quantity of force that will accelerate a mass of 1000 kg by 1 m/s^2 = 1000 N. Thus, one sthene is = 10^8 dynes = 224.809 lbf = 7233.01 poundals.[828]

sthène per square metre (sn/m²) See *pièze*.

Stich In Germany, during the twentieth century, a unit of length = the millimetre.

stick (stk) An informal unit of capacity and weight, used to measure butter. In the U.S., butter is usually sold in 1-pound packages containing 4 sticks. Thus, 1 stick equals ¼ lb = about 113 g, but one stick is also considered = ½ cup = about 118 mL.

stigma (σ) [<Gr.: = "dot"; symbol = Greek letter sigma] A unit of length, proposed in 1944,[829] = 10^{-12} m.

stilb (sb) [<Gr.: *stilbein* = "to glitter"] The CGS unit of illuminance, adopted by the International Commission on Illumination, = 1 cd/cm^2 = 10^4 nits.[830] The millistilb was more common than the stilb.[831] The name is believed to have been coined by the French physicist André Blondel (1863–1938) around 1920.

stimp The "speed" of a green in golf is measured by a device called a stimpmeter, after its inventor, Edward S. Stimpson (1904–1985), an amateur golfer from Massachusetts, who designed it in 1935. A golf ball rolls down a ramp inclined at an angle of 20° and then rolls across a level section of the green. Championship greens usually have stimp ratings of 8.5–12.

stock tank barrel or **petroleum barrel** A unit of volume, used in the oil industry, = (at a temperature of 60 °F (15.556 °C))[832] 42 U.-S. gal = about 0.158 99 scm = about 158.987 L.

stoke or **stokes (st, St,** or **S)** The CGS unit of kinematic viscosity. Kinematic viscosity is defined as being dynamic viscosity divided by the density of the liquid; this gives a quantity which depends only on the type of the liquid, independent of its concentration or density.[833]

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[823] Bureau Internationale des Poids et Mesures. *Proc.-Verb. Com. Int. Poids et Mesures,* 1879, p. 41. Federal Register *February 26, 1982*, 47 f. 8399–8400.

[824] He also, in 1946, introduced a theory of levels of measurement often used by statisticians. See: [STEV3].

[825] α varies for different visual attributes and from person to person. For electric shock, $\alpha = 3.5$, for temperature, $\alpha = 1.6$, for sucrose, $\alpha = 1.5$, for saltiness, $\alpha = 1$, for saccharin, $\alpha = 0.8$, and for brightness of light, $\alpha = 0.3$.

[826] [STUE, p. 256].

[827] Sthène was authorized in France by a statute of 1919 as part of the m.t.s.-system.

[828] Originally called the *funal* when proposed by the British Association in 1876. The unit was renamed, in 1914, the sthène.

[829] [CALL].

[830] There was no corresponding unit in MKS, and there are no special units for luminous emission in SI.

[831] The brightness of a clear sky at ground level is near 1 sb, the solar disc at the horizon is about 60 sb, and the solar disc at noon is about 1,600,000 sb.

[832] The corresponding metric unit is the standard cubic metre (scm) with the oil at 15 °C.

[833] The kinematic viscosity of water is regarded as 1.003 8 cSt for calibration puposes.

The quotient turns out to have units of length^2/time. Being a CGS unit, the stokes is therefore defined as being 1 cm^2/s = 10^{-4} m^2/s = 0.001 076 391 ft^2/s. The SI has no named unit of kinematic viscosity, requiring the use of m^2/s instead. The unit, called the stokes in Britain and the stoke in the U.S., is named after the Irish mathematician and physicist Sir George Gabriel Stokes (1819–1903), who described the basic principles of fluid mechanics in 1845. See also *lentor*.

Stokes number (*Stk*) A dimensionless number corresponding to the behavior of particles suspended in a fluid flow, defined as $Stk = (\tau U_0)/d_c$, in which τ = the relaxation time of the particle, U_0 = the air velocity of the flow well away from the obstacle and d_c = the characteristic dimension of the obstacle.[834] It is named after the Irish mathematician Sir George Gabriel Stokes (1819–1903).

stop A unit of relative exposure used in photography. The amount of light used to expose the film can be controlled either by varying the aperture, by varying the length of time the shutter is open to admit light, or by some combination of these two methods. Two exposures differ by one stop if one is made with twice the light of the other; similarly, they differ by n stops if one is made with 2^n times the light of the other.

stories See *story*.

story [*pl.* stories] In the U.S., during the twentieth century, a unit used mainly by the media to express the height of a building or nonbuilding structure = 8–10 feet = about 2.4–3 m.

størmer A unit of momentum for analyzing the behaviors of charged particles from space as they approach the Earth's magnetic field. The unit is named after the Norwegian geophysicist and mathematician Fredrik Carl Mülertz Størmer (1874–1957). It equals the momentum at which a particle can circle around the equator near the surface of the Earth without being intercepted. The störmer unit is calculated from data that includes the mass of the particle, its electric charge, and its velocity as it approaches the Earth from space.

story or **storey** An informal unit of length = the average distance between the vertical spacing of floors in a building. Typically, a story equals 10 − 12 ft = 3.0–3.6 m.

STP or **stp** An abbreviation for standard temperature and pressure. This notation often appears with statements of the volume of gases. It means the volume measurement is made at or adjusted to a temperature of 0 °C and a pressure of 101.325 kPa.

Stradivarius' constant A constant often defined as the difference between what is calculated, based on a more or less accepted theory, and what is true according to practice. See also *fudge factor* and *Riggs constant*.

straik A British name for the difference between a heaped and a flattered measure of grain.

Strehl intensity ratio An image quality measure used in lens design. It is defined as the ratio of the perceived luminous intensity in the central maximum of a source point to the intensity in absence of aberrations. The ratio was proposed by K. Strehl in 1909.[835]

strickle An instrument used to level off grain or other material in a measure. See also *striken*.

stride Another name for a pace.

striken or **struck** Qualifier of dry volume measure, meaning that the contents reach only the plane of the top of the vessel, achieved by striking a stick across the rim.

strob [<Gr.: *strobos* = "rotating"] A unit of angular velocity. The strob represents a rotation rate of one radian per second = 9.549 30 rpm.

Strong-Cobb unit (SC or **SCU)** Ad hoc unit of force previously used to measure the hardness of tablets in the pharmaceutical industry. The Strong-Cobb test machine applied pressure using a hand-operated air pump, and the hardness was read on a gauge marked in 30 arbitrary units called Strong-Cobb units. It is generally believed that 1.4 Strong-Cobb units represented roughly

[834] "For $Stk >> 1$, particles will continue in a straight line as the gas turns around the obstacle therefore impacting on the obstacle. For $Stk << 1$, particles will follow the gas streamlines perfectly" (en.wikipedia.org).

[835] [HAIG].

1 kg of force, so each Strong-Cobb unit represented roughly 0.7 kg of force = about 7 N.

strontium unit or **sunshine unit (SU)** A unit of radioactive concentration, used to measure the presence of the very dangerous radioisotope strontium-90 in the body or elsewhere. In the body or the environment, strontium atoms tend to replace or become mixed with atoms of calcium. One strontium unit is the number of microcuries of Sr^{90} absorbed per kilogram of calcium. In SI units, this is = exactly 37 Bq/kg.

Strouhal number (*St*) A dimensionless number, representing the ratio of unsteady and steady motion. It is used in the momentum transfer in general, and in both Von Karmann vortex streets and unsteady flow calculations in particular. *St* is defined by the equation: $St = df/U$, in which d is the characteristic length (which is the diameter of the cylinder in the case of vortex streets), f is the frequency of the observed phenomenon (Hz) and U is the velocity of the fluid. The number is named after the Czech physicist Vincenc Strouhal (1850–1922), professor of experimental physics.

sturgeon A unit of magnetic reluctance, suggested in 1892[836] by Sir Oliver Lodger. The unit is named after William Sturgeon (1783–1850),[837] inventor of the first suspended coil galvanometer, a device for measuring current.

S.U. See Saybolt Universal second.

sub See *shi*.

substance See *basis weight*.

substance number See *basis weight*.

sudanophobic unit Name of "the smallest amount of adrenocorti-cotropic hormone that will cause the disappearance of the sudanophobic zone of the adrenal cortex in at least two of three hypo-physectomized rats when they are injected morning and evening on eight consecutive days."[838]

Sumner unit For enzymes, the amount that liberates 1 mg of ammoniacal nitrogen in 300 s at pH 7.0 and 20°C = about 14.28 enzyme units. The unit was named after the American professor of biochemistry James Batcheller Sumner (1887–1955).

sun ($M_\odot$) A unit of weight used in astronomy to express the masses of stars. The best current estimate of the mass of the Sun is $1.988\ 55 \cdot 10^{30}$ kg.

superficial An adjective used to convert a unit of length into a unit of area. "Superficial," in this use, means "square": a superficial foot, for example, is = a square foot, and a superficial yard is = a square yard. In Australia, a superficial foot often means the *super foot*.

super foot British commercial unit of area = 1 ft^2. The name originated as an abbreviation (ft. super. or super. ft.) for the superficial foot.

super foot or **superfoot** In Australia and New Zealand, a unit of volume used for timber or lumber = the volume of a board one foot square and one inch thick. This unit is the same as the North American board foot. See also *board foot*.

supernova unit (SNu) A unit used in expressing the frequency with which supernova occur.

supplementary units Class of units in the SI, during 1960–1995, whose only members were the radian and steradian. The class of supplementary units was created in 1960 by the 11th CGPM (Resolution 12) to cover those units which are neither base units nor derived units. In 1995, the twentieth CGPM eliminated this class.[839]

surreal numbers Name of a superset of the real numbers, invented by the English mathematician John Horton Conway (b. 1937) for the analysis of games.[840] The idea is that the notation {L|R} represents a position in a game between two players ("left" and "right") which is guaranteed eventually to end and in which the

[836] [LODG].

[837] For more information about Sturgeon, see: [ASIM3].

[838] enacademic.com

[839] "International System of Units: Rules for the application of Resolution 12 of the 11th CGPM (1960)" in *Proces Verbeaux* **37**, 30. Recommendation 1. and "SI Supplementary Units (radian and steradian)." in *Proces Verbeaux* **48**, 24.

[840] The name was coined in 1974 by Donald E. Knuth (b. 1938). See also [KNUT], [CONW2], and [GONS].

winner is the player who moves last (that is, the one who leaves the opponent with no legal move). L is the set of positions that left can put the game in, if it is left's turn. Likewise, R is the set of positions that right can put the game in, if it is right's turn. Given a position, who is winning, and by how much? These are the questions that surreal numbers were invented to answer.

survey foot or **U.S. survey foot** A unit of length used for coastal and geodetic surveying within the U.S. When the U.S. adopted the international yard on July 1, 1959, the U.S. Coast and Geodetic Survey were authorized to continue to use the "survey foot" of the Mendenhall order,[841] $= 1,200/3,937 =$ about 30.480 060 96 cm = 1.000 002 international feet.

S. U. S. An abbreviation for Saybolt Universal Second.

suture sizes A system of sizing sutures. The traditional size numbers (defined by the United States Pharmacopeia) is based on a combination of diameter, tensile strength and knot security, so that sutures of the same size perform similarly in the body even if the diameter differs. The U.S.P. sizing is numerical. Larger whole numbers indicate larger sutures, thus number 4 suture is larger than 3. Larger numbers followed by an "-0" are smaller. A 4-0 (pronounced "four ought" or "four zero"), meaning 0000, is smaller than 3-0.[842] The European standard simply reports the suture diameter in tenths of a millimetre. Since this does not consider tensile strength, surgeons do not have a fixed conversion between U.S.P. sizes and metric sizes.[843]

Sv An abbreviation for sievert.

svedberg or **svedberg unit (S)** A unit of time, proposed in 1942,[844] = 0.000 000 000 000 1 s = 10^{-13} s, used to measure sedimentation coefficients of macromolecules in ultracentrifuge technology. The sedimentation coefficient of a particle is defined as being $s/(w^2 r)$, in which s is the sedimentation rate, w is the angular velocity of the centrifuge (in radians per second), and r is the radius at which the particle is being spun. The unit is named after the Swedish chemist Theodor Svedberg (1884–1971), who received the Nobel Prize in Chemistry 1926 for the invention of the ultracentrifuge and its use in studying the properties of colloids.

svedberg floatation unit (S_f) A unit of time = 0.000 000 000 000 1 s = 10^{-13} s, "used for expressing negative sedimentation coefficients of macromolecules that float rather than sink in a centrifuge, e.g., lipoproteins."[845]

sverdrup A unit of flow, sometimes used in oceanography to express the flow of ocean currents. One sverdrup equals 1,000,000 m^3/s. It gives an estimation of the amount of water transported in oceanic currents, and the information that it provides compliments that of speed. The unit is named after the Norwegian oceanographer and Arctic explorer Harald U. Sverdrup (1888–1957), director of the Norwegian Polar Institute.

Sw An abbreviation for shortwave.

SWU A symbol for the separative work unit, a unit used in the nuclear power industry to describe the work required to enrich uranium. Roughly speaking, about 4.5 SWU are needed to enrich 1 kg of uranium.

symbol per second (sym/s) A unit of transmission rate for radio signals, especially for the transmissions between satellites and ground stations. In the simplest form of transmission, data can be sent in bits, which have only two states (on or off). To increase data transmission rates as much as possible, information is sent in units called "symbols," which have a number of states, so that each symbol can include several bits of information. In practice, transmission rates are usually stated in ksym/s (thousands of symbols per second) or Msym/s (millions of symbols per second).

841 U.S. Coast and Geodetic Survey Bulletin 26, April 5, 1893.

842 The smallest sutures, which are used for ophtalmic and microsurgery, range down to 12-0 size. Number 2 is about the largest standard suture in common manufacture, but a few specialty sutures range up to 5.

843 *Suturing*. RCN Continuing Education. Sept. 11, 1996. **10**, 51, 49–56.

844 [BRID].

845 enacademic.com

symmetry number (σ) A number of indistinguishable orientations that a molecule can exhibit by being rotated around a symmetry axis.

Système International d'Unités (SI) or **the International System of Units** A modernized metric system, or what most people mean by "the metric system." It consists of seven base units, a number of derived units with special names, and two supplementary units.

système usuel A system of weights and measures (1812–1839) introduced to satisfy public resistance to the adoption of the metric system in France. A decree in 1800[846] by First Consul Napoleon permitted the substitution of the traditional names for the names of a number of metric units and decimal multiples and submultiples. A decree of February 1812 established the Système Usuel, which authorized use of traditional names of units, but with values much closer to their traditional ones. The Système Usuel was abolished in 1837 by a law[847] forbidding the use of non-metric units after January 1, 1840.

systems of units Formalization of the concept of weights and measures, initially developed for commercial purposes. Different systems of units are based on different choices of a set of fundamental units. The most widely used system of units is the International System of Units (SI).

20 T

T An abbreviation for tablespoon (in North America), tera or tesla.

T An informal abbreviation for "trillion," meaning the American trillion 10^{12}.

t An abbreviation, in North America, for teaspoon, and, in Britain, for ton and tonne.

Ta A unit for expressing thickness of Aberdeen and similar wool yarn, being the number of pounds per spindle of 14,400 yd = about 0.029 03 times the international tex figure.[848]

tahulla [<Arabic: *tahwila* = "field"] In medieval Lorca, Spain, a unit of irrigation water entitlement = 1 hour's flow.[849]

talbot (T) or **lumen seconds (lm s)** The MKS unit of luminous energy, first proposed in 1937,[850] defined as the energy carried by a light flux of one lumen in one second. For light of wavelength 555 nm, the talbot equals 1.464 mJ. For other wavelengths l, the talbot equals $1.464 \cdot V(l)$ mJ, in which $V(l)$ is the "luminous efficiency," a factor representing the relative sensitivity of the eye at wavelength l. The unit is named after the British physicist, inventor and pioneer of photography William Henry Fox Talbot (1800–1877).

tale See *tally*.

tall buildings Some buildings are commonly used as comparative heights of building constructions or mountains by newspapers and media. In the U.S., the Sears Tower (519 m), the Empire State Building (449 m), the Space Needle (184 m), the Washington Monument (169.3 m), and the Statue of Liberty (92.9 m) are used as comparative measurements of height, while in Canada, the CN Tower (553 m) and Calgary Tower (190 m) are similarly used, as are Blackpool Tower (158 m) and Nelson's Column (61.5 m) in Britain.[851]

tally [by tally] or **tale** Measuring by count, rather than by weight, volume or such.

TAN An abbreviation for Total Acid Number. See *acid number*.

tappet hen Size of a drinking vessel, containing two Scottish pints.

tare An empty container used as a counterbalance to obtain net weight.

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846 Arrêté relatif au mode d'exécution du système décimal des poids et mesures du 15 Brumaire. An 9 (15 November 1800).

847 Décret concernant les poids et mesures. Du 12 Févier 1812. Arrêté du ministre de l'intérieur pour l'exécution du décret du 12 Février 1812. Du 28 Mars 1812. Loi relative aux poids et mesures. Bulletin des lois No. 515. Signed 4 July 1837. Promulgated 8 July 1837.

848 [FENN].

849 [GLIC].

850 1937: *Journal of the Optical Society of America* **27**, 211.

851 In Europe, the Eiffel Tower (324 m) and Kaknästornet (155 m) are often used as comparative measurements of height.

tatami or **jo** In Japan, a traditional unit of area, measuring the area of a domestic room in houses and apartments. The tatami is a woven straw mat used as a floor covering. Its size became standardized in the Muromachi Period (1338–1573) at one ken long and half a ken wide. The ken, however, has varied over the centuries. It is now generally about 1.82 m, but reaches 1.97 m in the Kansai area, including the cities of Kyoto, Osaka, and Kobe. Thus, one tatami is about 1.62 – 1.95 m^2.

tayste See *crumb*.

TB An abbreviation for terabyte.

TBN An abbreviation for Total Base Number.

TBq An abbreviation for terabecquerel.

tbs An abbreviation for tablespoon.

tbspn An abbreviation for tablespoonful.

tce or **TCE** Symbol for tonne of coal equivalent, a unit of energy used in the international energy industry. One tce represents the energy available from burning one tonne of coal. This is considered equivalent to exactly 0.7 tonnes[852] = about 5.2 barrels of oil = 890 m^3 of natural gas = about 29.308 GJ = about 27.778 million Btu (MM Btu) = about 8.141 MWh.

tcf or **t.c.f.** An abbreviation for trillion cubic feet.

TCZW An abbreviation for Total Cubic Zirconia Weight.

Td See *denier*.

TDT or T.D.T. An abbreviation for Terrestrial Dynamical Time.

TDW An abbreviation for Total Diamond Weight.

tea chest A foil-lined wooden box for transporting tea. The original lining was lead foil. Later, aluminum foil was used. These days, most tea is shipped in foil-lined paper sacks and only the finest teas still travel in wooden chests or chests made of corrugated cardboard. They were 16 in × 20 in × 24 in. so a 3 × 3 array of them occupied 4 ft × 5 ft × 2 ft = 40 ft^3.

team A group of interacting individuals sharing a common goal and the responsibility for achieving it. It can have as few as two members, but usually has at least four members, or more. Team is also loosely used for any assemblage of people with a common purpose (e.g., Olympic team).

technical atmosphere (at) An obsolete[853] MKpS pressure and stress derived unit = one kilogram of force per square centimetre. The technical atmosphere equals about 980.665 mb = 98.066 5 kPa = about 28.96 inches of mercury (in Hg) = about 0.967 841 1 atm. This is about 97% of the average pressure of the earth's atmosphere at sea level.[854]

technical unit of weight See *kilohyle*.

tebi- (Ti-) Binary prefix meaning 2^{40} = 1,099,511,627,776. This prefix, adopted by the International Electrotechnical Commission in 1998, replaces tera- for binary applications in computer science. The prefix is a contraction of "terabinary."

techma A German abbreviation for *technische Masseinheit* = metric technical unit of weight.

technical atmosphere See *atmosphere*.

teenie A twenty-first century unit of monetary value, applied to stocks in stock exchanges, = 1/16 dollar.

telegraph nautical mile An obsolete unit of length, in concept = the distance traveled by a ship in an hour at a speed of one admiralty knot, = 6087 ft = about 1855.32 m.[855]

temperature or **temperature scale** See *degree Celsius*, *degree Fahrenheit*, *degree Réaumur*, *degree Rankine*, and *kelvin*.

Temporary Viscosity Loss (TVL) A measure of decrease in dynamic viscosity under high shear rates compared to dynamic viscosity

[852] *Energy In a Finite World, A Global Systems Analysis*, W. Häfele, Program Leader, Report by the Energy Systems Program Group of the International Institute for Applied Systems Analysis (IIASA) Cambridge, MA: Ballinger, 1981.

[853] According to IEEE/ASTM SI 10™-2002. *American National Standard for Use of the International System of Units (SI): The Modern Metric System*. New York: IEEE, December 30, 2002, Sect. 3.3.3, the technical atmosphere is not to be used in the U.S.

[854] [CARD].

[855] [CLAR3, p. 55].

under low shear. May be applied to fresh oil or used oil.

tenpenny nail (10d) Name of a nail 3 inches long.

tenth Vernacularly, a tenth of any implied unit.

tenth-meter or **tenth-metre** Old vernacular name for the *ångström*.

TEP A Frensh abbreviation for *Tonne Equivalent Pétrole*.

TEQ An abbreviation for Twenty Foot Equivalent Unit.

tera- (T-) [<Gr: *teras* = "monster"] A metric and SI prefix denoting 10^{12}. In 1948, the General Assembly of the International Union for Pure and Applied Physics approved it on the recommendation of its Commission on Symbols, Units and Nomenclature. The prefix was widely used, but not actually approved until the adoption of the SI by the 11th CGPM in 1960.

tera Name, in some contexts, of the value 1,099,511,627,776 = 2^{40}, as the binary power closest to 10^{12}.

terabecquerel (TBq) A unit of radioactivity = 10^{12} atomic disintegrations per second or 27.027 curies.

terabyte (TB) Term used in the world of computing to describe data storage space and system memory. When referring to a terabyte for disk storage, the hard drive manufacturers usually use the standard that a terabyte is 1000 gigabytes = 10^{12} bytes. When terabyte is used for real and virtual storage, then 1024 gigabytes is the appropriate notation.[856]

teraflops (Tflops) A unit of computing power = 10^{12} floating point operations per second. See *flops*.

terahertz (THz) A unit of frequency = 10^{12} per second = 1 per picosecond. Infrared and visible light waves have frequencies measured in terahertz.

terajoule (TJ) A metric unit of energy, commonly used in the energy industry, = 10^{12} J = 947.817 million Btu = 277.777 8 MW·h = about 9480 therms.

[856] whatsabyte.com

terametre (Tm) A metric unit of length = 10^{12} m = 10^9 km = about 6.684 6 AU.

terawatt (TW) A metric unit of power = 10^{12} W.

terawatt hour (TW·h) A metric unit of energy = 1 billion kW·h = 3.6 petajoules (PJ) = about $3.412 \cdot 10^{12}$ Btu.

termodynamic null Name of the absolute lowest point achievable on the thermodynamic teperature scale, being the point at which thermodynamic activity ceases. See *kelvin*.

termodynamic temperature scale See *kelvin*.

termometer An instrument for measuring heat; founded on the property which heat possesses of expanding all bodies, the rate or quantity of expansion being supposed proportional to the degree of heat applied, and hence indicating that degree.

terrapins A jocular and fancy unit = 10^{12} pins.[857]

tesla (T) The MKS and SI unit of flux density for magnetic fields and magnetic polarization, defined as the field intensity generating 1 N/(A · m) = 1 Wb/m^2 = 10,000 gauss. The tesla, defined in 1958, is named after the Austro–Hungarian electrical engineer Nikola Tesla (1856–1943), whose work in electromagnetic induction led to the first practical generators and motors using alternating current. In 1955,[858] the International Electrotechnical Commission (IEC) Technical Committee 24 recommended it be added to the Giorgi system, and the 11th CGPM (in 1960) adopted it as an SI unit.[859]

tesla metre (T m) See *weber per metre*. Not to be confused with *tetrametre* (Tm).

tesla square metre (Tm^2) See *weber*.

tetra. . . [<Gr: *téttares* = "four"] e.g., tetragon = having four angles.

tetrad A unit of quantity = 4.

[857] ourworld.compuserve.com

[858] [SMIT4].

[859] CIPM, 1956, Resolution 3; 11th CGPM, 1960, Resolution 12.

tetrad, hexit, quadbit or **nibble** A unit of digital information = 4 bits = ½ byte. The unit seems to be more common in German, in which it is spelled *tetrade*.

TEU or **T.E.U.** An acronym for Twenty Foot Equivalent Unit.

tex or **TEX (Tt)** A metric unit used in the textile industry, also the standard in Scandinavia, to measure the linear density of a single fiber of yarn. TEX refers to the number of grams per 1000 m of any yarn = 10 drex = 9 denier = 1 mg/m. TEX numbers vary with the type and weight of respective yarns, but the 1000 m number remains consistent. TEX 760 would mean that particular yarn requires 760 g to 1000 m of yarn. TEX 350 x 2 would indicate a 2 ply yarn.

Tg An abbreviation for teragram.

TGW An abbreviation for Total Gem Weight.

th An abbreviation for thermie.

thaum A jocular unit of magic = the amount of mystical energy required to conjure up one small white pigeon, or three normal-sized billiard balls. The unit was used by the British novelist Terry Pratchett (b. 1948) in the humorous and often satirical fantasy series of Discworld.

therblig A unit of physical activity used in time-and-motion studies in industrial engineering. A therblig[860] represents one of 18 standardized activities identified by the American industrial psychologists Frank B. Gilbreth (1868–1924) and Lillian Moller Gilbreth (1878–1972):

search =, find =, select =, grasp =, hold =,

position =, assemble =, use =, disassemble =,

inspect =, transport loaded =, transport unloaded =,

pre-position for next operation =, release load =,

unavoidable delay =, avoidable delay, plan =, and rest for overcoming fatigue =.[861]

therm [<Gr.: *therme* = "heat"] Name proposed for a unit defined as the heat required to raise 1 g of water through 1°C.[862]

therm (thm) [<Gr.: *therme* = "heat"] A commercial unit of heat energy first defined in Britain in 1920[863] and 1922[864] as 100,000 Btu. Because there have been several definitions of the Btu, there are two official definitions of the therm. In the U.S., the legal definition, established in 1968,[865] is that the therm equals 100,000 $Btu_{(59°F)}$ = 105.480 4 MJ. The European Union's definition, established in 1979[866] using the more current IT Btu, is 105.506 0 MJ. Either way, the therm is = 25,200 (large) calories = about 29.3 kWh of electrical energy. One therm can also be provided by about 96.7 ft^3 of natural gas. The therm has sometimes been confused with the thermie. In Britain, the therm was abolished, effective December 31, 1999, but it is still used by engineers in the U.S.

therm [<Gr.: *therme* = "heat"] In the U.S., a unit of capacity = a quantity of 1000 ft^3 of natural gas at standard temperature and pressure, defined as 100.000 $Btu_{(59°F)}$ = exactly 105.480 4 MJ.

therm per gallon (therm/Imp gal) In Britain, a unit of calorific value, = $2.320\,80 \cdot 10^{10}$ J/m^3.

thermal An adjective used with units of electricity to obtain analogical units of heat. Currently deprecated.

thermal ohm An informal name for the SI unit of thermal resistance, kelvins per watt (K/W) or degrees Celsius per watt (°C/W).

thermie (th) During the early nineteenth century, a metric unit of heat energy, part of the metre-tonne-second system, sometimes used by

[860] The word is Gilbreth spelled backwards (considering "th" as one letter).

[861] [GILB].

[862] The unit was proposed by the British Association at the Bath Meeting in 1888. See: *Rep. Brit. Ass.* 1888, p. 56.

[863] *Gas Regulating Act*, 1920, 10 & 11, Geo. V, c. 28.

[864] Departments of State and Official Bodies. Department of Scientific and Industrial Research. Fuel Research Board. *The Therm. Reports of the Fuel Research Board on gas standards*. H. M. Stationery Office: London, 1922.

[865] Federal Register of July 27, 1968.

[866] Council Directive of 20 December 1979. Council of the European Communities.

European engineers and legalized in France in 1919.[867] It was said to equal the amount of energy required to raise the temperature of 1 tonne of water by 1°C, = 1000 (large) calories = about 4.186 8 MJ.

thermie A unit of energy = 1,000,000 $calories_{15}$ = about 4.185 5 MJ.

thimbleful An informal unit of volume, often used as a prototypical small amount in statements such as "a thimbleful of matter from a neutron star would weigh 100 million tons." A thimble holds just about 1 cm^3.

third-octave A unit of frequency interval describing a band of frequencies such that the highest frequency is $2^{1/3}$ = 1.260 times the lowest. This unit is commonly used in noise control and abatement.

Thom unit In northwestern Europe, *c*. 3500 BCE, a unit of length used by the megalithic tomb-builders. It appears to have been 82.90 ± 0.09 cm. This was deduced by Professor Alexander Thom (1894–1985) in 1966, and the unit has sometimes been named after him, while the original name of the unit has been lost to antiquity.

thou [thousandth] British name (colloquial use by machinists) for what Americans usually call a *mil* = a unit of length = 0.001 in = 25.4 μm.

thou Informal contraction of "thousand," sometimes used by machinists in Britain and the U.S. as a unit of quantity.

thousand million cubic feet (TCM ft) In India, a unit used in water management = 28.317 million m^3.

thousand million cubic feet per day (TCM ft/day) In India, a unit used in water management = 11,574 ft^3/s = about 327.74 m^3/s.

thread In the U.S. and Britain, a unit of length for textiles, especially for cotton yarn, = 1/80 skein = 54 in = about 1.37 m. In Britain (for linen) = 2 ½ yards.

threepenny nail (3d) During the nineteenth century, a length of nail representing a length of 1 ¼ in.

THz An abbreviation for terahertz.

ti [<Vietnamese: = "ten-thousandth"] Prefix used in Vietnam and Southeast Asia.

tick An informal unit, used in commodities trading, to express the smallest allowable amount by which the price in a contract may change.

tick or **tick size** An informal unit, used in finance and investing to express the smallest measured change in a price or index. See also *pip*.

TID or **t.i.d.** [abbreviation for the Latin *ter in die*, three times a day] A unit of frequency traditionally used in medical prescriptions.

Timescale number (Y) A dimensionless number defined as *u*t/L, in which *u* = speed, t = timescale, and L = lengthscale.

tissue roentgen Formerly used name for the roentgen equivalent physical. See *rep*.

tithe A traditional unit of proportion = 1/10.

Tj Name of a measure used for expressing thickness of jute and similar yarns, being the number of pounds per spindle of 14,400 yd = about 0.029 03 times the international tex figure.

TMC or **TMC ft** An abbreviation for "thousand million cubic feet" = about 28.32 m^3.

TMC ft/day An abbreviation for "thousand million cubic feet per day".

TME, mug, or **engineering mass unit** A German abbreviation for Technische Mass Einheit (engineering mass unit). One TME is the mass accelerated at 1 m/s^2 by a force of 1 kgf, = 9.806 65 kg. This unit is sometimes called the **metric slug** in English, since the slug is defined in a similar way in the English system. See also *mug*.

t number Name for an equivalent *f* number of a fictitious lens that has a circular opening and 100% transmittance, which would give the same central illumination as the lens being considered = ½ EFL $(\pi/(At))^{1/2}$, in which EFL is the equivalent focal length, A is the area of the entrance pupil, and t is the transmittance of the lens system. For an unobscured system, the t number = $f/(\# t^{1/2})$.

tōdoryoku [Japanese] In Japan, an informal unit of energy used in the military[868] and defined

[867] Poincaré, R. 1919: *Rev. gen. Elect*. **6**, 311.

[868] [CRES, p 1161].

as the energy required to throw a shovelful of earth 4 m horizontally or 2 m vertically.

toe An abbreviation for tonne of oil equivalent, a unit of energy used in the international energy industry. One toe represents the energy available from burning one tonne of oil, = about 7.4 barrels of oil = about 1270 m^3 of natural gas = 1.4 tonnes of coal = 41.868 GJ = about 39.683 million Btu = about 11.630 MWh.

tog [“togs” is colloquial American slang for clothes or clothing] In the U.S., a metric unit used to describe the insulating properties of cloth. If the flow of heat through the cloth is 1 W/m^2, then the insulating value in togs is 10 times the temperature difference between the two sides of the cloth, = exactly 0.1 m^2K/W = about 0.645 clo.

toman [<Persian: *tumân* = a former currency] A historic unit of quantity = 10,000.

ton Informally used expression meaning a large amount of something.

ton A colloquially used expression in Britain for 100, especially the sum of 100 pounds, a speed of 100 miles per hour, or a score of 100 in darts or cricket.

ton (t or **tn)**, **metric ton**, or **tonne** A metric unit of weight = 1000 kg. The metric ton is now known officially as the **tonne**.

ton or **register ton (RT** or **rT)** A unit used traditionally to measure the cargo capacity of a merchant ship. During the Middle Ages, merchant ships were rated by the number of tons of wine they could carry. Today, the merchant marine ton is defined as being exactly 100 ft^3 = about 2.831 6 m^3. This unit is often called the **register ton**, since it is recorded in official registers of ships.

ton or **displacement ton (DT** or **dT)** A unit of volume traditionally used to measure the “displacement” of ships, especially warships, equal to the volume of sea water they displace when afloat. The displacement ton is defined as being exactly 35 ft^3 = about 0.991 1 m^3.

ton or **freight ton (FT)** A traditional unit of volume used for measuring the cargo of a ship, truck, train, or other freight carrier, = exactly 40 ft^3 = about 1.132 6 m^3.

ton or **ton of TNT (tn** or **T)** A unit of energy, used for measuring the energy of an explosion, especially for expressing the explosive power of a nuclear weapon. Defined as the amount of energy released by the explosion of one short ton of TNT (trinitrotoluene). This is defined in the U.S. as equalling exactly 4.184 GJ.

ton or **ton of refrigeration (RT)** In the U.S., a unit of heat flow rate used in refrigeration and air conditioning engineering = the power required to freeze one short ton of water at 0°C in 24 h = about 4.716 2 horsepowers = about 3.516 853 kW. A ton of refrigeration also represents an energy consumption rate of almost exactly 200 Btu_{IT}/min = 3 516.857 J/s = 0.839 6 Cal/s.

ton of force (tnf or **tn)** A traditional unit of force = 2000 pounds of force = about 8.896 4 kN in the U.S., and 2240 pounds of force = about 9.9640 kN in Britain.

ton per cubic yard (UKton/yd^3) In Britain, a unit of weight density = $1.328\ 94 \cdot 10^3$ kg/m^3.

ton per hour (UKton/h) In Britain, a unit of weight flow rate equal to 2240 lb/h = about 1 016.05 kg/h.

ton per mile (UKton/mile) In Britain, a unit of linear density = 0.631 342 kg/m.

ton per square inch (tnf/in^2 or **tsi)** A unit of pressure traditionally used in engineering. In the U.S., one tsi = 2 000 lb/in^2 = about 13.790 MPa, and in Britain, = about 15.444 MPa.

ton per square mile (UKton/$mile^2$) In Britain, a unit of surface density = 3 ½ lb/acre = about $3.922\ 98 \cdot 10^{-4}$ kg/m^2.

ton per thousand yards (UKton/1000 yd) In Britain, a unit of linear density = 1.111 16 kg/m.

tone Another name for the step as a musical unit describing the ratio in frequency between notes.

tonf An abbreviation for ton-force.

ton-force (tonf) In Britain, a premetric unit of force = 2240 lbf = about 9964.02 N. Later defined as 2000 lbf = about 8896.44 N.

ton-force foot (tonf · ft) In Britain, a premetric unit of moment of force and torque = 2240 lbf · ft = about 3037.03 Nm. Later defined as 2000 lbf · ft = about 2711.64 Nm.

ton-force per foot (tonf/ft) In Britain, a premetric unit of force per unit length = 32,690.3 N/m. Later defined as 29,187.8 N/m.

tonne (t) A metric unit of weight = 1000 kg = about 2204.623 lb av. The SI uses this French spelling for the metric ton to distinguish it clearly from the long and short tons of customary English usage, and recommends that large masses be stated as multiples of the tonne. Thus, a mass of 10^3 tonnes = 10^6 kg = 10^9 g should be called 1 kilotonne (kt) instead of 1 gigagram. In the U.S., the Department of Commerce recommends that the tonne be called the metric ton, to distinguish it from the English and other tons.

tonne of coal equivalent See *tce*.

tonneau de jauge international The French name for the unit register ton. It was authorized by a statute of 1872 as 100 ft^3.

tonneau d'encombrement The French name for the unit freight ton.

tonnes of oil equivalent (toe) A unit describing the energy content of a quantity of a fuel, by comparing it to the energy content of a metric tonne of oil. It is adopted by the OECD for the purpose of presenting its energy balances. One toe = 10^{10} cal_{IT} = 41.868 GJ.

tonnes of oil equivalent/capita (toe/capita) A unit of energy consumption.

tonnes of oil equivalent/$1,000 U.S. A GDP unit of energy efficiency.

tor A unit of pressure, suggested in 1913, = 1 N/m^2. The unit is named after the Italian scientist Evangelista Torricelli (1608–1647), who invented the mercury thermometer.

torr (Torr) A non-metric unit of atmospheric pressure = exactly 1/760 atmosphere = exactly $101{,}325/760\,\text{Pa}$ = about 133.322 368 Pa.[869] The pressure of 1 atmosphere is almost equal to the pressure of a column of 760 mm of mercury in a mercury barometer. As a result, 1 torr is the same thing as 1 mmHg within 1 ppm. The unit is named after Evangelista Torricelli (1608–1647), the Italian scientist who invented the barometer.

Total Acid Number (TAN) See *acid number*.

Total Base Number (TBN) A quantity of perchloric acid, expressed in terms of the equivalent number of mg of potassium hydroxide that is required to neutralize all basic constituents present in 1 g of fat, oil or wax.

Total Cubic Zirconia Weight (TCZW) A unit of weight used for cubic zirconias, the most successful simulated diamond. One TCZW with 100 Points equals one carat.

Total Diamond Weight (TDW) A unit of weight used for diamonds. One TDW with 100 Points equals one carat.

Total Gem Weight (TGW) A unit of weight used for gemstones. One TGW with 100 Points equals one carat.

tour [pronounced "tower"] Another name for a shift as a period of work, generally = 8 h. This unit is traditional on offshore oil rigs.

townsend (Td) The CGS unit of electrical breakdown in a gas which arises from the ratio E/N, in which E = field strength and N = number of gas molecules, = 10^{-17} V cm^2. The unit, proposed in 1966,[870] is named after the Irish physicist Sir John Townsend (1868–1957).

township (twp) A traditional unit of land area in the U.S. = 36 sections or the area of a square 6 miles on a side = 23,040 acres = about 93.239 939 km^2. A township was not required to be "six miles on a side" if an Indian reservation, land previously surveyed or patented, or a navigable river made such a square impractical.[871] Like the section, this unit is used by the U.S. Public Land Survey System, which applies to most of the U. S., except for the original 13 states, Alaska, and Hawaii.

toxic unit or **toxin unit** Name of the smallest dose of toxin which will kill a guinea pig weighing about 250 g in three to four days.[872]

[869] The torr was adopted by the British Standards Institution in 1958, in British Standards 2951.

[870] [HUXL2].

[871] U. S. Revised Statutes, 2395 (a1877).

[872] enacademic.com

tpi [threads per inch] A unit commonly used to describe screws and other items with similar threads.

traffic unit Alternate name for the erlang. See *erlang*.

trainload In North America, a unit of weight = the freight of a train of about 100 cars in typical length = about 10,000 short tons.

trait In France, a legal name (defined in the law of 13 Brumaire an IX (= 5 November 1800)) for the millimetre. A law of 1837 abolished the système usuelle.

transmission stops or **T-stops** A system for designating lens apertures, usually referred to as "T-stops." Instead of being calculated geometrically, as f-stops are, T-stops are determined by actually measuring the amount of light transmitted through the lens. The numbers and the relationships between them are the same as for f-stops. There is no fixed relationship between f-stops and T-stops.

transmission unit (TU) An early name[873] for the unit which became the *decibel*.[874]

trans-uranic elements Nomenclature, approved by the IUPAC in 1979,[875] for elements with atomic numbers greater than 100. Each digit in the atomic number is replaced by a syllable: 0 = nil; 1 = un; 2 = bi; 3 = tri; 4 = quad; 5 = pent; 6 = hex; 7 = sept; 8 = oct; 9 = enn. These syllables are used to make up trisyllabic words to which the ending *–ium* is added.

tray In the U.S., during the late twentieth century, a quantity of marijuana with a street price of three dollars.

trey [<OE = "three," derived from the old French *treis* (now spelled *trois*)] The word survives as the name for a three-spot showing in dice or a three card in card games.

tri. . . [<Gr: = "three"] e.g., *triangle* = having three angles.

[873] According to [JERR] used between 1923 and 1928. [JERR] refer to: [FLET2].

[874] See: [MART12].

[875] Recommendations for the Naming of Elements of Atomic Number Greater than 100 (Rules Approved 1978). *Commission on the Nomenclature of Inorganic Chemistry*, 1979 and [CHAT2].

triad A unit of quantity = 3.

tribometer An instrument for ascertaining the degree of friction.

trike Name for three revolutions.

trilliard A unit of quantity = 10^{21}, which is one sextillion in American terminology or 1000 trillion in traditional British terminology. The name is coined to parallel *milliard*, which has long been a name for 1000 million.

trillion cubic feet (tcf or **t.c.f.)** In North America, during the twentieth century, a unit of capacity, particulary for natural gas, = 10^9 m.c.f. = 10^{12} ft^3 = about $28.317 \cdot 10^9$ m^3.

trio [<Ital.] A traditional unit of quantity = 3, originated in the music of the Baroque era (early 1700's) in its meaning as a composition in three parts.

triple, triplet Name of a group of three items, especially three identical items; the word triplet is also used for one member of such a group. Mathematicians prefer triple for a set of three elements.

triumvirate A unit of quantity = 3. The name comes from the Latin *trium virum*, "of three men," and was first used to describe the governing alliance of Gaius Julius Caesar (100–44 BCE) with Gnaeus Pompeius Magnus (106–48 BCE) and Marcus Licinius Crassus (115–53 BCE) in 60 BCE.

tr/m A French abbreviation for Tour par minute.

troland (Td or **Trol)**, **luxon**, **photon**, or **trolland** In photometry, a unit used to measure the amount of light reaching the retina of the eye. Its defined as the visual stimulation experienced by a normal observer, when the entrance pupil of the eye has an opening of 1 mm^2, and the eye is observing a surface whose retinal illumination is at a level of 1 international candle/m^2. The unit was proposed in 1916[876] by the American experimental psychologist, engineer and optical inventor Leonard Thompson Troland (1889–1932), who called it a *photon*.

troop In the U.S. cavalry branch, a troop is the equivalent unit to the infantry company,

[876] [TROL2].

commanded by a captain and consisting of 3 or 4 platoons, and subordinate to a squadron (battalion).

Troy ounce In the English-speaking world, since the twelfth century, a unit of weight now used only for precious metals, = about 31.103 486 g. The Weights and Measures Act of 1985 redefined the Troy ounce as 12⁄175 of 0.453 592 37 kg. In the sale of gold bullion, the terms fine ounce and standard ounce are sometimes used, equal to 91.667% gold = about 22-carat.[877]

tr/s A French abbreviation for *Tour par seconde*.

TRU An abbreviation for turbidity reducing unit.

T-stops See *transmission stops*.

tsp, **tspn** An abbreviation for teaspoon.

T.T. An abbreviation for Terrestrial Time.

Tt See *tex*.

T.U. An abbreviation for Transmission Unit.

TU A French abbreviation for *Temps Universel*.

TUC or **T.U.C.** A French abbreviation for *Temps Universel Coordonné* = Coordinated universal time.

-tuple, ***n*-tuple**, or **tuple** Suffix[878] added to a number by mathematicians to create units of quantity, when the number n is known implicitly; e.g., 7-tuple contains seven objects, listed in a specified order.[879]

turbidity reducing unit or **turbidity unit (TRU)** Name of "the amount of hyaluronidase which is just sufficient to reduce the turbidity produced by 0.2 mg of hyaluronate to that produced by 0.1 mg after addition of acidified horse serum."[880]

turn or **revolution** A unit of angle measure = 360°.

turnover number (k_{cat}) In enzymology, defined as the maximum number of moles of substrate that an enzyme can convert to product per catalytic site per unit time.[881] k_{cat} is defined as $V_{max}/[E]_T$, in which V_{max} = the maximum velocity of the enzyme, and $[E]_T$ = the total amount of enzyme.

TVL An abbreviation for Temporary Viscosity Loss.

Twaddell number, **Twaddle number**, **Twaddle scale** A specific gravity scale. See *degree Twaddle*.

twain Old word for the number two, derived from the Anglo-Saxon *twegen*. The American author Samuel Clemens (1835–1910), who had been a riverboat pilot on the Mississippi in his youth, took his literary name from a traditional riverboat phrase "mark twain," meaning "exactly two" fathoms of water. This was the minimum depth needed for the boats to operate safely without running aground.

twelfth A unit used in music to describe the ratio in frequency between notes. Two notes differ by a twelfth if the higher note has a frequency exactly three times the frequency of the lower one. On the standard 12-tone scale, the perfect twelfth is approximated as 19 half steps, corresponding to a frequency ratio of $2^{19/12}$ = 2.996 6.

twenty-foot equivalent unit, **Twenty Foot Equivalent Unit**, or **twenty-foot unit (TEQ**, **T.E.Q.**, **TEU**, **T.E.U.**, **TFU**, or **T.F.U.)** A unit of cargo capacity, especially for container ships, used in the second half of the twentieth century.[882] The TFU is a containerized cargo capac-

[877] [QUEE, p. 97].

[878] The suffix has the same Latin root as -ply, meaning -fold.

[879] There are special names given to n-tuples for small n: monad.

(n = 1), pair or twins (n = 2), triple or triad (n = 3), quadruple or tetrad (n = 4), and quintuple or pentad (n = 5).

[880] enacademic.com

[881] The International Biochemistry Committee, in 1961, recommended that this unit be discontinued.

[882] In 1969, the British journalist Richard F. Gibney (1944–1989), who worked for the Shipbuilding and Shipping Records office of the U.K., came up with the term TEU while looking for a convenient way of compiling statistics of different ships and the different sized containers in use at the time. The acronym became a standard term during the late twentieth century. The first container ships of the 1950s carried fewer than 300 TEU. ([SMIL, p. 224] and bertilewis.com).

ity = one standard 20 f. (length) × 8 f. (width) × 8 f. 6 in (height) container = 6.10 m (length) × 2.44 m (width) × 2.59 m (height) = about 38 shipping ton = about 38.549 56 m^3. A TEQ was the capacity to hold one such container. See also *Forty Foot Equivalent Units*.

twip A unit of length used in computer graphics for high-resolution control of the elements of an image. One twip is = 1/1 440 in = about 17.639 μm = 0.070 556 kyu.[883] "Twip" is an acronym for "twentieth of a printer's point," which is accurate if the point is interpreted as being exactly 1/72 in.

tydbit See *crumb*.

typp [thousands of yards per pound] A unit indicating the fineness of wool, wool worsted, cotton, or spun rayon yarn. It is equal to the length in yards of 1 lb av of yarn, divided by 1000 = about 2.015 907 m/g, and *n* typp corresponds to a yarn density of 2.015 907/*n* tex.

21 U

U or **U factor** A commercial unit of thermal conductance (heat flow) = the conductance of heat through a construction assembly. This conductance is measured in Btu's of energy conducted times inches of thickness per hour of time per square foot of area per °F of temperature difference between the two sides of the material. U factors are used to compute the flow of heat through solid building components. A U-factor (U_o) is the inverse of the total R-value (R_t), in which U_o is the overall heat transfer coefficient of an entire assembly in Btu/($ft^2 \cdot F \cdot h$) and R_t is the total R-value of an entire assembly.[884]

U A symbol for the rack unit.

U A standard symbol for the enzyme unit.

U A German abbreviation for *Umdrehung* = revolution (r).

U An SI symbol for the unified atomic mass unit, defined in 1960 and accepted by both chemists and physicists.

u An incorrect replacement for the Greek letter μ as a symbol for the micron or micrometre. The correct symbol for this unit is μm. If the Greek letter is not available, the symbol **mcm** is acceptable.

ua A symbol for the astronomical unit.

ua or **UA** An informal abbreviation for micro-ampere (μA).

u.e.m. A French abbreviation for *unité électromagnétique* = electromagnetic unit (e.m.u.).

u.e.s. A French abbreviation for *unité électrostatique* = electrostatic unit (e.s.u.).

U factor See *U*.

U.H.F. [Ultra High Frequency] Term that designates a band of electromagnetic waves whose frequency is between 300 MHz and 3.0 GHz.

UI An alternate symbol for the international unit (IU). In many languages, the two words of the phrase "international unit" are reversed. In French, for example, the phrase is *unité international*.

UK or **U.K.** An abbreviation for the United Kingdom, often attached to the symbol of a unit used in the United Kingdom, particularly if a unit with the identical name was used in the United States.

uld [= "unit in the last digit"] A unit of data precision used in computer science = a change by 1 in the last (right-most) digit of data represented decimally.

ulp [= "unit in the last place"] A unit of data precision used in computer science = the smallest increment in a variable that can be recorded internally by the machine.

ultraviolet[885] **(U.V.** or **u.v.)** The name given to electro-magnetic radiation with a wavelength

[883] [MISC, p. 50].

[884] [BOBEN, p. 69].

[885] The name means "beyond violet" [<L: *ultra* = "beyond"], violet being the color of the shortest wavelengths of visible light.

shorter than that of visible light, but longer than soft X-rays. It can be subdivided into **near UV** (380–200 nm wavelength), **far** or **vacuum UV** (200–10 nm; abbreviated FUV or VUV), and **extreme UV** (1–31 nm; abbreviated EUV or XUV). When considering the effect of UV radiation on human health and the environment, the wavelength is often subdivided into:

U.V.A. (380–315 nm), also called Long Wave or "blacklight";

U.V.B. (315–280 nm), also called Medium Wave; and

U.V.C. (< 280 nm), also called Short Wave or "germicidal".

umptillion See zillion.

uncertainty of measurement A parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand.[886]

unit When counting, the word "unit" means "one." For example, if a car dealer expects a shipment of 20 units, that means 20 cars. In addition, the word is used as shorthand for a variety of named "units," such as the international unit in pharmacology.

unit (of measurement) A particular quantity, defined and adopted by convention, with which other quantities of the same kind are compared in order to express their magnitudes relative to that quantity.

unit A unit indicating the height of the front panel of rack-mounted electronic equipment. See *rack unit*.

unit In Australia, a premetric unit expressing the amount of a desired substance in a quantity of ore. One unit of a desired substance is the concentration of the substance in the ore in per cent, times 100, times the number of long tons of ore. Each unit is thus 22.4 lb of the substance. For some ores, the unit is based on assays of compounds, not the pure metal.

unit A twentieth century unit of volume, used for pulpwood in the southern United States, = a stack 8 feet long, 5 feet wide, and 4 feet high = 160 ft^3.[887]

unit (U) A unit, not coherent with the SI, = 1 μmol/min. This unit has been in widespread use in medicine and biochemistry since 1964 for expressing catalytic activity.[888] See *katal*.

unit (of blood) A unit of volume for human blood and various blood components or products. A unit of whole blood is 450 mL, which is about 0.951 0 U.S. pint. For components of blood, one unit is the amount of that substance that would normally be found in one unit of whole blood. The adult human body contains roughly 12 units of whole blood.

unit (of heroin) or **Asian unit** A unit of weight for heroin, used in the southeast Asian drug trade, = exactly 700 g. In the U.S., there is a drug enforcement group known as the Asian unit.

unit case A conventional unit of sales volume in the U.S. soft drink industry. A unit case consists of soft drinks, syrup, powder, or whatever equivalent to 24 eight-ounce servings (= about 5.678 L).

unit of oxytocin A USP unit expressing the uterus-stimulating activity of preparations of synthetic oxytocin, approximately = the strength of 2 μg of pure hormone.

unit (magnetic) pole A unit measuring the strength of a magnetic pole and used in defining various units in the CGS electromagnetic system of units. A unit magnetic pole repels an identical pole at a distance of 1 cm in a vacuum with a force of 1 dyne. The unit magnetic pole equals about 125.663 7 nWb.

universal conversion factor See *Boltzman constant*.

universal time (UT) A basis for coordinated dissemination of time signals, counted from 0000 at midnight.

universal time (UT, **U.T.**, or **TU** (= temps universel)) A measure of time that conforms,

[886] See also: [KIMO, p. 239].

[887] [APPA].

[888] www1.bipm.org

within a close approximation, to the mean diurnal rotation of the Earth and serves as the basis for civil timekeeping. Universal Time is determined from observations of the stars, radio sources, and from ranging observations of the Moon and artificial Earth satellites. The scale determined directly from such observations is designated Universal Time Observed (UTO), which is slightly dependent on the place of observation. When UTO is corrected for the shift in longitude of the observing station caused by polar motion, UT is obtained. Universal Time corresponds to GMT increased by 12 h. It is descibed by the symbol **UT_0**. It is possible to calculate **UT_1** introducing corrections for small displacements of the Earth around its axis of revolution. **UT_2** is possible to calculate by introducing corrections for seasonal variations of the Earth's revolution. See also *Universal Time Coordinated*.

universal time coordinated (**UTC** or **TUC** (=temps universel coordonne)) A measure of time that replaced GMT on January 1st, 1972. It corresponds to the **TAI** (Temps Atomique International) fitted to 1 s to ensure approximate scale concordance with UT_1. Universal time coordinated is based on emitted coordinated time rate signals and standard frequencies. The international abbreviation UTC is now employed in all languages. 1 UTC = TAI − 10 s.

uranium unit A proposed unit of α-activity, defined as the activity of the oxide U_3O_8 with a density of surface coating of 20 mg/cm^2. A uranium unit creates an ionizing current in air, having a density of $5.78 \cdot 10^{-13}$ A/cm^2.

US or **U.S.** An abbreviation for the United States, often attached to the symbol of a unit used in the United States, particularly if a unit with the identical name was used in the United Kingdom.

U.S.-C. See *U.S. Customary system.*

U.S.-C.-ap See *U.S. Customary system.*

U.S.-C.-av See *U.S. Customary system.*

U.S.-C.-troy See *U.S. Customary system.*

U.S. Metrification Board A metrification board, set up in 1978.

U.S. (Uniform System) **number** or **US number** A aperture numbering system, adopted as a standard by the Photographic Society of Great Britain in the 1880s.[889,890] See also *f number*.

USP unit A unit used in the U.S. to measure the mass of a vitamin or drug based on its expected biological effects. For each substance[891] to which this unit applies, the U. S. Food and Drug Administration has determined the biological effect associated with a dose of 1 USP unit. Other quantities of the substance can also be expressed in terms of this standard unit. In most cases, the USP unit is = the international unit (IU). "USP" is an abbreviation for the United States Pharmacopeia, a handbook describing the established properties of drugs legal for use in American medicine.

U.S. Survey acre (ac U. S. Surv.) An obsolete U.S. unit of area employed in geodetic measurement. 1 U. S. Survey acre = 4840 sq yd = about 4046.872 610 m^2.

U.S. Survey acre-foot (af)[892] An obsolete U.S. unit of capacity, employed to express volume of water in surveyor's measurements, = 1233.489 239 m^3.

UT or **U.T.** An abbreviation for Universal Time.

ut An "original name for the note do, i.e., doh of the movable English tonic sol-fa, used fixedly for C within the French/Italian notation."[893]

UTC An abbreviation for Universal Time Coordinated, sometimes expressed as Coordinated Universal Time.

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889 [BOTH].

890 "... U.S. 16 is the same aperture as f/16, but apertures that are larger or smaller by a full stop use doubling or halving of the U.S. number, for example f/11 is U.S. 8 and f/8 is U.S. 4. The exposure time required is directly proportional to the U.S. number." Wikipedia contributors, "F-number", en.wikipedia.org

891 The USP unit of vitamin A is defined as the specific biological activity of 0.3 μg of the all-*trans* isomer of retinol.

892 The symbol af is widely used in reservoir management in the U.S., often in combinations such as kaf (1000 acre feet) or maf (million acre feet; this symbol should be Maf).

893 [FENN, p. 551].

UV or **U.V.** An abbreviation for ultraviolet.

UVA, **U.V.A.**, or **u.v.A.** See *ultraviolet*.

UVB, **U.V.B.**, or **u.v.B.** See *ultraviolet*.

UVC, **U.V.C.**, or **u.v.C.** See *ultraviolet*.

U-value or **U value** A measure of thermal conductance, used by the British building industry, = 1 B.t.u. per square foot per hour per degree Fahrenheit = about 5.678 3 W/(K m^2). The American and European U-values differ. See also *R.S.I.* and *R-value*.

UX A French abbreviation for *unité X* = X-unit.

22 V

V [strictly upper case] An SI and metric abbreviation for volt.

V or **v** An ancient Roman numeral symbol for 5.

v. An abbreviation for virgate.

VA An SI and metric abbreviation for volt ampere.

vac A unit of pressure, suggested by Professor Aurel Florescu in 1960, = 1000 dyne/cm^2.[894]

V.A.C. or **V.a.c.** An abbreviation for volts alternating current. See *volt*.

val or **Val** An abbreviation for valency.

value (of a quantity) The magnitude of a particular quantity generally expressed as a unit of measurement multiplied by a number.

Van 't Hoff factor (*i*) A name, used in physical chemistry, for the dimensionless number of moles of solute actually in a solution per mole of solid solute added. It is named after the Dutch physical and organic chemist Jacobus Henricus van 't Hoff (1852–1911), the winner of the first Nobel Prize in chemistry.

var [acronym for volt-ampere-reactive] A unit of the reactive electric power delivered by an alternating current circuit.[895] The var was recommended as the practical unit of reactive power by the Advisory Committee on Nomenclature of the International Electrotechnical Commission at a meeting in Stockholm in 1930, approved in 1954 and confirmed in 1976 by Statutory Instrument.[896] One var = 1 W. See also *blindwatt*.

Varley unit or **Varley's unit** A premetric unit of electrical resistance, standardized at the Electric Telegraph Company in Great Britain, and in concept = the resistance of 1 mile of copper telegraph wire.[897] The unit is named after Cromwell F. Varley (1828–1883), an engineer working for the company who devised a method of locating faults in underground wires by comparing their resistance to that of good wires. One Varley unit was later taken as = 25 Siemens' mercury units = about 23.5 Ω.[898]

vel or **velo** A name for a proposed British unit of velocity = 1 ft/s.[899]

velocity of sound An occasionally used unit of speed = (at standard pressure): in dry air, = about 331.4 m/s, in fresh water, = about 1410 m/s, and in sea water, = about 1540 m/s. An approximate speed of sound in 0% humidity air, in m/s, at temperatures near 0 °C, can be calculated from: $c_{air} = (331.5 + (0.6 \cdot \vartheta))$ m/s, in which ϑ = the temperature in °C.

verber A unit of charge, used in the early 1860s, almost equal to the coulomb.

Verdet constant (α) A factor of an equation of the Faraday effect, which is the rotation of the plane of light polarization by transparent materials in a magnetic field.[900] $\alpha = \omega^{\epsilon}$ H, in which α is the angle of rotation, ϵ is the depth of the medium transversed by the light and H is the power of the magnetic field; ω represents the

[894] [NATUR4].

[895] See also: [IEC64].

[896] [BARN, p. 82].

[897] [BRPP].

[898] [HUNT3].

[899] [CLAR3].

[900] The Verdet constant for most materials is extremely small and is wavelength-dependent. It is strongest in substances containing paramagnetic ions such as terbium. The highest Verdet constants are found in terbium doped dense flint glasses or in crystals of terbium gallium garnet (TGG). This material has excellent transparency properties and is very resistant to laser damage.

Verdet constant and is measured in arc minutes cm^{-1} $gauss^{-1}$.[901]

Vereinskerze [<G: = "union candle"], **verein candle**, **association candle**, or **German candle** In Prussia, a premetric unit of luminous intensity. It was defined as the light from a cylindrical candle made of paraffin, with a diameter of 20 mm and a length of 314 mm, burning with a flame height of 50 mm. The wick consisted of 25 strands of twisted cotton thread. It was equal to about 1.05 British standard candles = about 1.16–1.224 hefner = about 0.95 international candle.

verein candle See *Vereinskerze*.

vergency Name given to the power of a lens system.

Vernier interferometer A phase-shift interferometer used to detect the relative angular speeds or positions of two concentric rotors.

VF or **V.F.** An abbreviation for video frequency.

VHF or **V.H.F.** An abbreviation for very high frequency.

vieth A degree hydrometer scale used in lactometry defined as a specific gravity index on lactometric degree.

Villard unit An absolete unit of radiation intensity, defined as the quantity of radiation which liberates by ionization 1 esu of electricity per cubic centimetre of air under normal conditions of temperature and pressure.[902] In late 1918, the Villard unit was adopted as the "e unit."[903] See also *French Roentgen*.

VIM An abbreviation for Vocabulaire International de Métrologie. See also *IVM*.

violle A unit of luminous intensity, used during the late nineteenth–early twentieth centuries, = the luminous intensity actually emitted by 1 cm^2 of incandescent platinum, at 2045 K and 101,325 Pa, = 20.17 cd. It was the first unit of light intensity that did not depend on the properties of a particular lamp. The unit is named after the French optical scientist Jules Louis Gabriel Violle (1841–1923), who proposed it at the International Conference of Electricians in Paris on September 21, 1881. It was adopted as a unit by the International Conference for the Determination of the Electrical Units in 1884, reconfirmed as a unit at the International Conference of Electricians in Paris on May 21, 1889, at the International Congress in Chicago in 1893, and at the International Conference of Electricians in Geneva, 1896.

vision A term often used with a Snellen fraction in phrases such as "20/20 vision."

visual magnitude (m_ν) A system for describing the apparent magnitude of a star, by estimating it according to the human eye. The system began with Hipparchus of Nicaea (*c*. 190–*c*. 120 BCE), a Greek astronomer who compiled the first star catalog. In 1856, a mathematical definition of magnitude was suggested by the English astronomer Norman Robert Pogson (1829–1891).[904]

vi vi [<Cantonese and Vietnamese: = "million-millionth"] A prefix used in Vietnam.

VLF or **V.L.F.** An abbreviation for very low frequency.

Vodka index A somewhat jocular index, purported to evince how well literacy fares in a given country, = the relation between the price of a litre of standard vodka and the mean price of a hardbound book in a particular country.

voegtlin A unit of activity for pituitary extract, named after the American pharmacologist Carl Voegtlin (1879–1960).

volt (V) An SI unit of electric potential, potential difference, electromotive force, thermoelectromotive force and Peltier coefficient = 1 m^2 kg/(A s^3)= 1 W/A = 1 AΩ = 1 Wb/s = 1 J/C. It was proposed, as the "ohma," by the British electrical engineers Sir Charles Tilston Bright (1832–1888) and Josiah Latimer Clark (1822–1898) in 1861. Two years later, it was renamed the **volt**. The unit is named after the Italian scientist Count Alessandro Giuseppe

[901] [LAND3].

[902] [VILL].

[903] [KRÖN]. The e unit was later modified in [BEHN] to become the R unit (i.e., Roentgen unit), later also called the German unit of x-radiation.

[904] [POGS].

Anastasio Volta (1745–1827), the inventor of the first battery.

volt-ampere (VA) An SI unit of electrical load used in power engineering and apparent power. In an alternating current circuit, if the potential (measured in volts) and the current (measured in amperes) vary in phase with each other, then the power delivered (measured in watts) is the product of the potential and the current. In actual circuits, the potential and current are usually out of phase. The product of the potential and the actual current is the load, measured in volt-amperes.

volt per ampere (V/A) See *ohm*.

volt per kelvin (V/K) The SI unit of Seebeck coefficient and Thomson coefficient.

volt per metre (V/m) The SI unit of electric field strength.

volt per mil (V/mil) The unit of electric field strength = $3.937\ 01 \cdot 10^4$ V/m.

volt second (V s) See *weber*.

volt second metre (V s m) See *weber metre*.

volt second per ampere (V s/A) See *henry*.

volt second per ampere metre (V s/(A m)) See *henry per metre*.

volt second per square metre (V s/m^2) See *tesla*.

volt squared per kelvin squared (V^2/K^2) The SI unit of Lorenz coefficient.

volume unit (vu or VU) [described as, for example, "minus 3 vee you"] A unit used in telecommunications to monitor audio power levels of a radio or television signal, so that the signal can be weakened or amplified to bring it within the optimal range for recording or broadcast. In May 1939, a reference power level of 1 mW into 600 Ω was proposed by the Institute of Radio Engineers.[905] This value was adopted in 1951 by the American Standards Association.[906] For a pure sine wave, 1 VU = 1 dB, but the value of the "volume unit" for real world audio signals is embodied in the unique characteristics of the metre itself.[907]

volumetric unit (vu) A unit of volume, used in the U.S. forest products industry for wood chips and other sawmill by-products, = 200 ft^3 = about 5.663 m^3.[908]

volumetric weight or **dimensional weight** A measure of the size of a package used for billing purposes by postal companies and other freight industries. The volumetric weight, in kg, of a package. It is usually said to equal $lwh/6000$, in which l, w, and h are the maximum length, width, and height measurements of the package, in cm, making the volumetric weight = 166.667 kg/m^3. Some companies divide by 5000, making the volumetric weight = 200 kg/m^3, or even 7000, making it = 142.857 kg/m^3.

von Klitzing constant (R_K) The name of the resistance unit h/e2, evaluated as 25,812.807 455 5(59) Ω. It was discovered by, and is now named after, the German physicist Klaus von Klitzing (b. 1943).

vulgar fraction or **common fraction** An arithmetic expression that consists of one integer divided by a non-zero integer, e.g., ¾.

VV or **vv** A rarely used numeral symbol representation, from the ancient Roman Middle Ages, for 10. See *X*.

v/v An abbreviation for "by volume," used in chemistry and pharmacology to describe the concentration of a substance in a mixture or solution. Thus, 2% v/v means that the volume of the substance is 2% of the total volume of the solution or mixture.

23 W

W An abbreviation for watt or Warp speed factor.

wagonload A premetric unit of weight, in concept equal to a load of a four-wheeled wagon designed to carry large loads at low

905 [CHIN].

906 *Acoustical terminology*. American Standards Association Z 24.1, 1951 and The American National Standard C16.5–1942.

907 IEEE Standard 151-1965 (reaffirmed 1971) Standard Definitions of Terms for Audio and Electroacoustics.

908 interfor.com

speed, and drawn by a team of draft animals at a walking pace.

wales An informal unit of area in Britain, used much as Rhode Island[909] has been used in the U.S. Wales has an area of about 8016 square miles = about 20,761 km^2.

walnut A unit of volume, used to express the size of small things in everyday life.[910] An ordinary walnut has a volume of about 4–5 cm^3. See also *pea*.

ward An area defined as the geographic and administrative sub-division within the context of local government, but rarely of defined size.

Warp speed factor (W) A science fiction concept, used in the Star Trek series and movies, explaining how spaceships can travel over vast interstellar distances. In The Original Series (TOS), the warp equation is generally accepted as being $v = c \cdot W^3$, in which v = the velocity of the spaceship, c = the speed of light, and W = the Warp factor. During the TNG-era (The Next Generation, Deep Space Nine, and Voyager), the Warp speed formula was modified.

watchglass See *hourglass*.

water column (WC) A notation seen in pressure measurements. See *inch of water*, *centimetre of water*, or *millimetre of water*.

water horsepower (whp or Whp) A unit of power used in the U.S., primarily in rating pumps. The water horsepower equals 746.043 W.

water inch A traditional unit of water flow, supposed to equal the flow through a circular opening 1 inch in diameter, assuming the flow is caused only by gravity. One common estimate of this flow rate (that assumes the water level as being constantly 1/12 inch above the top of the opening) is 2520 gal/day = 6.530 L/min. Another estimate (that assumes the top of the opening is 7/12 inch below the water level) is 500 ft^3/day = 3740 gal/day = about 9.832 L/min.

water measure A measure formerly used for articles brought by water, such as coals, oysters, etc. It was defined in 1495 as a bushel of 5 pecks, and in 1701, as 4 heaped pecks, with the clear implication of 25% heaping. During the nineteenth century, the water-measure bushel was said to be 3 gallons larger than the Winchester bushel. See also *bushel*.

water resistant Term indicating that a specific watch is able to withstand splashes of water from rain or a shower. Higher degrees of resistance are indicated by phrases such as: water resistant to 100 m.

water ton In Britain, a premetric unit of capacity used for Petroleum products, in concept = the volume occupied by a mass of one long ton under the conditions which define the imperial gallon, = 224 Imp gal = 1018.324 16 L.

watt (W), sometimes called **absolute watt** or **joule-second** The SI unit of power, heat flow rate and sound energy flux = about 3.412 97 btus/h = 6.115 08 kg-m/min = 44.287 87 ft-lb/min. The watt was proposed by the German born English engineer and inventor C. William Siemens (1823–1883) in his presidential address to the British Association in 1882. The unit is named after the Scottish engineer James Watt (1736–1819), who invented the first practical steam engine.

watt hour (W·h) A common metric unit of work or energy, representing the energy delivered at a rate of one watt for a period of 1 h. This is equivalent to exactly 3.6 kJ of energy = about 3.412 141 Btu = 0.859 846 (kilogram) Calories = about 2 655 ft-lb.

watt per ampere squared (W/A^2) See *ohm*.

watt per cubic foot (W/ft^2) A unit of heat release rate = about 35.314 7 W/m^3.

watt per cubic metre (W/m^2) A unit of heat release rate = 10 erg/(cm^3 s) = about 0.859 845 $kcal_{IT}/(m^3\ h)$ = about $9.662\ 11 \cdot 10^{-2}$ Btu/(ft^3 h).

watt per foot degree Celsius (W/(ft·°C)) A unit of thermal conductivity = about 3.280 84 W/(m K).

watt per kelvin (W/K) An SI unit of thermal conductance.

watt per kilogram (W/kg) An SI unit of absorbed dose rate and kerma rate = 1 Gy/s = 10,000 erg/(g s) = 100 rad/s.

watt per metre degree Celsius (W/(m °C)) See *watt per metre kelvin*.

[909] Wales is about 7.67 times the size of Rhode Island.

[910] mydesert.com

watt per metre kelvin (W/(m K)) An SI unit of thermal conductivity = 1 W/(m °C) = 100,000 erg/(cm s °C) = about 0.577 789 Btu/(ft h °F) = about 6.933 47 Btu in/(ft^2 h °F) = about 0.859 845 $kcal_{IT}$/(m h °C).

watt per square centimetre (W/cm²) A unit of heat flow rate = 10,000 W/m^2.

watt per square foot (W/ft²) A unit of heat flow rate = about 10.763 9 W/m^2 = about 1332.76 $kcal_{IT}$/(m^2 h) = about 491.348 Btu/(ft^2 h).

watt per square inch (W/in²) A unit of heat flow rate = about 1550.00 W/m^2 = about 9.255 29 $kcal_{IT}$/(m^2 h) = about 3.412 14 Btu/(ft^2 h).

watt per square metre (W/m²) An SI unit of density of heat flow rate, radiant exitance, irradiance, sound intensity, sound energy fluence rate, and Poynting vector. 1 W/in^2 = 1000 erg/(cm^2 s) = about 0.859 845 $kcal_{IT}$/(m^2 h) = about 0.316 898 Btu/(ft^2 h).

watt per square metre degree Celsius (W/(m² °C)) See *watt per square metre kelvin*.

watt per square meter kelvin (W/(m² K)) An SI unit of coefficient of heat transfer = 1 W/(m^2 °C) = 1000 erg/(cm^2 s °C) = about 0.859 845 $kcal_{IT}$/(m^2 h °C) = about 0.176 110 Btu/(ft^2 h °C).

watt per square metre kelvin to the fourth power (W/(m² K⁴)) An SI unit of Stefan-Boltzmann constant.

watt per steradian (W/sr) An SI unit of radiant intensity = 10,000,000 erg/(s sr).

watt per steradian square metre (W/(sr m²) An SI unit of radiance = 1000 erg/(s sr cm^2).

watt second (W s) See *joule*.

wave or **wavelength** A unit of relative distance = the length of a wave: this could be a light wave, a radio wave, or even an ordinary water wave. In communications engineering, the length of an antenna is often stated in waves. In optics, the surfaces of lenses and mirrors are required to be precisely polished to within a very small fraction of a wavelength of green light (546 nanometres).

wavelength meter A device that measures the wavelength of an electromagnetic wave.

wavenumber A name adopted in 1872 by the British Association to replace the reciprocal wavelength in spectroscopy. Originally, it represented the number of wavelengths per millimetre, but today it is the number of wavelengths per centimetre. The name of the unit was proposed by George Johnstone Stoney (1826–1911) and J. E. Reynolds in 1871.[911]

Wb An abbreviation for weber.

We An abbreviation for Webber number.

weber (Wb) An SI unit of magnetic flux and fluxoid quantum. The unit is named after the German physicist Wilhelm Eduard Weber (1804–1891), one of the early researchers of magnetism.

weber A unit of current, proposed by the British Association in 1881.[912] At the First IEC meeting, held shortly afterwards in Paris, the decision was made to name the unit of current the ampere, a suggestion that was readily followed by the British Association.

weber A premetric unit of pole strength. A pole had the strength of 1 weber when it produced a field of 1 gauss at a distance of 1 cm in air.[913]

weber metre (Wb · m) An SI unit of magnetic dipole moment = 1 $m^3kgs^{-2}A^{-1}$ = 1 N · m^2/A = 1 V · s · m.

Weber number (We) A dimensionless number, used in momentum transfer in general and bubble/droplet formation and breakage of liquid jets calculations in particular, normally defined as (L v^2 ρ)/(g_c σ), in which L = characteristic length, v = velocity, ρ = density, g_c = dimensional constant and σ = surface tension. It is named after the German engineer Moritz Weber (1871–1951).

weber per ampere (Wb/A) See *henry*.

weber per ampere metre (Wb/(Am)) See *henry per metre*.

weber per metre or **weber per meter (Wb/m)** The SI unit of magnetic vector potential = 1 m · kg · s^{-2} · A^{-1} = 1 V · s/m = T · m.

weber per square metre or **weber per square metre (Wb/m²)** See *tesla*.

911 [STON].
912 [BAAS2].
913 [CLAR3].

wedge photometer A photometer that uses a wedge, marked to show its reduction of flux density, to make two light sources equal in intensity for comparison of luminous intensities. By reading the wedge scale, it is possible to determine the proportion by which the flux density has been reduced.

wei [<Mandarin: = "millionth"] A prefix used equivalent to micro.

wei wei [<Mandarin: = "million-millionth"] A prefix used equivalent to pico.

Weissenberg number (*Wi* or *We*) A dimensionless number, used in the study of viscoelastic flows, defined as the ratio of the relaxation time of the fluid and a specific process time. $Wi = \dot{\gamma}\,\lambda$, in which $\dot{\gamma}$ = the shear rate and λ = the relaxation time. It indicates the degree of anisotropy or orientation generated by the deformation and is appropriate to describe flows with a constant stretch history. The number is named after the Austrian physicist Karl Weissenberg (1893–1976).

Weisskopf unit (W. u.) An obsolete unit employed in nuclear physics to express the nuclear quantum state's transition probability.[914] It was first used by Professor Victor F. Weisskopf (1908–2002) in 1951,[915] and was named after him in 1958.[916] See also *Moszkowski unit*.

Wet Bulb Globe Temperature (WBGT) A number used to express the heat stress imposed on the human body by a certain environment. Studies commissioned at the Department of the Navy resulted in an index called the Wet Bulb Globe Temperature, suggested in 1989 as an international standard (ISO 7243). WBGT was measured using three different thermometers:

1. A standard dry bulb thermometer (DB);
2. A standard dry bulb thermometer whose bulb is wrapped in a cotton sleeve, the bottom of which lies in a pool of distilled water, so that the cotton sleeve will always be wet, allowing continuous evaporative cooling of the thermometer's bulb, simulating the evaporation of sweat (WB); and
3. A standard dry bulb thermometer whose bulb is inserted into a 6 inch black ball to allow measurement of the effects of sunshine and other radiant heat (GT).

These three temperatures are integrated as follows:

$$WBGT = 0.7\ WB + 0.2\ GT + 0.1\ DB.$$

wet ton, dry ton Units used to measure sludge, slurries, compost, and similar mixtures in which solid material is soaked with or suspended in water. A wet ton is an ordinary ton of the material in its natural, wet state; a dry ton is a ton of the solid material that would remain if all the water were removed.

wheaton An informal measure of Twitter followers. It is named after the American actor and blogger Wil Wheaton (b. 1972), who achieved 500,000 Twitter followers when the measurement was standardized in late 2009. As most Twitter users have a lot fewer followers, the milliwheaton (500 followers) is more commonly used.

whetstone An obsolete benchmark for evaluating the performance of computers. It was first written in Algol 60 in 1972 at the National Physical Laboratory in the United Kingdom and derived from statistics on program behaviour gathered on a KDF9 computer (made by English Electric), using a modified version of its Whetstone Algol 60 compiler. Originally, it measured computing power in units of *kilo-Whetstone Instructions per seconds* (kWIPS).[917] See also *Dhrystone*.

whiz A unit, proposed in 1981 by Dr. Bryan P. Kibble (1938–2016) of the National Physical Laboratory in Middlesex, = 1/299,792,458 of the velocity of plane electromagnetic radiation in free space. With the second and a redefined volt (as that potential step which would correspond to radiation of $4.835\ 94 \cdot 10^{14}$ Hz in a Josephson junction) and ampere (defined as the current

[914] See also the use of W. u. for estimating electric transitions in [WARD].

[915] [WEIS].

[916] Wilkinson, D. H., A.E.R.E. (Harwell) Rep. T/R 2492, 1958.

[917] [CURN].

flowing through a quantized Hall effect device which would give rise to a Hall potential of 6 453.2 V), the whiz would give a system of units whose basis is completely free of material standards.

whole space The name of the equivalent in three dimensions of the whole or full revolution for the planar degree.

whole step or **whole tone** Alternate names for the step, a unit used in music to express the ratio in frequency between two tones.

WI An abbreviation for Wobbe index.

Wien displacement law constant (b) The name of the product of the wavelength of maximum intensity from a black body and the thermodynamic temperature. This appears in Wien's displacement law and equals 2.897 768 6(51) · 10^{-3} m · K, with standard uncertainty 1.7 · 10^{-6}. It is named after the German physicist Wilhelm Carl Werner Otto Fritz Franz Wien (1864–1928).

wigtje A name given to the gram in Belgium and the Netherlands, when the metric system was adopted in 1820.

Winchester quart An informal British unit of volume used for certain chemicals, such as acids, shipped in cylindrical, narrow-necked bottles. A Winchester quart originally held 2 Imperial quarts = about 2.273 L.

Wing's chain During the seventeenth–eighteenth centuries, a unit of length used by American surveyors = 40 Wing's links = 33 ft = 10.058 4 m. The unit was introduced during the late seventeenth century by the English land-surveyor Vincent Wing (1619–1668).[918]

wink A metre-gram-wink-unit of time, proposed in 1957,[919] = 1/3000 µs. See also *blink*, *einstein*, *samson*, and *simon*.

winter index (*I(w)*) A numerical index based on the mean daily maximum temperature (T)°C, the number (S) of days with snow lying at 0900 h (GMT) and the number (F) of night ground frosts (grass minimum temperature 0.0 °C). The index was applied to data obtained from Durham, Edgbaston, Leuchars, and Swansea:

$$I(w) = 10T - 18.5S^{1/3} - F + 200$$

Winter is defined as December to March inclusive. A low index value indicates a severe winter.[920]

W/(m K) An abbreviation for watt per metre-Kelvin.

Wobbe index (I_w or WI) or **Wobbe number** A dimensionless number used for measuring the quality of a gas mixture or the interchangeability of fuel gases, with respect to its energy content and metered air/fuel ratio, = the high heating value of the gas in Btu per standard cubic foot divided by the square root of its specific gravity with respect to air.[921] Sometimes, WI are calculated on the basis of MJ/m^3 instead of Btu/scf.

Womersley number (α) A dimensionless number in biofluid mechanics defined as the ratio of pulsatile flow frequency versus viscosity. It is named after the British mathematician John R. Womersley (1907–1958).[922] The Womersley number can be written as: $\alpha = R\,[(\omega\,\rho)/\mu]^{1/2}$, in which R is an appropriate length scale, ω is the angular frequency of the oscillations, ρ the kinematic viscosity, and µ the dynamic viscosity of the fluid. It may also be written as: $(\pi\, Re\, St)^{1/2}$, in which Re = Reynolds number and St = Strouhal number.

Wood's unit See *peripheral resistance unit*.

wool counts Method used to account for the fact that hand knitting yarns vary a lot in weight per yard, from brand to brand and type to type. For example, a superwash wool is heavier than a regular wool.[923]

Woolhouse unit A unit proposed by the British actuary Wesley Stoker Barker Woolhouse (1809–1893) in his 1835 *Essay on musical intervals*, as 1/730 part of an octave.

word A unit of information in computer science, often representing the amount of data processed by a computer in a single instruction. A **shortword** is 2 bytes, a **longword** (or **double**

[918] [MILT].

[919] [MCNI].

[920] [HULM].

[921] ASTM D 1945, American Gas Association Bulletin, No. 36.

[922] [WOME].

[923] yarnfwd.com

word) is 4 bytes (32 bits), a **quadword** is 8 bytes (64 bites), an **octword** (or octaword) is 128 bites, and a **hexword** is 256 bites.

word A unit of information in typing. Typing speed is usually expressed in words per minute (wpm). For this purpose, a "word" is considered to be exactly 5 characters (spaces included).

working level (WL) A unit of radiation exposure used for measuring exposure to radon gas in the U.S. One working level is exposure to air in which radon is releasing 100 pCi/L. In homes, the U.S. Enviromental Protection Agency recommends exposure levels not exceeding 0.04 WL.

working level months (WLM) A unit of cumulative exposure of workers in the U.S., representing exposure to one working level for 170 h. In underground mining, U.S. law says that the cumulative exposure for miners must not exceed 4 WLM per year.

wpm An abbreviation for words per minute.

WS A German abbreviation for *Wassersäule*, water column, seen in pressure measurements. See *centimetre of water* or *millimetre of water*.

W/sr An abbreviation for watt per steradian.

wt A not-recomended obsolete abbreviation, attached to the symbol of a unit of weight when it was used as a unit of "weight". Example: kg (wt) for kilogram-force.

w/v An abbreviation for "weight by volume," a slightly confusing phrase used in chemistry and pharmacology to describe the concentration of a substance in a mixture or solution. The weight by volume is the mass (in grams) of the substance dissolved in or mixed with 100 mL of solution or mixture. Thus, 1% w/v is = 1 g/dL = 10 g/L.

w/w An abbreviation for "by weight," used in chemistry and pharmacology to describe the concentration of a substance in a mixture or solution. The metric symbol g/g has the same meaning as w/w.

wyde A unit of information in computer science = 2 bytes = 16 bits. This name for the "double byte" was proposed by the American computer scientist Professor Donald E. Knuth (b. 1938).

24 X

x or **X** A common symbol for power as a unit of magnification. More generally, x is used in the context of its mathematical meaning, "times," to indicate that a measurement is a multiple of some standard or reference measurement.

X The Roman numeral for 10.

X An abbreviation for X-unit and for reactance.

X.E. A German abbreviation for *X-Einheit* = X-unit.

xellion See *zillion*.

xian [<Mandarin Pin-Yin: = "ten-millionth"] A prefix used in China for "millionth," with a subsequent qualified unit for modern measures.[924]

x-ray diffractometer An instrument that uses a crystal to diffract x-rays for the measurement of the intensities of the diffracted rays.

x-ray unit See *Kienböck unit*.

Xu, **xu**, or **X.U.** An abbreviation for X-unit.

X-unit (X, Xu, xu, or **X.U.)** or **Siegbahn unit** A unit of length formerly used for describing the wavelength of x-rays and γ-rays. The unit has an alternative name taken from the Swedish physicist K. Manne G. Siegbahn (1886–1978), who defined it, in 1925, as the distance between lattice planes with the Miller index (200) of a calcite crystal (Island Spath) at 18º C measured by X-Ray diffraction using a $CuK_{\alpha 1}$ spectral line.[925] This value was chosen with the intention of making the X-unit about 10^{-13} m. The **copper x-unit** is based on taking the wavelength of the $K\alpha_1$ line of copper to be exactly 1537.400 XU. According to the 2014 CODATA recommendations, it is = $1.002\,076\,97(28) \cdot 10^{-13}$ m. Its symbol is xu($CuK\alpha_1$). The **molybdenum x-unit** is based on taking the $K\alpha_1$ line of molybdenum to be exactly 707.831 XU. According to the 2014 CODATA recommendations, it is = 1.002

[924] Sometimes, like "kilo", used without a subsequent qualified unit.

[925] [SIEG] and [SIEG2, pp. 42–44].

099 52(53) · 10^{-13} m. Its symbol is xu (Mo$K\alpha_1$).[926] Around 1965, some scholars began to use the A* unit in place of the X-unit.

25 Y

Y [strictly upper case] An SI abbreviation for yotta-.

y [strictly lower case] An SI abbreviation for yocto-.

yard (yd) A traditionally used unit of area for materials sold in standard rolls, such as cloth, carpet, linoleum, fencing, and so on. In each case, one yard represents an area one yard long and as wide as the roll width.

yard per pound (yd/lb) A U.S. and British unit of specific length = 2.015 91 m/kg.

yd or **yd.** An abbreviation for yard.

yd/lb An abbreviation for yard per pound.

yi In Chinese, a unit of quantity = 100,000,000. The yi is used with the wan (10,000) in expressing large numbers, one yi being the same as one wan wan (ten thousand ten-thousands).

yi [<Mandarin: = "hundred million"] A prefix denoting 10^9. Sometimes used without a subsequent qualified unit.

yik [<Canotese and Fuknese: = "hundred million"] A prefix denoting 10^9, and sometimes used without a subsequent qualified unit.

Ym An abbreviation for yottametre.

yocto- (y-) An SI prefix denoting 10^{-24} of the unit. Adopted by the CIPM in 1990, and approved by the nineteenth CGPM in 1991, the prefix is derived from the Latin *octo* and Greek *okto*, meaning 8, because this is the eighth prefix (n = 8 in 10^{-3n}) in the SI system of metric prefixes. The *y* was added arbitrarily to provide a non-confusing letter for abbreviations. "o" might have been confused with the numeral for zero. See also *yotta-*.

yotta- (Y-) An SI prefix denoting 10^{24} of the unit. The name is derived from the Latin *octo*, meaning 8, because this is the eighth prefix (n = 8 in 10^{-3n}) in the SI system of metric prefixes. The *y* was added to avoid using the letter *o* as a symbol, because it might be confused with the numeral for zero. The prefix was coined to parallel the prefix yocto-.

yottabyte Term used to describe data storage space and system memory. When referring to a yottabyte for disk storage, a yottabyte is generally considered to be 10^{24} bytes. When yottabyte is used for real and virtual storage, then 1024 zettabytes is the appropriate notation.

yottagram (Yg) A metric unit of weight = 10^{24} g.

yottameter or **yottametre (Ym)** A metric unit of length = 10^{24} m = 32.408 Mpc = 105.7 million light years.[927]

yukawa A twentieth century unit of length = $1.0 \cdot 10^{-15}$ m, named after the Japanese physicist Hideki Yukawa[928] (1907–1981), Professor of Theoretical Physics at Kyoto University. This unit is identical to the *fermi*.

26 Z

Z An abbreviation for SI-prefix zetta; e.g., Zg = zettagram.

z A symbol for redshift, a shift in the frequency of a photon toward lower energy, or longer wavelength. The redshift is defined as the change in the wavelength of the light divided by the remaining wavelength of the light, as z = (Observed wavelength − Rest wavelength)/(Rest wavelength). Positive values of z correspond to increased wavelengths (redshifts).

z An abbreviation for SI-prefix zepto; e.g., zg = zeptogram.

zaspel An obsolete yarn measure in Germany, mainly used in Bohme, Moravie, and Austrian Silesie, = 1/3 strehn = 20 gebind or ècheveaux.

Zeisel number A specific number $N = p_1 p_2 \ldots p_n$, in which the p_is are distinct primes and $n \geq 3$ such that $p_i = A\, p_{i-1} + B$, i = 1, 2, . . ., n, p_0

[926] [COHE].

[927] The radius of the observable universe is no more than about 200 yottametres.

[928] See the Biography in [YUKA].

taken as 1, and with *A* and *B* some fixed integers.[929] It is named after its founder, the Austrian mathematician Helmut Zeisel.[930] Zeisel found that p = 2^(k−1) + k is prime if k = 1885.

zepto- (z-) A metric submultiplier prefix indicating 10^{-21} of the unit modified. Proposed by the CIPM in 1990, and adopted by the nineteenth Conférence Générale des Poids et Mesures (CGPM) in 1991. The name[931] was coined from the Latin *septem*, meaning 7, because this is the seventh prefix ($n = 7$ in 10^{-3n}) in the SI system of metric prefixes.[932] Compare *zetta-*.

zeptogram (zg) A multiple unit of the SI base unit of weight = 10^{-24} kg.

zeptometer or **zeptometre (zm)** A multiple unit of the SI base unit of length = 10^{-21} m.

zero An integer denoting 0 that, when used as a counting number, means that no objects are present.

zetta- (Z-) A metric multiplier prefix indicating 10^{21}. It was proposed by the CIPM in 1990, and adopted by the nineteenth CGPM in 1991. The prefix was coined to parallel the prefix zepto-. See also *zepto*.

zettabyte Term used in the world of computing to describe data storage space and system memory. When referring to a zettabyte for disk storage, the hard drive manufacturers usually use the standard that a zettabyte is 10^{21} bytes. When zettabyte is used for real and virtual storage, then 1024 exabytes is the appropriate notation.[933]

zettagram (Zg) A multiple unit of the SI base unit of weight = 10^{18} kg.

zettameter or **zettametre (Zm)** A multiple unit of the SI base unit of length = 10^{21} m = about 32.408 kpc = 105,702 light years. This is a little more than the diameter of the Milky Way galaxy.

Zhubov scale or **ball** A unit measuring the degree of ice coverage of polar seas. The scale goes from one ball to ten. One ball equals about 10% coverage, two ball denotes about 20% coverage, etc. In general: 1–3 ball indicates sparse ice cover, 4–6 ball: broken ice, 7–8 ball: concentrated ice, and 9–10 ball: complete cover.[934]

The unit was invented by the Russian naval officer N. N. Zhubov (1895–1960), who specialized in Arctic Oceanography. He was one of the first men to circumnavigate Franz Joseph Land.

zillion An indefinite and fictitious large number without a well-defined value. It is used in a jocular context, or in loose, unconfined conversation. Almost equally used fictious large numbers: ananillion, bagillion, bajillion, bazillion, brazillion, buhmillion, fafillion, gad-zillion, gagillion, gajillion, gazillion, godzillion, gonillion, googillion, grillion, hojillion, jillion, julillion, kabajillion, kabillion, kajill-ion, optillion, quilliard, quillion, schmillion, skajillion, skillion, squ-illion, umptillion, and xellion. There is no accepted order, and none is necessarily larger or smaller than any of the others.

zodiac celestial coordinate system A coordinate system for mapping positions in the sky, using the Greek names of the signs of the zodiac. Aries (0°), Taurus (30°), Gemini (60°), Cancer (90°). Leo (120°), Virgo (150°), Libra (180°), Scorpio (210°), Sagittarius (240°), Capricorn (270°), Aquarius (300°) and Pisces (330°).

zumosimeter An instrument proposed by the Dutch naturalist and microscopist Jan Swammerdam (1637–1680)[935] for ascertaining

[929] For example, 1885 = 1 x 5 x 13 x 29 is a Zeisel number with (A,B) = (2, 3) since 5 = 2 x 1 + 3; 13 = 2 x 5 + 3; 29 = 2 x 13 + 3, as is 114,985 = 1 x 5 x 13 x 29 x 61 since 5 = 2 x 1 + 3; 13 = 2 x 5 + 5; 29 = 2 x 13 + 3; 61 = 2 x 29 + 3.

[930] The first Zeisel numbers are 105, 1419, 1729, 1885, 4505, 5719, 15387, 24211, 25085, 27559, 31929, 54205, 59081, 114985, 207177, 208681, 233569, 287979, 294409, 336611, 353977, 448585, 507579, 982513, 1012121, 1073305, 1242709, 1485609, 2089257, 2263811, 2953711.

[931] Since the *s* was already a symbol for the second, the symbol for a septosecond would have been *ss*. To avoid this type-prone outcome, *z* was substituted for *s*; hence, zepto.

[932] In 1993, some researchers had to refer to units of 10^{-21} V, but they didn't yet have the prefix *zepto*, so they called it "milliattovolt."

[933] whatsabyte.com

[934] [FAIR, p. 37].

[935] See also [SCHI].

the degree of fermentation occasioned by the mixture of different liquids, and the degree of heat which they acquire in fermentation.

zymometer or **zymoscope** [<Gr: *zumóō* = "to leaven"'] An instrument, in use during the seventeenth–twentieth centuries, for ascertaining the degree of fermentation occasioned by the mixture of different liquids, and the degree of heat which they acquire in fermentation.

Time Measurements and Calendars

1 The Scientific Field

The area of historical metrology called *historical chronology* is usually said to include the study of historical units of time, calendars and calendar eras, as well as regnal chronology (which studies lists of kings, rulers and statesmen), historiography (which examines the writing of history and the use of historical methods) and historical chronometry (which deals with various former methods for timekeeping). Despite this, I have mainly compiled information on what is sometimes called *calendariography*, a subject that includes the study of historical, fictional and scientific calendars. In a separate section, other units of time and certain useful general terms have been compiled.

2 Common Types of Calendars

The measurement of time began when people started counting repeating events, like the rising and setting of the sun, the moon's changing, and the cycle of the seasons. In 1991, Alexander Marshack, an independent American scholar and Paleolithic archaeologist, purported that notches on bone plaques, some of which he believed to date from as far back as *c.* 27,000 BCE, marked the lunar cycle. Even if not everyone accepts Marshack's idea that these Paleolithic carvings represent calendar sticks, it is well known that some ancient cultures marked the calendaric cycles on bone, others notched trees, and yet others knotted strings.

Because day (the time from sunrise to sunrise), month (the time it takes the moon to go from full to new to full again), and year (the time it takes for a season to return) have no common factor, all calendars are approximations requiring some periodic correction. This fact has led to a variety of calendars having been designed.

Thus, the *lunar calendars* followed the phases of the Moon, ignoring the Sun, and adding occasional intercalary days as correction against natural phenomena of any kind. Lunar months may run from full moon to full moon or new moon to new moon, depending on tradition, e.g., in southern India, the month begins with the new moon, but in other parts of India, the full moon signals the beginning of a month. The practice of recording days of a lunar calendar appear to have been common throughout the world. Lunar scribes have been found in Nicobar Island calendar sticks, Mayan wooden calendars, Native American sticks, and ancient Egyptian calendars.

Each lunar month has an average length of 29½ days. This amounts to about 354 days for a 12 month year, which is about 11.4 days shorter than the tropical year. The Islamic calendar is an example of a common lunar calendar.

A *solar calendar* uses days to approximate the tropical year or the sidereal year by keeping it synchronised with the seasons. The solar year is

J. Gyllenbok, *Encyclopaedia of Historical Metrology, Weights, and Measures*, Science Networks. Historical Studies 56, https://doi.org/10.1007/978-3-319-57598-8_4

the time it takes Earth to make a full revolution around the Sun, which is approximately 365 days, 5 hours, 48 minutes, and 46 seconds. The Egyptians were probably the first people to create a solar calendar. They used a calendar with 12 months of 30 days each, with five extra days added each year to keep the calendar in line with the solar year. In 238 BCE, King Ptolemy III made the calendar even more accurate by adding an extra day every fourth year. This type of year, with an extra day, is called a leap year.

A *lunisolar calendar* uses lunar months to approximate the tropical or sidereal year. The months usually alternate between 29 and 30 days long, but because the synodic month (the time from the new Moon to the next new Moon) is a little longer than 29½ days, there must be a certain amount more of 30-day months than 29-day months during a solar year. The lunisolar calendar year usually contains 12 synodic months, which amount to 354 days. As this is shorter than the tropical year (365¼ days), an occasional insertion of a 13th intercalary month is inserted to delay the beginning of a season, based on practical observations such as if the rain season is not fully over, the lambs are still young and weak, the barley has not yet ripened, and so on. In some calendars, the heliacal rising and setting of a fixed star or observations of solstices and equinoxes are used to define and calibrate the calendar with the seasons.

As the ratio between a tropical year (365.242 days) and a synodic month (29.5306 days) is 12.3683, an ideal calendar, on average, should contain 12.3683 months. A key problem is then to find out how often an intercalary month must be added to eliminate the deficit in relation to the tropical year. If we use an 8-year cycle (for example: 12—12—13—12—12—13—12—13), the average length of the calendar year is $99/8 = 12.3750$ months, which is pretty close to the ideal value of 12.3683 months. In fact, this 8-year cycle calendar will operate satisfactorily for about 149 years until the surplus of $(12.3750 - 12.3683) = 0.0067$ months will amount to an extra month.

A much better solution to the above-detailed problem is a 19-year cycle (for example: 13—12—12—13—12—12—13—12—12—13—12—12—13—12—12—13—12—12—13) in which the average length of the calendar year is $235/19 = 12.3684$ months. A 19-year cycle like this was introduced into the Attic calendar in 432 BCE by the Greek astronomer Meton. For this reason, this type of cycle is known as the *Metonic cycle*. Some 200 years later, the Greek astronomer Callipus continued the work of Meton, and proposed a 76-year cycle, later called the *Callippic cycle*. Ironically, we now know that the Callipic cycle is about 6 minutes less accurate than the Metonic cycle, which only renders a deviation of a full day every 219 years.

The *stellar calendars* of antiquity were triggered by the heliacal rising of a star, *lunistellar calendars* were synchronized to the motion of the Moon, as well as some stars and/or star constellations, and finally, there was the *planetar calendar*, the most extraordinary and unique type, developed by the Mayan people, which incorporated the cycles of planets.

3 Calendar Year Components

Except for the single day, changes in weather, hours of daylight, and ecology are the natural phases which penetrate closely into the life of man.These phases, the seasons, are dependent on where you are on the globe. In subpolar and temperate regions, four distinct seasons are usually recognized: spring, summer, autumn and winter, even if some cultures recognize more than two intermediate seasons between winter and summer. In hot regions, two or three seasons are defined as the dry season and the rainy season, while in some tropical regions, they are defined as the cool season and the mild season. Natural phenomena, such as thaw, hurricanes and wildfires, and ecological phenomena, such as breeding, egg-laying and flower blooming, have also been used for defining seasons in some cultures.

There is no change in the sky that lasts 7 days. This cycle, the week, comes from the Jewish custom of reserving the Sabbath as a holy day, every seventh day. In some cases, the term "week" is expanded to refer to other time units as well, comprising 1, 2, 3, 4, 5, 6, 8, 9, or 10 days.

The Babylonians divided the circular path of the sun across the day sky into 12 equal parts, and awarded the night cycle 12 parts as well, concluding with a 24-h day. The circular path of the sun was divided into 360 degrees, awarding each degree 60 minutes.

The day is, by convention, the smallest calendrical unit of time. The measurement of fractions of a day is usually classified as time-keeping, due to the diversity of methods that have been used in creating calendars. Many calendars are regulated by astronomical observations, but some are based on perpetually repeating cycles of no astronomical significance. Calendars have been designed to meet the desire to organize units of time to satisfy the needs and preoccupations of society. They have provided the basis for planning agricultural, hunting, and migration cycles, for divination and prognostication, and for maintaining cycles of religious and civil events. As the requirements of various civilizations also differed dramatically from one another, the calendars historically have been extremely diverse.

As nations switch over to the Gregorian calendar, old methods of timekeeping linked to local environmental cycles are rapidly fading from memory. Ancient ecological calendars are important sources for our understanding of the rhythms of life that were once crucial to human survival prior to recorded history. It is therefore also crucial to me to present some of the calendar systems that were once used.

4 Significant Books

The first pathbreaking publication in historical chronology may be *Opus de emendation temporum* ... ('On correct chronology ...') by Joseph Scaliger from 1583, but the first scientific work was developed by the Jesuit chronologist Denis Petau and published in his ... *Opus de doctrina temporum* in 1627. Some chronological studies were published by Johannes van der Hagen in the 1730s. In 1747, James Dodgson created a compilation of the most remarkable cycles, eras, and periods. D. H. Hegewisch put together a comprehensive single volume *Introduction to Historical Chronology*, in 1837, but by far the most important work during the nineteenth century was the two-volume *Handbuch der mathematischen und technischen Chronology*, 1825–1826, by Ludwig Ideler. Friedrich Ginzel published a reference work, under the same title as Ideler, in three volumes between 1906 and 1914. These volumes are still indeed very useful. An informative compilation, *Time Measurement and Calendar Construction*, was published in 1956 by B. Richmond. In *Empires of Time: Calendars, Clocks, and Cultures*, published in 1989, Anthony F. Aveni traced the roots of our modern timekeeping system and compared it with those of tribal societies. In 1999, E. G. Richards published *Mapping Time: The Calendar and Its History*, a useful compilation of time measurement and various calendars, both ancient and modern. This book is also well worth seeking out. *Calendars in Antiquity: Empires, States, and Societies* by Sacha Stern, published in 2012, is a compilation of ancient calendars with some political conclusions. Finally, I will mention *Universalgeschichte der Zeit* by Hans Lenz, second edition 2013, which provides a comprehensive and enthralling overview of most aspects of the concept of time as perceived in both ancient and modern times.

5 360-Day Calendar

This is a simplified calendar that is sometimes used in computer models, financial markets, and some ancient literature. The calendar consists of 12 months of 30 days each. The names of the months are usually the same as in the Gregorian calendar. See also *Gregorian calendar*.

The usual names of the months:

1. January (30 days)
2. February (30 days)
3. March (30 days)
4. April (30 days)
5. May (30 days)

6. June (30 days)
7. July (30 days)
8. August (30 days)
9. September (30 days)
10. October (30 days)
11. November (30 days)
12. December (30 days)

Main source: [BROW7]

6 Abenaki Calendar

This lunar calendar was used by the Abenaki people in northeastern North America.

The names of the months:

1. alamikos (greetings maker Moon), = ~ January
2. piaôdagos (makes branches fall in pieces Moon), = ~ February
3. mozokas (moose hunter Moon), = ~ March
4. sigwankas (spring season maker Moon), = ~ mid-March
5. sogalikas (sugar maker Moon), = ~ April
6. kikas (field maker Moon), = ~ May
7. nokahigas (hoer Moon), = ~ June
8. temaskikos (grass cutter Moon), = ~ July
9. temezôwas (cutter Moon), = ~ August
10. skamonkas (corn maker Moon), = ~ September
11. penibagos (leaf falling Moon), = ~ October
12. mzatanos (freezing river maker Moon), = ~ November
13. pebonkas (winter maker Moon), = ~ December

The names of the weekdays:

1. Sanda, = Sunday
2. Kizsanda, = Monday
3. Nisda alokan, = Tuesday
4. Nseda alokan, = Wednesday
5. Iawda alokan, = Thursday
6. Skawatukwikisgad, = Friday
7. Kadawsanda, = Saturday

Main source: [LAUR2]

7 (Ancient) Aboriginal Calendars

These calendars were used by the Australian aborigines well into the twentieth century. Different aboriginal tribes recognised different seasons. The seasons were distinguished by the growth of particular plants, the appearance of various creatures, and alterations in the weather. The constellations in the sky, along with the waxing and waning of the moon in respect to a particular solar position, was often seen as a calendar that indicated when the seasons were shifting and when certain foods were available. Planets, stars and constellations were usually given names that varied according to locality.

The Emu constellation is oriented so it appears to be either running or sitting down. Depending on its position, people in the western desert knew it was time to hunt for emus or collect their eggs. When the Scorpius is visible towards the end of April, the people of Groote Eylandt knew the wet season was over and the dry marimariga wind would soon begin to blow. When Neilloan (Lyra) appeared in the north-west sky around April, the Boorong people knew that the birds would be preparing their mound-like nests. The disappearance of Neilloan in late September or early October meant it was time to start gathering.

The Bininj/Mungguy people of the Kakadu region in the Northern Territory divided the year into six seasons:

1. Gudjewg (Monsoon season), ~ late December–early March
2. Banggerreng (Knock’em down storm season), ~ early March–late April
3. Yegge (Cooler but still humid season), ~ early May–mid June
4. Wurrgeng (Cold weather season), ~ mid-June–mid-August
5. Gurrung (Hot dry weather), ~ mid-August–mid-October
6. Gunumeleng (Pre-monsoon storm season), ~ mid-October–late December

The Yaraldi tribe in South Australia recognised four distinct seasons:

1. Riwuri (time of growing and mating), = spring, ~ August–October
2. Luwadang (time of warmth), = summer, ~ November–January
3. Marangani or Marangalkadi (time of the crow), = autumn, ~ February–April
4. Yutang (time of cold), = winter, ~ May–July

The Yaraldi tribe in South Australia also divided the day into seven sectors:

1. ngarangi (before dawn)
2. nanggi (dawn with rising sun)
3. nanggawolin (morning)
4. geiwel (noon)
5. geiwel-nanggawolin (afternoon)
6. djalyidjerawolin or djaldjeri (sun going down and twilight)
7. djangaliwolin (darkness and night)

Main sources: [BERN2], [HAYN], and [TURN2]

8 (Old) Achehnese Calendar

This lunar calendar, with 354 days, was used in the Aceh Sultanate until the late nineteenth century.

The names of the months and related months in the Islamic calendar:

1. Asan-Usén, = المحرّم Muharram, (30 days)
2. Sapha, = صـــفر Safar, (29 days)
3. Mòlōt, = ربيـــع الأوّل Rabi' al-awwal, (30 days)
4. Adòë mòlōt, = ربيـــع الثاني Rabī' al-Thānī, (29 days)
5. Mòlot Seuneulheuëh, = جمادى الأولى Jumada al-Oola, (30 days)
6. Kanduri bòh kayèë, = جمادى الثاني Jumada al-Thani, (29 days)
7. Kanduri Apam, = رجب Rajab, (30 days)
8. Kanduri Bu, = شـــعبان Sha'aban, (29 days)
9. Puasa or Ramulan, = رمضـان Ramadan, (30 days)
10. Uròë Raya or Charway, = شوّال Shawwāl, (29 days)
11. Meuapét or Dōy Kaidah, = ذو القعدة Dhu al-Qa'dah, (30 days)
12. Haji or Dōy Hijah, = ذو الحجة Dhu al-Hijjah, (29 days and 30 days in leap year)

The names of the days of the week:

1. Seunanyan, = Monday
2. Seulasa, = Tuesday
3. Rabu, = Wednesday
4. Hamèh, = Thursday
5. Jeumeuah, = Friday
6. Sabtu, = Saturday
7. Aleuhat, = Sunday

Main sources: [GINZ] and [MAHM]

9 (Ancient) Aetolian Calendar

This calendar was used in ancient Aetolia on the north coast of the Gulf of Corinth.

The names of the months:

1. Prokyklios, = ~ August–September
2. Athanaios, = ~ September–October
3. Βουκάτιος Boukatios, = ~ October–November
4. Δῖος Dios, = ~ November–December
5. Euthyaios, = ~ December–January
6. Ομολώϊος Homoloios, = ~ January–February
7. Ἑρμαίος Hermaios, = ~ February–March
8. Διονυσιος Dionysios, = ~ March–April
9. Agynios, = ~ April–May
10. Ἱπποδρόμιος Hippodromios, = ~ May–June
11. Thyios, = ~ June–July
12. Πάναμος Panamos, = ~ July–August

Main source: [GINZ]

10 (Old) Afghan Lunar Calendar

This lunar calendar, which used July 15, 622 as its epoch, was used in Afghanistan before 1922. It contained 12 months. The last month had 29 days in a common year and 30 days in a leap year.

The names of the months in Kagani, Western Afghani Pashto, Eastern Afghani Pashto, and related months in the Islamic calendar:

1. ‘Āšūr, Hasan wa huseyn, and Hasan huseyn, = المحرّم Muharram, (30 days)
2. Ṣafar, Gul shakara, and Sapara = صفر Safar, (29 days)
3. Algō-ye awwal, Rumbey chor, and Lumrey khor = ربيع الأوّل Rabi’ al-awwal, (30 days)
4. Algō-ye dovvom, Dwayema chor, and Dwaheyma khor = ربيع الثاني Rabī’ al-Thānī, (29 days)
5. Algō-ye sevvom, Dreyema chor, and Dreyma khor = جمادى الأولى Jumada al-Oola, (30 days)
6. Algō-ye čahārom, Thalorema chor, and Thalarema khor = جمادى الثاني Jumada al-Thani, (29 days)
7. Rajab, Do Hadai miasht, and Do hadai taali miasht = رجب Rajab, (30 days)
8. Ša’bō, Shawkadar, and Barat = شعبان Sha’aban, (29 days)
9. Ramażō, Rozha, and Do rozha miasht = رمضان Ramadan, (30 days)
10. ‘Īd, Warukay achtar, and Kuchnay Akhtar = شوّال Shawwāl, (29 days)
11. Ḵalī, Miyana miasht, and Miyana = ذو القعدة Dhu al-Qa’dah, (30 days)
12. Qorbō and Loy achtar = ذو الحجة Dhu al-Hijjah, (29 days and 30 days in leap year)

Main sources: [BAUS], [LENT], and [YARS]

11 Afghan Solar Calendar

This is also called **Shamsi calendar**.

This solar calendar is used in Afghanistan. The names of the months are the same as the Arabic terms for the Zodiacal signs. Before 1957, the numbers of days in a month ranged from 29 to 32 according to the year. In 1957, the number of days was fixed at 31 days in each of the first 6 months, 30 days in the next five, and 29 in the last. There are eight leap years in a 33 year cycle, the first seven of which occur every 4 years, with the eighth occurring in the 33rd year of the cycle. An extra leap day is usually added at the end of the leap year.

The names of the seasons:

1. bahar, = spring
2. tabestan, = summer
3. khazan, = autumn
4. zemestan, = winter

The names of the months, in Dari and Pashto, representing the Zodiac signs:

1. حمل (Ḥamal) / ورى (Woray) (31 days)
2. ثور (Sawr) / غويى (Ğwayay) (31 days)
3. جوزا (Jawzā) / غبرگولى (Ğbargōlay) (31 days)
4. سرطان (Saraṭān) / چنگاښ (Čongāx̌) (31 days)
5. اسد (Asad) / زمرى (Zmaray) (31 days)
6. سنبله (Sonbola) / وږى (Wažay) (31 days)
7. ميزان (Mizān) / تله (Təla) (30 days)
8. عقرب (‘Aqrab) / لړم (Laṛam) (30 days)
9. قوس (Qaws) / ليندى (Līndəi) (30 days)
10. جدى (Jadī) / مرغومى (Marğūmay) (30 days)
11. دلو (Dalvæ) / سلواغه (Salwāğa) (30 days)
12. حوت (Hūt) / كب (Kab) (29 or 30 days)

There is also a 12-year cycle, the Chagatai, for which the years are named after animals:

1. mush (mouse)
2. palang (leopard)
3. nahang (dragon)
4. faras (hare)
5. shadi (ape)
6. kalb (dog)
7. baqar (ox)
8. khargush (rabbit)
9. mar (snake)
10. gusfand (sheep)
11. murgh (hen)
12. khuk (pig)

Main sources: [ADAM5] and [VASI]

12 Akamba Calendar

This lunar calendar was used by the Wakamba people in Ukambani, Kenya. Each month had 31 days, and ended with an intercalary day, making a year of 354 days. They probably also included 13 or 14 more intercalary days.

The names of the months:

1. mwa (planting month), = ~ mid-October–late November
2. wima (month of the autumn rains), = ~ late November–December
3. wiu (month of sprouting), = ~ January
4. mveu, = ~ February–early March
5. onkonono, = ~ early March–early April
6. thandatu (commence reaping), = ~ early April–early May
7. moanza, = ~ early May–mid-June
8. nyanya, = ~ mid-June–mid-July
9. kenda (ninth month), = ~ mid-July–mid-August
10. ekumi (tenth month), = ~ mid-August–mid-September
11. mubiu (month of grass-burning), = ~ mid-September–mid-October

Main source: [NILS]

13 Akan Calendar

This calendar is used by the Akan culture, an ethnic group in Ghana and Côte d'Ivoire, which migrated between the fifteenth century and seventeenth century from the Brong area to southern Ghana. The members are the Akuapem, Ashanti, Fanti, Brong, and Denkyera people. They use a calendar that is based on a 42 day cycle, 4 seasons, and 12 months.

The Adaduanan cycle is composed of six prefixes, based on an older 6-day week (referred to as *Nnanson*) and a 7-day week (referred to as *NnawƆtwe*). The 2 weeks were brought in from two different tribes during ancient times.

The days of the *Nnanson* week are:

1. Fo (council day or judgment day)
2. Nwuna (sleep day or funeral day)
3. Nkyi (behind (hate-taboo) day or destroyed day)
4. Kuru (political day or royal day)
5. Kwa ('just like that' day or unrestrained day)
6. Mono (fresh day or starting day)

The days of the *NnawƆtwe* week are:

1. Dwowda (quiet day or calm day), = Monday
2. Benada (birthday of ocean), = Tuesday
3. Wukuda (birthday of Spider (mortal version of God)), =Wednesday
4. Yawoada (birthday of Earth (a woman)), = Thursday
5. Fida (fertility day), = Friday
6. Memenda (birthday of Sky God (a man)), =Saturday
7. Kwasiada (universe day), =Sunday

By combining the 6-day week with the 7-day week, it effects a 42-day cycle. Below is a cycle based on the cycles recorded by [BART2] in Kwawu and [RATT] in Bono Techiman:

1. Fɔdwoɔ, 2. Nwonabena, 3. Nkyiwukuo, 4. Kuruyawoɔ, 5. Kwafie, 6. Monomemene, 7. Fɔkwasie, 8. Nwonadwoɔ, 9. Nkyibena, 10. Kwawukuo, 11. Kwayawoɔ, 12. Monofie, 13. Fɔmemene, 14. Nwonakwasie, 15. Nkyidwoɔ, 16. Kurubena, 17. Kwawukuo, 18. Monoyawoɔ, 19. Fɔfie, 20. Nwɔnamemene, 21. Nkyikwasie, 22. Kurudwoɔ, 23. Kwabena, 24. Monowukuo, 25. Fɔyawoɔ, 26. Nwonafie, 27. Nkyimemene, 28. Akwasidɛɛ, 29. Kwadwoɔ, 30. Monobena, 31. Fookuo, 32. Nwonayawoɔ, 33. Nkyifie, 34. Kurumemene, 35. Kwakwasie, 36. Monodwoɔ, 37. Fɔbena, 38. Nwonawukuo, 39. Nkyiyawoɔ, 40. Kurofie, 41. Kwamemene, and 42. Monokwasie.

The number of cycles lies between eight and nine. Since there are various adaduanan cycles within a year, they differ from tribe to tribe, as well as from year to year. The Akan priests use a cycle that is equal to about 3 years of the Roman calendar. As nine such cycles make a total of 378 days per year instead of 365¼ days, one of the nine named adaduanan is omitted every 3 years. According to this, the Akan cycle is 3 days short, compared to the Roman calendar, for a period of 3 years (see calculation below).

Akan: 3 years × 9 cycles × 42 days − 42 day cycle = 1092 days.
Roman: 3 years × 365 days = 1095 days.

The Akan Calendar has cycles and not years, but Christian Akan scholars have arbitrarily applied it to the Roman calendar of 12 months anyway, as shown below:

1. ɔpepɔn, = January
2. ɔgyefuiɛ, = February
3. ɔbɛnem, = March
4. Oforisuo Agyenkɔ, = April
5. Ohawam Kotonimaa, = May
6. Ayɛwohomumu, = June
7. Kutawonsa, = July
8. Sanaa, = August
9. ɛbɔ, = September
10. Ahinime, = October
11. Obubuo, = November
12. ɔpɛnimma, = December

The names of the seasons:

1. ɔpɛ Bere, = Ɔpɛnimma–ɔbɛnem
2. Asusue Bere, = Oforisuo Agyenkɔ–Ayɛwohomumu
3. Ofupɛ Bere, = Kutawonsa–Sanaa
4. Bamporɔ Bere, = Ɛbɔ–Obubuo

Main sources: [BART2], [BOSH], [BUSI], [GOOD], [KONA], [MENS], and [RATT]

14 Alabaamo Calendar

This calendar was used by the native people of Alabama.

The names of the months:

1. hasi hachàalímmòona hasiholtina ałłámmòona, = ~ January
2. hasiholtina istatókla, = ~ February
3. hasiholtina istatótchìina, = ~ March
4. hasiholtina istonóostàaka, = ~ April
5. hasiholtina istatáłłàapi, = ~ May
6. hasiholtina istahánnàali, = ~ June
7. hasiholtina istontóklo, = ~ July
8. hasiholtina istontótchìina, = ~ August
9. hasiholtina istachákkàali, = ~ September
10. hasiholtina ispókkòoli, = ~ October
11. hasiholtina istapókkòolawah cháffàaka, = ~ November
12. hasiholtina istapókkòolawah tóklo, = ~ December

Internet source: glosbe.com

15 Aleut Calendar

This lunar calendar was used among the Aleut people in Kamchatka Krai.

The names of the months:

1. month when people gnaw belts (starting in March)
2. month when one is outside the house
3. month of flowers
4. young-of-animals month
5. month when the young animals are fat
6. the warm month
7. month in which the hair grows
8. hunting month
9. the month after the hunting month
10. month when the sea lions are caught
11. month that is longer than any other
12. month when coromants are caught in nets

Main source: [NILS]

16 Alexandrian Calendar

See *Coptic calendar*.

17 Algonquin Calendars

This lunar calendar was used by the native Algonquin people (Ojibwa Indians) of central Canada, along the Atlantic coast and around the Great Lakes.

The names of the months, according to Phil Konstantin:

1. papsapquoho (the year begins Moon), = ~ December
2. squochee kesos (sun has not strength to thaw Moon), = ~ January
3. wapicuummilcum (ice in river is gone Moon), = ~ February
4. namossack kesos (catching fish Moon), = ~ March
5. suquanni kesos (when they set Indian corn Moon), = ~ April/May
6. moonesquanimock kesos (when women weed corn Moon), = ~ May
7. twowa kesos (when they hill Indian corn Moon), = ~ June
8. matterllawaw kesos (squash are ripe and Indian beans begin to be edible Moon), = ~ July
9. micheenee kesos (when Indian corn is edible Moon), = ~ August
10. pohquitaqunk kesos (middle between harvest and eating Indian corn Moon), = ~ September
11. pepewarr (white frost on grass and ground Moon), = ~ October
12. quinne kesos (white frost still on grass and ground Moon), = ~ November

Main source: [WATE3]

18 (Ancient) Amphissan Calendar

This calendar was used during ancient times in Amfissa in Phocis.

The name of the months:

1. Agrastyon, = ~ July
2. ?
3. ?
4. Bukatios, = ~ October
5. Panagyrios, = ~ November
6. Gigantios, = ~ December
7. ?
8. Poitropios, = ~ February
9. ?
10. Pokios, = ~ April
11. Amon, = ~ May
12. Panamos, = ~ June

Main source: [GINZ]

19 (Old) Anglo-Saxon Calendar

This lunisolar and agricultural calendar was used among the Saxons until the tenth century. The names of the weekdays were adopted during the reign of the Western Roman Empire.

The names of the months according to *De Temporum Ratione* by the Northumbian Monk Bede (673–735) in 725:

1. Ærra Geola, = ~ December
2. Æfterra Geola, = ~ January
3. Solmōnað, = ~ February
4. Hrēðmōnað, = ~ March
5. Ēostermōnað, = ~ April
6. Ðrimilcemōnað, = ~ May
7. Ærra Liða, = ~ June
8. Æfterra Liða, = ~ July
   Ðriliðimōnað (intercalary month some years)
9. Weodmōnað, = ~ August
10. Hāliȝmōnað, = ~ September
11. Þinterfilleð, = ~ October
12. Blōtmōnað, = ~ November

The names of the months during the mid-ninth century:

1. Ærra ȝēola (before-yule month), = ~ December

Modra-niht (mothers' night; this was the longest night and the birth of a new solar year)
2. Æftera ʒēola (after-yule month), = ~ January
3. Solmōnaþ (month of the returning Sun), = ~ February
4. Hlydmōnaþ or Hrēðmōnaþ (month of Hréða (glory-goddess)), = ~ March
5. Eosturmōnaþ (month of the Eostre (Easter, goddess of the radiant dawn)), = ~ April
6. Maiusmōnaþ or Đrimilce-mōnaþ (month of the three milkings (cows milked three times a day)), = ~ May
7. Ærra Líða-mōnaþ (first travelling month), = ~ June
8. Æfterra Líða-mōnaþ (second travelling month), = ~ July
   Sēremōnaþ or Þriliðimōnaþ (intercalary month some years)
9. Ƿēodmōnaþ (weed month), = ~ August
10. Hāliʒmōnaþ (holy month), = ~ September
11. Ƿinterfylleð (winter full moon month; first full moon of autumn), = ~ October
12. Blōtmōnaþ (blood (sacrifice) month), = ~ November

The names of the weekdays:

1. Sunnandæg, = Sunday
2. Mōnandæg, = Monday
3. Tīwesdæg, = Tuesday
4. Wōdnesdæg, = Wednesday
5. Þūnresdæg, = Thursday
6. Frīgedæg, = Friday
7. Sæturnesdæg, = Saturday

Main sources: [BEDE] and [BOSW]

20 Anishnaabe Calendar

This lunar calendar was used by the Ojidwe and Chippewa people in northeastern North America.

Biboon (winter):

1. gichi-manidoo-giizis or min-ah-doh gee-ssonhs giizis (the Moon of the great spirit), = ~ December
2. manidoo-giizisoons or min-ah-doh geezehss giizis (the Moon of the small spirit), = ~ January
3. namebini-giizis (”the sucker-fish Moon”) or mah-kwah giizis (bear Moon), = ~ February
4. onaabani-giizis or oh-nah-bid-in giizis (the snow-crust Moon), = ~ March

Ziigwan (spring):

5. iskigamizige-giizis (the maple-sap-boiling Moon or broken snowshow Moon), = ~ April
6. waabigwanii-giizis or waabigoni-giizis (the flowering Moon) or zaagibagaa-giizis (the leaf Moon), = ~ May

Niibin (summer):

7. ode'imini-giizis (the strawberry Moon), = ~ June
8. aabita-niibino-giizis (the raspberry Moon or the midsummer Moon) = ~ July
9. manoominike-giizis (the ricing Moon) or miini-giizis (the berry Moon), = ~ August

Dagwaagin (autumn):

10. waatebagaa-giizis or wa-bah-ba-gah giizis (the Moon when the leaves are changing color), = ~ September or October
11. binaakwe-giizis or bi-nah-kway giizis (the Moon of the falling-leaves), = ~ October
12. gashkadino-giizis or bah-shkah-koh-din giizis (the freezing Moon), = ~ November

Main source: [TORN]

21 (Ancient) Antiochene Calendar

This solar calendar was used in the ancient city of Antioch, during the Seleucid dynasty. Shortly after the Roman invasion of Syria in 64 BCE, the Syrans also adopted this calendar, but with the New Year moved to *Loos* (early August). This Syrian calendar used 48 BCE as its epoch.

The names of the months:

1. Ὑπερβερεταῖος Hyperberetaios, = ~ 9 October– (30 days)
2. Δῖος Dios, = ~ November (30 days)
3. Ἀπελλαῖος Apellaios, = ~ December (30 days)
4. Audnaios, = ~ January (30 days)
5. Περίτιος Peritios, = ~ February (30 days)
6. Δύστρος Dystros, = ~ March (30 days)
7. Ξανδικός Xanthikos, = ~ April (30 days)
8. Ἀρτεμίσιος Artemisios, = ~ May (30 days)
9. Δαίσιος Daisios, = ~ June (30 days)
10. Πάνημος Panemos, = ~ July (30 days)
11. Λῷος Loos, = ~ August (30 days)
12. Γορπιαίος Gorpaios, = ~ September (30 days)

Five epagomenal days or, in leap year, six.

Main source: [STER]

22 Arapaho Calendar

This lunar calendar was used by the Northern Arapaho people in Nebraska and Wyoming.

The names of the months:

1. Moon of snow blowing spirits in the wind, = ~ January
2. Moon of frost shining in the wind, = ~ February
3. Moon when buffalo calves are born, = ~ March
4. Moon of ice breaking in the river, = ~ April
5. Moon when the ponies shed their shaggy hair, = ~ May
6. Moon when the hot weather begins, = ~ June
7. Moon when the buffalo bellow, = ~ July
8. Moon when the geese shed their feathers, = ~ August
9. Moon of the drying grass, = ~ September
10. Moon of the falling leaves, = ~ October
11. Moon when the rivers start to freeze, = ~ November
12. Moon of popping trees, = ~ December

Main source: [ROBI6]

23 Aristasian Calendar

See *Filianic calendar*.

24 Armelin's Calendar

This perennial calendar was developed in 1887 by the French astronomer Gustave Armelin, and was discussed under the auspices of the Société astronomique de France. The year was divided into four quarters of 3 months each. The first and second month of each quarter had 30 days, and the third month 31 days. The year begins with "New Year's Day," a day that does not belong to any week or any month. Once every 4 years, a "Leap Day" proceeds New Year's Day.

The names of the months:

1. January (30 days)
2. February (30 days)
3. March (31 days)
4. April (30 days)
5. May (30 days)
6. June (31 days)
7. July (30 days)
8. August (30 days)
9. September (31 days)
10. October (30 days)
11. November (30 days)
12. December (31 days)

Main sources: [BEST] and [BLÁH]

25 (Ancient) Armenian Calendar

This solar calendar was used in ancient Armenia. The calendar started at Navasardi 1 (August 11), 2492 BCE, when King Haik defeated the Babylonians. In order to commemorate the event, he changed the first day of the year to this date, and renamed most of the months, using his sons' and daughters' names.

The year consisted of 12 months of 30 days each, plus 5 additional days collectively called Aveliats. As the actual solar year is 365¼ days, the effect of the shorter year was that every 4 years, the year began 1 day before, every 8 years, 2 days before, etc., until they reappeared on their original day after 1460 years. This 1460-year cycle was called the Haikia.

In the second council of Dvin in 555 CE, it was decided that a new system would be used for counting years, called Hayots Mets Tvakane. The new calendar was designated as starting on July 9, 552 CE. The year consisted of 12 months of 30 days each, plus a 13th month, called epagomenê, containing 5 days in a regular year. Dates were marked by the letters ԹՎ or the like, often with a line over them, indicating "t'vin" ("in the year") followed by 1–4 letters of the Armenian Alphabet, each of which stands for an Armenian numeral.

The year was divided into four traditional seasons. Special names were given to each day of the month, and even each hour of the day had a special name.

In 1084, the Armenian scientist Hovhannes Imastaser (*c*. 1047–1129) initiated the introduction of the Julia calendar of 365 days with a leap day added every 4 years.

The names of the seasons:

1. Գարուն—Garun, = spring
2. Ամառն—Amaṙn, = summer
3. Աշուն—Ašun, = autumn
4. Ձմեռն—Jmeṙn, = winter

The names of the months (transliterated according to the Hübschmann-Meillet-Benveniste system):

1. նաւասարդ(Nawasard = August 11–September 9)
2. հոռի (Hoṙi = September 10–October 9)
3. սահմի (Sahmi = October 10–November 8)
4. տրէ (Trē = November 9–December 8)
5. քաղոց (K'adoç = December 9–January 7)
6. արաց (Araç = January 8–February 6)
7. մեհեկան (Mehekan = February 7–March 8)
8. արեգ (Areg = March 9–April 7)
9. ահեկան (Ahekan = April 8–May 7)
10. մարերի (Marēr = May 8–June 6)
11. մարգաց (Margaç = June 7–July 6)
12. հրոտից (Hrotiç = July 7–August 5)

Epagomenal days: Ավելյաց (Aveliats = August 6–August 10)

The names of the days of the month:

1. Արեգ—Areg
2. Հրանդ—Hrand
3. Արամ—Aram
4. Մարգար—Margar
5. Ահրանք—Ahrank
6. Մազդեղ—Mazdeł
7. Աստղիկ—Astłik
8. Միհր—Mihr
9. Ձոպաբեր—Jopaber
10. Մուրց—Murç
11. Երեզկան—Erezkan
12. Անի—Ani
13. Պարխար—Parxar
14. Վանատ—Vanat
15. Արամազդ—Aramazd
16. Մանի—Mani
17. Ասակ—Asak
18. Մասիս—Masis
19. Անահիտ—Anahit
20. Արագած—Aragac
21. Գրգոռ—Gorgor
22. Կորդուիք—Kordi
23. Ծմակ—Cmak
24. Լուսնակ—Lusnak
25. Ցրօն—Çrōn
26. Նպատ—Npat
27. Վահագն—Vahagn
28. Սէին—Sēin
29. Վարագ—Varag
30. Գիշերավար—Gišeravar

The five epagomenal days were sometimes named after the five "wandering stars":

1. Փայլածու—Pʻaylažu (Mercury)
2. Արուսյակ—Arusyak (Venus)
3. Հրատ—Hrat (Mars)
4. Լուսնթագ—Usntʻag (Jupiter)
5. Երևակ—Erewak (Saturn)

The names of the weekdays:

1. արեգակ—aregak, = Sunday
2. լուսին—lusin, = Monday
3. հրատ—hrat, = Tuesday
4. փայլաժու—pʻaylažu, = Wednesday
5. լսնթագ—lusntʻag, = Thursday
6. լուսաբեր—lusaber, = Friday
7. երևակ—erewak, = Saturday

The Christian Armenians adopted the 7-day week from the Jews:

1. կիրակի օր—kiraki ōr, = Sunday, also called միաշաբաթի—miašabatʻi ("first after Sabbath")
2. երկուշաբթի—erkušabatʻi, = Monday
3. երեքշաբթի—erekʻšabatʻi, = Tuesday
4. չորեքշաբթի—čʻorekʻšabatʻi, = Wednesday
5. հինգշաբթի—hingšabatʻi, = Thursday
6. ուրբաթ—urbatʻ, = Friday
7. շաբաթ—šabatʻi, = Saturday

Daytime hours:

այգ—ayg (6–7),
ծայգ—tsayg (7–8),
զայրացեալ—zayracʻeal (8–9),
ճառագայթեալ—čaṙagaytʻeal (9–10),
շառաւիղեալ—šaṙawiłeal (10–11),
երկրատես—erkrates (11–12),
շանթակող—šantʻakoł (12–13),
հրակաթ—hrakatʻ (13–14),
հուր փայլեալ—hur pʻayleal (14–15),
թաղանթեալ—tʻałantʻeal (15–16),
արագոտ—aragot (16–17),
արփող—arpʻoł (17–18),

Nightime hours:

խաւարակ—xawarak (18–19),
աղջամուղջ—ałǰamułǰ (19–20),
մթացեալ—mtʻacʻeal (20–21),
շաղաւօտ—šaławot (21–22),
կամաւօտ—kamawōt (22–23),
բաւական—bawakan (23–24),
խօթափեալ—xōtʻapʻeal (0–1),
գիզակ—gizak (1–2),
լուսածեմ—lusatsem (2–3),
առաւօտ—aṙawōt (3–4),
լուսափայլ—lusapʻayl (4–5), and
փայլածու—pʻaylatsu (5–6).

Main sources: [ALIŠ], [BĂNĂ], [DULA], [GIPP], [GIUG], and [MANO]

Internet source: haytomar.com by Rouben Sardaryan and Artavazd Eghiazaryan

26 (Ancient) Asianian Calendar

This lunisolar calendar was used in the Roman province of Asia until the seventh century. The calendar was based on the Macedonian calendar.

The names of the months:

1. ΚΑΙΣΑΡΙΟΣ (Kaisarios) 24 September–23 October (30 days)
2. ΤΙΒΕΡΙΟΣ (Tiberios) 24 October–23 November (31 days)
3. ΑΠΑΤΟΥΡΙΟΣ (Apaturios) 24 November–24 December (31 days)
4. ΠΟΣΕΙΔΑΩΝ (Poseidaon) 25 December–23 January (30 days)
5. ΛΗΝΑΙΟΣ (Lenaios) 24 January–21 February (29 days)
6. ΪΕΡΟΣΕΒΑΣ (Hierosebastos) 22 February–23 March (30 days)
7. ΑΡΤΕΜΙΣΙΟΣ (Artemisios) 24 March–23 April (31 days)
8. ΕΥΑΓΓΕΛΙΟΣ (Euangelios) 24 April–23 May (30 days)
9. ΣΤΡΑΤΟΝΙΚΟΣ (Stratonikos) 24 May–23 June (31 days)

10. ΕΚΑΤΟΜΒΑΙΟΣ (Hekatombaios) 24 June–24 July (31 days)
11. ΑΝΤΕΟΣ (Anteos) 25 July–24 August (31 days)
12. ΛΑΟΛΙΚΙΟΣ (Laodikios) 25 August–23 September (30 days)

The names of the months in the calendar used in the capital of Asiana, Ephasos:

1. Καῖσαριος Kaisarios 24 September–23 October (30 days)
2. Ἀπελλαῖος Apellaios 24 October–23 November (31 days)
3. Αὐδυναῖος Audynaios 24 November–24 December (31 days)
4. Περίτιος Peritios 25 December–23 January (30 days)
5. Δύστρος Dystros 24 January–21 February (29 days)
6. Ξανδικός Xanthikos 22 February–23 March (30 days)
7. Ἀρτεμίσιος Artemisios 24 March–23 April (31 days)
8. Δαίσιος Daisios 24 April–23 May (30 days)
9. Πάνημος Panemos 24 May–23 June (31 days)
10. Λῷος Loos 24 June–24 July (31 days)
11. Γορπιαῖος Gorpiaios 25 July–23 August (30 days)
12. Ὑπερβερεταῖος Hyperberetaios 24 August–23 September (31 days)

Main source: [GINZ]

27 Assamese Calendar

See also *Hindu calendars*.

This Hindu lunisolar calendar was mainly used in Assam.

The names of the months:

1. Bahāg (~ mid-April–mid-May)
2. Jeṭh (~ mid-May–mid-June)
3. Āhār (~ mid-June–mid-July)
4. Sāon (~ mid-July–mid-August)
5. Bhād (~ mid-August–mid-September)
6. Ahin or Ashviin (~ mid-September–mid-October)
7. Kāti or Kongali (~ mid-October–mid-November)
8. Āghon or Agranayan (~ mid-November–mid-December)
9. Puh or Kume (~ mid-December–mid-January)
10. Māgh (~ mid-January–mid-February)
11. Phāgun (~ mid-February–mid-March)
12. Ca't or Chot (~ mid-March–mid-April)

The names of the weekdays:

1. ra'bi bār or deobār, = Sunday
2. som bār, = Monday
3. manal bār, = Tuesday
4. budh bār, = Wednesday
5. bṛhaspatibār, = Thursday
6. śukur bār, = Friday
7. śanibār, = Saturday

Main sources: [SEN] and [SHAR2]

28 (Ancient) Ashkelonian Calendar

This lunisolar calendar was used in Ashkelon, in present-day Israel.

The names of the months:

1. Ὑπερβερεταῖος Hyperberetaios, 28 October –26 November (30 days)
2. Δῖος Dios, 27 November–26 December (30 days)
3. Ἀπελλαῖος Apellaios, 27 December–25 January (30 days)
4. Αὐδυναῖος Audynaios, 26 January–24 February (30 days)
5. Περίτιος Peritios, 25 February–26 March (30 days)
6. Δύστρος Dystros, 27 March–25 April (30 days)
7. Ξανδικός Xanthikos, 26 April–25 May (30 days)

8. Ἀρτεμίσιος Artemisios, 26 May–24 June (30 days)
9. Δαίσιος Daisios, 25 June–24 July (30 days)
10. Πάνημος Panemos, 25 July–24 August (30 days)
11. Epagomenal days, 25 August–28 August (5 days)
12. Λῷος Loos, 29 August–27 September (30 days)
13. Γορπιαῖος Gorpiaios, 28 September–27 October (30 days)

Main source: [GINZ]

29 Assiniboine Calendar

This lunar calendar was used by the Assiniboine people in the Northern Great Plains of North America.

The names of the months:

1. wicogandu-sungagu (center Moon's younger brother), = ~ December
2. wicogandu (center Moon), = ~ January
3. amhanska (long dry Moon), = ~ February
4. wicinstayazan (sore eye Moon), = ~ March
5. tabehatawi (frog Moon), = ~ April
6. indiwiga (idle Moon), = ~ May
7. wahequosmewi (full leaf Moon), = ~ June
8. wasasa (red berries Moon), = ~ July
9. capasapsaba (black cherries Moon), = ~ August
10. wahequosmewi (yellow leaf Moon), = ~ September
11. anukope (joins both sides Moon), = ~ October
12. tasnaheja-hagikta (striped gopher looks back Moon), = ~ late-October
13. cuhotgawi (frost Moon), = ~ November

Main source: [GREE3]

30 (Ancient) Assyrian Calendar

This agricultural calendar was used from about 2200 BCE over an extensive area in ancient Near East by the Assyrians and the Hittites. The week had 5 days. There is no certain occurrence of any intercalary month.

The names of the months:

1. Qarrātu, = ~ January
2. Kalmartu, = ~ February
3. Kanunu, = ~ March
4. Kuzallu, = ~ April
5. Allanatu, = ~ May
6. Belat ekalli, = ~ June
7. Ša serrate, = ~ July
8. Ša kenate, = ~ August
9. Muḫur ilani, = ~ September
10. Abū šarrāni, = October
11. Ḫubur, = ~ November
12. Şippu, = ~ December

From about 1000 BCE, the Assyrians adopted the Babylonian calendar.

The names of the months in the Babylonian calendar:

1. mana, = ~ March/April
2. aiarum, = ~ April/May
3. makranum (the month of irrigation), = ~ May/June
4. dumuzi (the month of the goddess Dumuzi), = ~ June/July
5. abum, = ~ July/August
6. tirum, = ~ August/September
7. niqmum, = ~ September/October
8. kinunum (the month of the fire festival), = ~ October/November
9. thamkhirum, = ~ November/December
10. nabrium or dagan, = ~ December/January
11. mammitum, = ~ January/February
12. adarum, = ~ February/March

Main source: [COHE3]

31 Assyrian Calendar

This lunar-based calendar begins in the year 4750 BCE, inspired by an estimate of the date of the first temple of Aššur. The calendar is official in Lebanon, Iraq, Jordan, Palestine, and Syria.

The names of the months:

1. ܢܝܣܢ Nisan-Nison (month of happiness), = ~ March/April (31 days)
2. ܐܝܪ Yaar-Iyar (month of love), = ~ April/May (31 days)
3. ܚܙܝܪܢ Khzeeran-Hzirin (month of building), = ~ May/June (31 days)
4. ܬܡܘܙ Tammuz-Tamuz (month of harvesting), = ~ June/July (31 days)
5. ܛܒܚ /ܐܒ Tdabbakh (Ab)-Tibbax (Ob) (month of ripening of fruit), = ~ July/August (31 days)
6. ܐܝܠܘܠ Elool-Ilul (month of sprinkling of seeds), = ~ August/September (30 days)
7. ܐ ܬܫܪܝܢ Tishrin I (month of giving), = ~ September/October (30 days)
8. ܒ ܬܫܪܝܢ Tishrin II (month of awakening of buried seeds), = ~ October/November (30 days)
9. ܐ ܟܢܘܢ Kanoon I (month of conceiving), = ~ November/December (30 days)
10. ܒ ܟܢܘܢ Kanoon II (month of resting), = ~ December/January (30 days)
11. ܫܒܛ Shwat (Sebat)-Ishwit (month of flooding), = ~ January/February (30 days)
12. ܐܕܪ Adaar – Odar (month of evil spirits), = ~ February/March (29 days)

Main sources: [BEND4] and [COHE3]

32 Athna Calendar

This calendar was used by the Athna tribes in Alaska.

The names of the months:

1. ‘alts’eni n’a’aaye’ = January
2. gistaani na’aaye’ = February
3. konts’aghi na’aaye’ = March
4. hwdlii na’aaye’ = April
5. c’eggaay na’aaye’ = May
6. c’eggaay na’aaye’ = June
7. cots’ na’aaye’ = July
8. unen naxay’nelyaexi = August
9. hwtsiic na’aaye’ = August-September
10. benghaan’ saeni = October
11. debae saa = November
12. ts’its’aange saa = December

Other measures:

xay = year
na’aay = month
konts’aghi yuuł = week
dzaen = day

Main sources: [KARI]

33 Atikamekw Calendar

This lunisolar calendar is used among the indigenous inhabitants in the upper Saint-Maurice River Valley of Quebec, Canada. The year is divided into six seasons and 12 months.

The names of the seasons:

1. Sîkon, = pre-Spring
2. Mirôskamin, = Spring
3. Nîpin, = Summer
4. Takwâkin, = Autumn
5. Pîtcipipôn, = pre-Winter
6. Pipôn, = Winter

The names of the months:

1. Kenôsitc Pisimw (Longest Winter Moon), = ~ January
2. Akokatcic Pisimw (Groundhog Emerges Moon), = ~ February
3. Nikikw Pisimw (Otter Moon), = ~ March
4. Kâ Wâsikatotc Pisimw (Reflects on the Ice Moon), = ~ April
5. Wâpikon Pisimw (Flower Moon), = ~ May
6. Otehimin Pisimw (Strawberry Moon), = ~ June

7. Mikomin Pisimw (Raspberry Moon), = ~ July
8. Otâtokon Pisimw (Bird Fledges Moon), = ~ August
9. Kâkône Pisimw (Porcupine Mates Moon), = ~ September
10. Namekosi Pisimw (Trout Spawns Moon), = ~ October
11. Atikamekw Pisimw (Whitefish Spawns Moon), = ~ November
12. Pîtcipipôn Pisimw (Winter Arives Moon), = ~ December

Internet source: luonnonkansat.livejournal.com

34 (Ancient) Attic Calendar

This lunisolar calendar was used locally in ancient Attica during the fifth and fourth centuries BCE. The year, also called the festival year, began at sunset with the first visible crescent moon following the summer solstice, usually at the end of June.

Θέρος (Summer):

1. Ἑκατομβαιών, Hekatombaion (the Month when it is time to sacrifice the hecatombs), ~ 15/20 June–15/20 July
2. Μεταγειτνιών, Metageitnion (the Month when people flit and change neighbours), ~ 15/20 July–15/20 August
3. Βοηδρομιών, Boedromion (the Month in memory of the conquest of the Amazons by Theuses), ~ 15/20 August–15/20 September

Φθινόπωρον (Autumn):

4. Πυανεψιών, Pyanepsion (the Month when beans are eaten from a dish), ~ 15/20 September–15/20 October
5. Μαιμακτηριών, Maimakterion (the Month of Zeus Maimactes), ~ 15/20 October–15/20 November
6. Ποσειδεών, Poseideon (the Month of Poseidon), ~ 15/20 November–15/20 December

Χεῖμα (Winter):

7. Γαμηλιών, Gamelion (the Month of weddings), ~ 15/20 December–15/20 January
8. Ἀνθεστηριών, Anthestrion (the Month of flowers), ~ 15/20 January–15/20 February
9. Ἐλαφηβολιών, Elaphebolion (the Month of deer hunting), ~ 15/20 February–15/20 March

Ἔαρ (Spring):

10. Μουνιχιών, Mounichion (Month of the Munychian Artemis festival), ~ 15/20 March–15/20 April
11. Θαργηλιών, Thargelion (Month of the festivals for Apollo and Artemis), ~ 15/20 April–15/20 May
12. Σκιροφοριών, Skirophorion (Month of the Parasol bearers festival of Athena), ~ 15/20 May–15/20 June

The year consisted of 354 days and began with the first sighting of the new moon after the summer solstice (= when the rising and setting point of the sun on the horizon appear to remain in the same place for a few days). Every third year, an extra month had to be inserted, leading to a leap year of 384 days. This extra month was achieved by using the same month name twice in a row. The months 1, 2, 6, 7 and 8 were all attested as being repeated during leap years. The first day of a month was named *noumenia* (new moon) and the last day *hena kai nea* (old and new).

In addition to this festival calendar, Athenians maintained a calendar for the political year. This “conciliar” year, basically the same length as the festival year, was subdivided into “prytanies,” one for each of the “phylai” (clans). Even more confusing, the number of phylai, and hence the number of prytanies, varied over time. Until 307 BCE, there were ten phylai, but after that, the number varied between 11 and 13. Thus, ancient documents dated by prytany are difficult to assign to a specific equivalent in the Julian calendar.

Main sources: [HANN3], and [PRIT2]

35 (Ancient) Avestan Calendar

This calendar was used in ancient Persia, from *c.* 300 BCE–800 CE. It consisted of 12 months, each containing 30 days. At the end of the year, the five Gātha days were added. These were called Ahunavaiti, Uštavaiti, Spənta Mainyu, Vohu Xšaəra, and Vahištoišti.

The names of the months:

1. Frauuašinąm, ~ March-April
2. Ašahe Vahištahe, ~ April-May
3. Haurvatātō, ~ May-June
4. Tištryehe, ~ June-July
5. Amərətātō, ~ July-August
6. Xšaθrahe Vairyehe, ~ August-September
7. Miθrahe, ~ September-October
8. Apąm, ~ October-November
9. Āθrō, ~ November-December
10. Daθušō, ~ December-January
11. Vaŋhəuš Manaŋhō, ~ January-February
12. Spəntayå Ārmatōiš, ~ February-March

The year was also divided into four seasons of 3 months each:

1. vahār (= spring; Frauuašinąm to Haurvatātō)
2. hāmín (= summer; Tištryehe to Xšaθrahe Vairyehe)
3. pātīs (= autumn; Miθrahe to Āθrō)
4. zamistān (= winter; Daθušō to Spəntayå Ārmatōiš)

Main sources: [DARM, pp. 33–41], [HARL], [HART2], [HAUG, p. 87], [ROTH3], [YARS], and [WEST3]

36 Aymaran Calendar

This calendar was used by the Aymaran people in Bolivia.

The names of the months:

1. kamay phajsi, = ~ January
2. kajmay phajsi, = ~ February
3. marka qhulliwi, = ~ March
4. jupha llamayu, = ~ April
5. amqa llamayu, = ~ May
6. jacha auti, = ~ June
7. jacha chimu, = ~ July
8. jiska chimu, = ~ August
9. kasu laphaqa, = ~ September
10. satawi laphaqa, = ~ October
11. waña pacha, = ~ November
12. uma pacha, = ~ December

The names of the seasons:

1. juyphipacha, = winter
2. lapaki, = spring
3. junt'upacha, = summer
4. caratacu, = autumn

Internet source: tierra-inca.com

37 (Ancient) Aztec Calendars

See also *Tonalpohualli calendar* and *Xiuhpohualli calendar*.

The ancient Aztec culture used two calendars, a sacred 260-day calendar (Tonalpohualli) and a 365-day calendar (Xiuhpohualli).

38 Babwende Calendar

This calendar was used by the Babwende in Congo.

The names of the seasons:

1. utombo (rain season), = ~ late September–January
2. kianza (lesser dry season), = ~ January–February
3. ndolo (later rain season), = ~ March–May
4. sivu (dry season), = ~ June–mid-August
5. mbangala (when the grass withers), = ~ mid-August–September

Main source: [NILS]

39 (Ancient) Babylonian Calendar

This lunisolar calendar was used in the ancient Near East and Middle East. Around about 2700 BCE, the year was divided into 12 months, each beginning at the New Moon. The year started in May when the barley was harvested. In about 1800 BCE, the Babylonians and Assyrians adopted the calendar of the sacred Sumerian city of Nippur. The months alternated between 29 and 30 days, making a year equal to 354 days.

After 19 years, the cycles of the moon and the sun re-align, and so an intercalary month was added once each 3–4 years to bring the calendar back in line with the seasons. It would still be out by 1 day every 342 years (18 cycles), but it is not certain whether this correction was applied. The intercalations were performed irregularly after notices were sent in the king's name to the priestly officials at temples throughout Babylonia. During the Persian period, the announcements of intercalations came from the scribes at the temple Esangila, who forwarded it to the officials at other temples. Eventually, regulation of the calendar passed into the hands of the bureaucracy.

In the years 3, 6, 8, 11, 14, and 19 of the 19-year cycle, an extra Adaru (12b in the table below) month was intercalated, and in the 17th year of each cycle, an extra Ulūlu (6b in the table below) was probably intercalated.

The names of the months and seasons[1]:

Season: Reš Šatti

1. Nisânu [ ] (the month of sowing), = ~ March/April (30 days)
2. Ayaru or Âru [ ] (the month of flowering), = ~ April/May (29 days)
3. Simanu [ ] (the month of maturity), = ~ May/June (30 days)
4. Du'uzu [ ] (the month of the feast of Dumuzi), = ~ June/July (29 days)

Season: Mišil Šatti

5. Abu [ ] (the month of the feast of the ancestors), = ~ July/August (30 days)
6. Ulûlu I [ ] (the month of purification), = ~ August/September (29 days)
   6b. Ulûlu II [ ] (29 days)
7. Tiš-ri-tu [ ] (the opening month), = ~ September/October (30 days)
8. Arakhsamna [ ] (the eighth month), = ~ October/November (29 days)

Season: Kīt Šatti

9. Kislimu [ ], = ~ November/December (30 days)
10. Ḍabitu or Ṭebêtu [ ] (the month of flooding), = ~ December/January (29 days)
11. Šabaṭu [ ], = ~ January/February (30 days)
12. Adâru I [ ] (the month of the darkening of the stars), = ~ February/March (29 days)
    12b. Adâru II [ ] (30 days)

Main sources: [PARK5] and [YARS]

[1] Symbols according to: www.friesian.com

40 Badí Calendar

See *Bahá'í Calendar*.

41 Bahá'í Calendar

Also called **Badí Calendar** or **Bahá'í Era**.

(Abbreviated **BE** or **B.E.**)

This calendar started on March 21, 1844, according to the Gregorian calendar, for a worldwide religion, the Bahá'í Faith, based on the teachings of Baha'u'llah (1817–1892). He stated that the time had come for the people of the world to put aside their differences and to unite on the basis of the teachings that he had brought. This is the date on which the Bab in the Kitáb-i-Asmá, the Bahai prophet, started his ministry. The Bahai year starts on March 21, and contains 365 or 366 days, just like the Gregorian calendar. Leap years are handled in just the same way. The year consists of 19 months of 19 days each.

Month 18 is then followed by 4 or 5 intercalary days, called Ayyám-i-Há, which are devoted to spiritual preparation for the fast, hospitality, feasting, charity and gift giving. Each cycle of 19 years is called a Váhid. 19 such cycles constitute a period called Kull-i-Shay.

The names of the years in each cycle are:

Alif—The Letter "A", Bá—The letter "B", Ab—Father, Dál—The letter "D", Báb—Gate, Váv—The letter "V",
Abad—Eternity, Jád—Generosity, Bahá—Splendour, Hubb—Love, Bahháj—Delightful, Javáb—Answer,
Ahad—Single, Vahháb—Bountiful, Vidád—Affection, Badí—Beginning, Bahí—Luminous, Abhá—Most Luminous, and
Váhid—Unity.

The names of the months:

1. بهاء Bahá, 21 March–8 April
2. جلال Jalál, 9 April–27 April
3. جمال Jamál, 28 April–16 May
4. عظمة 'Aẓamat, 17 May–4 June
5. نور Núr, 5 June–23 June
6. رحمة Rahmat, 24 June–12 July
7. كلمات Kalimát, 13 July–31 July
8. كمال Kamál, 1 August–19 August
9. اسماء Asmá', 20 August–7 September
10. عزة 'Izzat, 8 September–26 September
11. مشية Mashíyyat, 27 September–15 October
12. علم 'Ilm, 16 October–3 November
13. قدرة Qudrat, 4 November–22 November
14. قول Qawl, 23 November–11 December
15. مسائل Masá'il, 12 December–30 December
16. شرف Sharaf, 31 December–18 January
17. سلطان Sulṭán, 19 Janaury–6 February
18. ملك Mulk, 7 February–25 February
    ايام الهاء Ayyám-i-Há, (intercalary days), 26 February–1 March
19. علاء 'Alá, 2 March–20 March

The names of the weekdays:

1. جلال Jalál, = Saturday
2. جمال Jamál, = Sunday
3. كمال Kamál, = Monday
4. فضال Fidál, = Tuesday
5. عدال 'Idál, = Wednesday
6. استجلال Istijlál, = Thursday
7. استقلال Istiqlál, = Friday

Main source: [ESSL] and *Internet source*: www.bahai.us

42 Bakongo Calendar

This seasonal calendar was used by the Bakongo people in the Kingdom of Kongo until 1857.

The names of the seasons and sub-seasons:

1. sivu (cold season), = ~ mid-May–July
2. mbangala (dry season), = ~ July–mid-October
   2a. mpiaza (the grass-burning season), = ~ second half of July–September
3. masanza (early light rains), = ~ October–December
4. nkianza (short dry season), = ~ January–early February
5. kundi usafi (fruit season), = ~ late February–May
   5a. kintombo (heavy rains), = ~ March–April
   5b. nkiela (when the rains cease), = ~ early May–late May

The names of the days of the 4-day week:

1. Konzo
2. Nkenge
3. Nsona (sacred day)
4. Nkandu

Main sources: [MACG3] and [NILS]

43 (Ancient) Baltic Calendar

This calendar was used among Baltic people in ancient times. Calendars have been found on burial urns dated *c*. 600–200 BCE. Archaeological evidence suggests a sidereal month divided into three 9-day weeks.

Internet source: www.lithuanian.net/mitai

44 Bangabda

See *Bengali calendar*.

45 Baronga Calendar

This seasonal calendar was used by inhabitants of the Baronga Islands.

The names of the seasons:

1. nhlangula (when the flowers are swept from the trees), = ~ October
2. nwendjamhala (when the antelope *mhala* brings forth its young), = ~ November
3. mawuwana (when the *tihuhlu* are plucked), = ~ December
4. hukuri (when the fruits of the *nkwakwa* are ripe),= ~ January
5. ndjati (when everyone is eating the new cobs of mealies) or sibandlela (when the grass hides the path), = ~ February
6. nywenywankulu (the season of the birds *nyenyana*), = ~ March/April
7. mudashini (harvest season), = ~ May/June
8. khotubushika (winter season), = ~ July–September

Main source: [NILS]

46 (Old) Basque Calendar

This lunar and agricultural calendar was used in Basque Country. The Basque language is one of the oldest in Europe, and has evolved slowly since the days of the first inhabitants of the country. At any rate, there have been many local names in use, and the listing below is just an example of names that might have been in common use.

The names of the months:

1. urrila (the wet month), = ~ October
2. hazila (the month of sowing), = ~ November
3. bellzila (the dark months), = ~ December/January
4. olzaila (the cold month), = ~ February
5. ephaila (the month for grafting), = ~ March
6. yorraila (the month of weeding), = ~ April
7. ostoila or orrilla (the month of leaves), = ~ early May
8. lorailla (the month of flowers), = ~ late May/early June
9. ekhaila (the month of the sun), = ~ late June/early July
10. uztaila (the month of harvesting), = ~ late July
11. agorrila (the month of drought), = ~ August
12. buruila (the last month), = ~ September
13. iraila (the transitional month), = month added every third year to align the calendar with the solar year

It is also assumed that the Basques had six seasons:

1. urriaro, = the water season
2. azaro, = the planting season
3. otzaro, = the cold season
4. ostaro, = the season of leaves
5. errearo, = the dry season
6. uztaro, = the crop season

Main source: [VINS]

47 (Ancient) Batak Calendar

This lunisolar calendar was used among the ethnic groups, such as the Angkola, Karo, Mandailing, Simalungun and Toba, in North Sumatra.

The names of the months:

1. Sipahasada, = ~ April (30 days)
2. Sipahadua, = ~ May (30 days)
3. Sipahatolu, = ~ June (30 days)
4. Sipahaopat, = ~ July (30 days)
5. Sipahalima, = ~ August (30 days)
6. Sipahaonom, = ~ September (30 days)
7. Sipahapita, = ~ October (30 days)
8. Sipahawalu, = ~ November (30 days)
9. Sipahasia, = ~ December (30 days)

10. Sipahasampulu, = ~ January (30 days)
11. Li, = ~ February (30 days)
12. Hurung, = ~ March (30 days)

One intercalary month (Lobi-lobi) was added once every 5 or 6 years.

Within each month, each day had a certain name:

1. Artya, 2. Suma, 3. Anggara, 4. Muda, 5. Boraspati, 6. Singkora, 7. Samisara, 8. Antian Ni Aek, 9. Suma Ni Mangadop, 10. Anggara Sampulu, 11. Muda Ni Mangadop, 12. Boraspati Ni Tangkup, 13. Singkora Purnama, 14. Samisara Purasa, 15. Tula, 16. Suma Ni Holom, 17. Anggara Ni Holom, 18. Muda Ni Holom, 19. Boraspati Ni Holom, 20. Singkora Mora Turun, 21. Samisara Moraturun, 22. Antian Ni Angga, 23. Suma Ni Mate, 24. Anggara Na Begu, 25. Muda Ni Mate, 26. Boraspati Na Gok, 27. Singkora Duduk, 28. Samisara Bulan Mate, 29. Hurung, 30. Ringkar.

Even each hour had a specific name:

1. guling = 1 p.m.
2. guling dao = 2 p.m.
3. tolu gala = 3 p.m.
4. dua gala = 4 p.m.
5. andos potang = 5 p.m.
6. bot, bonom mataniari = 6 p.m.
7. samon = 7 p.m.
8. haitha manga = 8 p.m.
9. tungkap hudon = 9 p.m.
10. sampe modom = 10 p.m.
11. sampe sinok modom = 11 p.m.
12. tonga borngin = 12 p.m.
13. haroro ni panangko = 1 a.m.
14. martahuak mirik = 2 a.m.
15. martahuak manuk pasadaon = 3 a.m.
16. bola-bola ijuk = 4 a.m.
17. torang ari = 5 a.m.
18. bincar mataniari = 6 a.m.
19. manyogot = 7 a.m.
20. tarbakta = 8 a.m.
21. tarbakta raja = 9 a.m.
22. sagang, paagakkon mangan = 10 a.m.
23. humara hos = 11 a.m.
24. hos = 12 a.m.

Main sources: [ARIT], [GINZ], [HARA], and [PELA]

48 Bengali Calendar

This has also been called the **Bangabda**.

This Hindu lunisolar calendar was used in eastern India and Bangladesh. The calendar was mainly introduced during the reign of King Shashanka (*r.* 600–625) in Bengal. The year begins on Pôhela Baishakh (or Poela Boishakh), which falls on April 15 in India (which uses the old calendar) and April 14 in Bangladesh.

The Bengali era was probably initiated by King Shashanka (r. 590–625) of the Gauda Kingdom, and started on April 14, 594. During the reign of the Mughals, the calendar became officially implemented throughout the empire, but was abandoned, apart from in Bengal, with the end of the Mughal rule.

The Bengali tropical solar calendar used in present-day Bangladesh was modified by a committee headed by the Bengali educationist Dr. Muhammad Shahidullah (1885–1969) under the auspices of the Bangla Academy on February 17, 1966.

In short, the recommendations of the Academy were: (1) The first 5 months will consist of 31 days each, (2) The last 7 months will consist of 30 days each, (3) An additional day will be added in the month of Falgun every leap year of the Gregorian calendar. This revised calendar was adopted in 1987.

In West Bengal, India, the old non-reformed calendar, which is not fixed with respect to the Gregorian calendar, is still in use. This is a sidereal solar calendar, in which the length of the months are not fixed, but rather based on the true movement of the Sun.

The day begins and ends at sunrise, unlike in the Gregorian calendar, in which the day starts and ends at midnight.

The calendar consisted of six seasons:

1. গ্রীষ্ম Grishmô, = summer
2. বর্ষা Bôrsha, = monsoon
3. শরৎ Shôrôt, = autumn
4. হেমন্ত Hemôntô, = dry season
5. শীত Šhit, = winter
6. বসন্ত Bôsôntô, = spring

The names of the months were derived from the Surya Siddhanta:

1. বৈশাখ Bôishakh (Traditional Hindu calendar: 30 or 31 days; In Bangladesh: 31 days)
2. জ্যৈষ্ঠ Jyôishţhô (Traditional Hindu calendar: 31 or 32 days; In Bangladesh: 31 days)
3. আষাঢ় Ashaŗhô (Traditional Hindu calendar: 31 or 32 days; In Bangladesh: 31 days)
4. শ্রাবণ Shrabôn (Traditional Hindu calendar: 31 or 32 days; In Bangladesh: 31 days)
5. ভাদ্র Bhadrô (Traditional Hindu calendar: 31 or 32 days; In Bangladesh: 31 days)
6. আশ্বিন Ashbin (Traditional Hindu calendar: 30 or 31 days; In Bangladesh: 30 days)
7. কার্তিক Kartik (Traditional Hindu calendar: 29 or 30 days; In Bangladesh: 30 days)
8. অগ্রহায়ণ Ogrôhayôn (Traditional Hindu calendar: 29 or 30 days; In Bangladesh: 30 days)
9. পৌষ Poish (Traditional Hindu calendar: 29 or 30 days; In Bangladesh: 30 days)
10. মাঘ Magh (Traditional Hindu calendar: 29 or 30 days; In Bangladesh: 30 days)
11. ফাল্গুন Falgun (Traditional Hindu calendar: 29 or 30 days; In Bangladesh: 30 days, but 31 in leap years)
12. চৈত্র Chôitrô (Traditional Hindu calendar: 30 or 31 days; In Bangladesh: 30 days)

The names of the weekdays:

1. রবিবার Rôbibar, = Sunday
2. সোমবার Shombar, = Monday
3. মঙ্গলবার Mônggôlbar, = Tuesday
4. বুধবার Budhbar, = Wednesday
5. বৃহস্পতিবার Brihôshpôtibar, = Thursday
6. শুক্রবার Shukrôbar, = Friday
7. শনিবার Shônibar, = Saturday

Main source: [NICH2, chap. 1]

49 Berber Calendar

This calendar is used by the Berber people in North Africa, for agricultural purposes. It is composed of four seasons, with 3 months for each season.

Alternative names of months in various regions:

Seasons	Berber	Algeria	Djerba	Morocco	Tunisia	in Gregorian calendar
Tagrest (winter)						
1.	ⴷⵓⵊⴰⵏⴱⵉⵔ	bu-jember	dujámber	dujanbir	dejember	17 December–13 January
2.	ⵉⵏⵏⴰⵢⵔ	yennayer	yenni	innayr	yennayer	14 January–13 February
3.	ⴱⵕⴰⵢⵕ	furar	furár	xubrayr	furar	14 February–13 March
Tafsut (spring)						
1.	ⵎⴰⵕⵚ	meghres	mars	maris	mars	14 March–13 April
2.	ⵉⴱⵔⵉⵔ	ibrir	ibrír	ivril	abril	14 April–13 May
3.	ⵎⴰⵢⵢⵓ	maggu	mayu	mayyuh	mayu	14 May–13 June
Iwilen (summer)						
1.	ⵢⵓⵏⵢⵓ	yunyu	yunyu	yunih	yunyu	14 June–13 July
2.	ⵢⵓⵍⵢⵓⵣ	yulyu	yulyu	yuliuz	yulyu	14 July–13 August
3.	ⵖⵓⵛⵜ	awussu	ghusht	ghusht	aghusht	14 August–13 September
Amewan (autumn)						
1.	ⵛⵓⵜⴰⵏⴱⵉⵔ	shtember	shtámber	shutanhir	shtamber	14 September–13 October
2.	ⴽⵜⵓⴱⵔ	tuber	ktúber	kṭuber	uktuber	14 October–13 November
3.	ⵏⵓⵡⴰⵏⴱⵉⵔ	wamber or nunember	number	duwanbir	nufember	14 November–13 December

Alternative names of months in various Berber languages:

Seasons	Kabyle	Tamazight	Tachelhit	Tuareg	in Gregorian calendar
Tagrest (winter)					
1.	djember	dujambir	dujanbir	dejamber	17 December–13 January
2.	yannayer	innayer	innayr	innar	14 January–13 February
3.	furar	khubrayer	xubayr	forar	14 February–13 March
Tafsut (spring)					
1.	meghres	mars	mars	mars	14 March–13 April
2.	yebrir	ibrir	ibrir	ibri	14 April–13 May
3.	mayyu	mayyu	mayyuh	mayo	14 May–13 June
Iwilen (summer)					
1.	yunyu	yunyu	yunyu	yunioh	14 June–13 July
2.	yulyuz	yulyuz	yulyuz	yulyez	14 July–13 August
3.	ghucht	ghucht	ghusht	ghuchet	14 August–13 September
Amewan (autumn)					
1.	chtember	chutanbir	shutambir	chetember	14 September–13 October
2.	tuber	kjuber	ktuber	tuber	14 October–13 November
3.	nwamber	ennwamber	nuwambir	wanber	14 November–13 December

In 1968, the Paris-based Académie berbère introduced a calendar era for the Berber calendar, fixed to the accession year of the Egyptian Pharaoh Shoshenq I, who they identified as the first prominent Berber. The Académie berbère set the year zero at 950 BCE.

The old names for the weekdays:

1. ⴰⵙⴰⵎⴰⵙ (Asamas), = Sunday
2. ⴰⵢⵏⴰⵙ (Aynas), = Monday
3. ⴰⵙⵉⵏⴰⵙ (Asinas), = Tuesday
4. ⴰⴽⵔⴰⵙ (Akras), = Wednesday
5. ⴰⴽⵡⴰⵙ (Akwas), = Thursday
6. ⴰⵙⵉⵎⵡⴰⵙ (Asimwas), = Friday
7. ⴰⵙⵉⴹⵢⴰⵙ (Asidyas), = Saturday

The Académie berbère also set names for the weekdays:

1. aram, = Monday
2. arim, = Tuesday
3. ahad, = Wednesday
4. amhad, = Thursday
5. sem, = Friday
6. sed, = Saturday
7. acer, = Sunday

Main source: [HADD]

50 Bikram Sambat

See *Bikram Samwat*.

51 Bikram Samwat

This is also called the **Bikram Sambat**. See also *Hindu calendars*.

(Abbreviated as **B.S.** or **BS**)

This Hindu calendar is used in Nepal. It is 56.7 years ahead (in count) of the Gregorian calendar. It was established by the Indian emperor Vikramaditya of Ujjain during the first century BC.

The year begins with the Baishakh-month, usually around April 14. Months may not have the same number of days every year.

The names of the months:

1. बैशाख (Baishākh), = ~ mid-April to mid-May (30/31 days)
2. जेठ or ज्येष्ठ (Jeṭha), = ~ mid-May to mid-June (31/32 days)
3. असर or आशाढ (Asār), = ~ mid-June to mid-July (31/32 days)
4. सउन (Sāun) or श्रावण (Shrawan), = ~ mid-July to mid-August (31/32 days)

5. भद (Bhadau), = ~ mid-August to mid-September (31/32 days)
6. असज or आश्विन (Asoj), = ~ mid-September to mid-October (30/31 days)
7. कार्तिक or कार्तिक (Kārtik), = ~ mid-October to mid-November (29/30 days)
8. मसर or मार्ग (Mangsir), = ~ mid-November to mid-December (29/30 days)
9. पौष or पुष (Poush), = ~ mid-December to mid-January (29/30 days)
10. मघ (Magh), = ~ mid-January to mid-February (29/30 days)
11. फागुन or फाल्गुण (Phāgun), = ~ mid-February to mid-March (29/30 days)
12. चैत or चैत्र (Chaitra), = ~ mid-March to mid-April (30/31 days)

Main source: [LLC]

52 (Ancient) Bithynian Calendar

This lunisolar calendar was used in the Bithynian kingdom during the third century.

The names of the months:

1. Ἡραῖος Heraeios, 23 September–23 October (31 days)
2. Ἕρμαιος Hermaeius, 24 October–22 November (30 days)
3. Μητρῷος Metrous, 23 November–23 December (31 days)
4. Διονύσιος Dionysios, 24 December–23 January (31 days)
5. Ἡράκλειος Herakleios, 24 January–20 February (28 days)
6. Δῖος Dios, 21 February–23 March (31 days)
7. Βενδιδαῖος Bendidaios, 24 March–22 April (30 days)
8. Στράτειος Strateios, 23 April–23 May (31 days)
9. Περιέπιος Periepios, 24 May–22 June (30 days)
10. Ἄρειος Areios, 23 June–23 July (31 days)
11. Ἀφροδίσιος Aphrodisios, 24 July–22 August (30 days)
12. Δημήτριος Demetrios, 23 August–22 September (31 days)

Main sources: [GINZ] and [SMIT3]

53 (Ancient) Boeotian Calendar

This lunisolar calendar was used in ancient Boeotia.

The names of the months:

1. Βουκάτιος (Boukatios), ~ late (about 23) September–late October
2. Ἑρμαίος (Hermaios), = ~ late October–late November
3. Προστατήριος (Prostaterios), = ~ late November–late December
4. Ἀγριώνιος (Agrionios), = ~ late December–late January
5. Θιούϊος (Thioyios), = ~ late January–late February
6. Ομολώϊος (Homoloios), = ~ late February–late March
7. Θειλούθιος (Theilouthios), = ~ late March–late April
8. Ἱπποδρόμιος (Hippodromios), = ~ late April–late May
9. Πάναμος (Panamos), = ~ late May–late June
10. Παμβοιώτιος (Pamboiotios), = ~ late June–late July
11. Δαμάτριος (Damatrios), = ~ late July–late August
12. Ἀλαλκομένιος (Alalkomenios), = ~ late August–late September

Five epagomenal days

Main source: [GINZ]

54 (Ancient) Borana Calendar

See (Ancient) *Oromo calendar*.

55 (Ancient) Bostran Calendar

This lunisolar calendar was used in Bostra (now part of Syria).

The names of the months:

1. Ξανδικός Xanthikos, 22 March–20 April (30 days)
2. Ἀρτεμίσιος Artemisios, 21 April–20 May (30 days)
3. Δαίσιος Daisios, 21 May–19 June (30 days)
4. Πάνημος Panemos, 20 June–19 July (30 days)
5. Λῷος Loos, 20 July–18 August (30 days)
6. Γορπιαῖος Gorpiaios, 19 August–17 September (30 days)
7. Ὑπερβερεταῖος Hyperberetaios, 18 September–17 October (30 days)
8. Δῖος Dios, 18 October–16 November (30 days)
9. Ἀπελλαῖος Apellaios, 17 November–16 December (30 days)
10. Αὐδυναῖος Audynaios, 17 December–15 January (30 days)
11. Περίτιος Peritos, 16 January–14 February (30 days)
12. Δύστρος Dystros, 15 February–16 March (30 days)

Epagomenal days, 17 March–21 March (5 days)

Main source: [GINZ]

56 Buddhist Calendars

See also *Burmese calendar* and (Old) *Sinhala calendar*.

These lunatic calendars were used for many centuries in various parts of Southeast Asia, and were largely based on older versions of the Hindu calendar. They had minor variations, such as month names and numbering, intercalation schedules and use of cycles.

To synchronize the calendar with the solar year, 11 intercalary days were added every 57 years, and seven extra months of 30 days were inserted during every 19-year cycle.

The names and order of the months in the Lan Xang and Sukhothai systems:

	Kingdom of Lan Xang	Sukhothai Kingdom	Gregorian months	Number of days
1	Māgasira	เดือนอ้าย	~ November–December	29
2	Phussa	เดือนยี่	~ December–January	30
3	Māgha	เดือน ๓	~ January–February	29
4	Phagguṇa	เดือน ๔	~ February–March	30
5	Citta	เดือน ๕	~ March–April	29
6	Visakha	เดือน ๖	~ April–May	30
7	Jeṭṭha	เดือน ๗	~ May–June	29
8	Āsāḷha	เดือน ๘	~ June–July	30
9	Sāvaṇa	เดือน ๙	~ July–August	29
10	Poṭṭhapāda	เดือน ๑๐	~ August–September	30
11	Assayuja	เดือน ๑๑	~ September–October	29
12	Kattikā	เดือน ๑๒	~ October–November	30

The names of the months in Kentung:

	Kengtung	Gregorian months	Number of days
1	တန်ဆောင်မုန်း (Tarzaungmon)	~ October–November	30
2	နတ်တော် (Natdaw)	~ November–December	29
3	ပြာသို (Pyatho)	~ December–January	30
4	တပို့တွဲ (Tabodwe)	~ January–February	29
5	တပေါင်း (Tabaung)	~ February–March	30

(continued)

	Kengtung	Gregorian months	Number of days
6	တန်ခူး (Tagu)	~ March–April	29
7	ကဆုန် (Kason)	~ April–May	30
8	နယုန် (Nayon)	~ May–June	29
9	ဝါဆို (Waso)	~ June–July	30
10	ဝါခေါင် (Wagaung)	~ July–August	29
11	တော်သလင်း (Tawthalin)	~ August–September	30
12	သီတင်းကျွတ် (Thadingyut)	~ September–October	29

The names of the months in some other regions:

	Pali	Khmer	Chiang Mai	Gregorian months	Number of days
1	Citta	ចេត្រ	เดือน ๕	~ March–April	29
2	Visakha	ពិសាខ	เดือน ๖	~ April–May	30
3	Jeṭṭha	ជេស្ឋ	เดือน ๗	~ May–June	29
4	Āsāḷha	អាសាឍ	เดือน ๘	~ June–July	30
5	Sāvaṇa	ស្រាពណ៍	เดือน ๙	~ July–August	29
6	Poṭṭhapāda	ភទ្របទ	เดือน ๑๐	~ August–September	30
7	Assayuja	អស្សុជ	เดือน ๑๑	~ September–October	29
8	Kattikā	កត្តិក	เดือน ๑๒	~ October–November	30
9	Māgasira	មិគសិរ	เดือนอ้าย	~ November–December	29
10	Phussa	បុស្ស	เดือนยี่	~ December–January	30
11	Māgha	មាឃ	เดือน ๓	~ January–February	29
12	Phagguṇa	ផល្គុន	เดือน ๔	~ February–March	30

Main source: [EADE]

57 (Ancient) Bulgar Calendar

This 12-year cyclic solar calendar is a hypothetical calendar probably used by the Bulgars, who flourished in the Pontic Steppe and around the banks of Volga from at least the sixth century onwards.

The only ancient source used for the reconstruction of the calendar is a fifteenth century transcription in the Russian language of a fragmentary inscription of Khan Omurtag Juvigi (r. 814–831). A reconstructed cyclic calendar was originally proposed by Finnish Slavist Jooseppi Julius Mikkola in 1913. Various modifications were later proposed by scholars during the twentieth century. The era of the calendar began, according to Professor Vassil Zlatarski (1866–1935), in 5505 BCE.

The year started when the day was the shortest during winter solstice, around December 21. This was a single calendar unit, not part of any of the months. It was called Eni-Alem or Ednajden (= "one day").

The other 364 days of the non-leap year were spread over four seasons of 91 days each. Each season started on the exact same day every year, with the first month of each season having 31 days, and the rest 30.

Each fourth year was a leap year that included an extra day, called Eni-Dzhitem, after the sixth month. The calendar had two parts, one for 12 years and another for 1 year. The 12-year cycle was connected to the orbit of Jupiter around the Sun (about 11.86 years) and each year had a distinctive animal name, similar to the Chinese and Mongolian calendars. The one for the 1 year had 12 months, all of them making a year of 360 days, and five unholy days which were not written together with the holy ones.

The names of the years in the 12-year cycle:

1. Karan, Shashi, Somor, or Sursu (= mouse)
2. Buza, Kuvrat, Shegor, or Volyach (= ox)
3. Bars, Baras, or Paras (= tiger)
4. Dvansh (= rabbit)
5. Ver, Dragun, Kala, Lamya, or Slav (= dragon)
6. Dilom, Delian, or Attila (= snake)
7. Alasha, Tag, Tek, or Tih (= horse)
8. Maimun, Shebek, Pesin, or Pisin (= monkey)
9. Saver, Sever, Surah, or Rassate (= ram)
10. Tah or Toh (= rooster)
11. Eth, Iht, Kuche, or Mugel (= dog)
12. Dok, Doks, or Prase (= pig)

The names of the seasons:

1. зима (zima), = winter
2. пролет (prolet), = spring
3. лято (ljato), = summer
4. есен (esen), = autumn

The names of the weekdays:

1. понеделник (ponedelnik), = Monday
2. вторник (vtornik), = Tuesday
3. сряда (srjada), = Wednesday
4. четвъртък (četvãrtãk), = Thursday
5. петък (petãk), = Friday
6. събота (sãbota), = Saturday
7. неделя (nedelja), = Sunday

Main source: [JIRE]

58 Burmese Calendar

See also *Buddhist calendars* and *Burmese zodiacal calendar*.

This lunisolar calendar is used as the traditional civil calendar in Myanmar. It was introduced in 640 CE in the Kingdom of Sri Ksetra, but was later also the official calendar in the kingdoms of Arakan, Cambodia, Lan Na, Lan Xang, Siam, Sukhothai, and Xishuangbanna.

Approximately seven intercalary months, always consisting of 30 days, are inserted between Wa-zo and Wa-gaung during a 19-year cycle.

The names of the months:

1. နတ်တော် (Natdaw), = ~ November–December (29 days)
2. ပြာသို (Pyatho), = ~ December–January (30 days)
3. တပို့တွဲ (Tabodwe), = ~ January–February (29 days)
4. တပေါင်း (Tabaung), = ~ February–March (30 days)
5. တန်ခူး (Tagu), = ~ March–April (29 days)
6. ကဆုန် (Kason), = ~ April–May (30 days)
7. နယုန် (Nayon), = ~ May–June (29 days, but 30 days during a "big leap" year)
8. ဝါဆို (Waso), = ~ June–July (30 days)
9. ဝါခေါင် (Wagaung), = ~ July–August (29 days)
10. တော်သလင်း (Tawthalin), = ~ August–September (30 days)
11. သီတင်းကျွတ် (Thadingyut), = ~ September–October (29 days)
12. တန်ဆောင်မုန်း (Tarzaungmon), = ~ October–November (30 days)

An extra month was added during leap years by counting Waso (of 30 days) twice, and during "big leap" years, an extra day was also added to Nayon, making it 30 days. In the Arakanese calendar, the intercalary month was inserted after the vernal equinox, and the intercalary day was added to Tagu, making it 30 days.

The names of the weekdays:

1. တနင်္ဂနွေ (Taninganwe), = Sunday
2. တနင်္လာ (Taninla), = Monday
3. အင်္ဂါ (Inga), = Tuesday
4. ဗုဒ္ဓဟူး (Boddahu), = Wednesday
5. ကြာသပတေး (Kyathababe), = Thursday
6. သောကြာ (Thaukkya), = Friday
7. စနေ (Sanay), = Saturday

The day was also subdivided:

ရက်	ဗဟို	နာရီ	ပါဒ်	ဗီဇနာ	ပြန်	ခရာ	ခဏ	လယ	အနုခရာ	Equal to
yet										1 day
8	**baho**									3 h
60	7½	**nayi**								24 min
240	30	4	**pat**							6 min
3600	450	60	15	**Bizana**						24 s
21,600	2700	360	90	6	**pyan**					4 s
216,000	27,000	3600	900	60	10	**khaya**				0.4 s
2,592,000	324,000	43,200	10,800	720	120	12	**khana**			0.033 33 s
10,368,000	1,296,000	172,800	43,200	2880	480	48	4	**laya**		0.008 33 s
12,960,000	1,620,000	216,000	54,000	3600	600	60	5	1¼	**anukhaya**	0.006 67 s

Main sources: [FURN], [LUCE], and [MACD2]

59 Burmese Zodiacal Calendar

See also *Burmese calendar*.

This zodiacal calendar is based on 12 signs called *yathi*. Each yathi is divided into 30 degrees, each degree into 60 minutes, and each minute into 60 seconds. The zodiacal month consists of 27 days, and each zodiacal day (nekkhat) represents a segment of the ecliptic along which the Moon revolves around the Earth.

The names of the zodiacal months:

Sign	Latin	Ruling planet	Longitude
Meittha	Aries	Mars	0°
Pyeiitha	Taurus	Venus	3°
Mehton	Gemini	Mercury	6°
Karakat	Cancer	Moon	90°
Thein	Leo	Sun	120°
Kan	Virgo	Mercury	150°
Tu	Tula	Libra	180°
Byeissa	Scorpio	Mars	210°
Danu	Sagittarius	Jupiter	240°
Makara	Capricorn	Saturn	270°
Kon	Aquarius	Saturn	300°
Mein	Pisces	Jupiter	330°

The names of the zodical days along with the range of each segment:

1. Athawani (350°–8°)
2. Barani (8°–18°)
3. Kyattika (18°–34°)
4. Yawhani (34°–46°)
5. Migathi (46°–60°)
6. Adra (60°–65°)
7. Ponnahpukshu (65°–92°)
8. Hpusha (92°–106°)
9. Athaleiktha (106°–118°)
10. Maga (118°–129°)
11. Pyobba Baragonni (129°–145°)
12. Ottara Baragonni (145°–154°)
13. Hathada (154°–164°)
14. Seiktra (164°–179°)
15. Thwati (179°–192°)
16. Withaka (192°–213°)
17. Anuyada (213°–224°)
18. Zehta (224°–229°)
19. Mula (229°–242°)
20. Pyobba Than (242°–257°)
21. Ottara Than (257°–262°)
22. Tharawun (262°–275°)
23. Danatheikda (275°–287°)
24. Thattabeiksha (287°–313°)
25. Pyobba Parabaik (313°–323°)
26. Ottara Parabaik (323°–339°)
27. Yewati (339°–350°)

The names of the days of the 8-day zodiacal week:

Burmese name	Related Gregorian day	Animal sign	Cardinal direction
Taninganwe	Sunday	Garuda	Northeast
Taninla	Monday	Tiger	East
Inga	Tuesday	Lion	Southeast
Boddahu	Wednesday a.m.	Tusked elephant	South
Rahu	Wednesday p.m.	Tuskless elephant	Northwest
Kyathabade	Thursday	Rat	West
Thaukkya	Friday	Guinea pig	North
Sanay	Saturday	Nāga	Southwest

Main sources: [CHIT], [IRWI3], and [SCOT8]

60 Buryat Calendar

This lunar calendar was used among the Buryats in the Lake Baikal region.

The names of the months:

1. Moon in which the brooks freeze (starting in early January)
2. Moon when the winter stores are seen to
3. roe Moon
4. deer Moon
5. sheep Moon
6. Moon when the ice breaks
7. spring Moon
8. grass Moon
9. bulb Moon
10. milk Moon
11. milch Moon
12. Moon when the aftermath comes
13. Moon when it ripens

The Buryats living in the Nizhneudinsky region used another calendar with only 12 months, but this calendar probably had some epagomenal days.

1. month when horns grow on the roe
2. month when the deer is caught
3. month when the sheep pair
4. month of the red ridge of land
5. fish-spawning month
6. leek month
7. the wild month
8. month when the roes pair
9. month when the deer pair
10. month the squirrel is caught
11. month when the sables are caught
12. month whe the animals creep into their dens and nests

Main source: [NILS]

61 (Ancient) Byzantine Calendar

This is also called **Creation Era of Constantinople** or **Era of the World**.

This calendar was used by the Eastern Orthodox Church from c. 691 until 1728 in the Ecumencial Patriarchate. It was also the official calendar of the Byzantine Empire between 988 and 1453, and in Russia from *c*. 988 to 1700. It was identical to the Julian calendar except that its year one was 5509–5508 BCE, the names of the months were transcripted into Greek, and the first day of the year was September 1. The leap day was obtained by doubling February 24. The calendar is still used by a few Eastern Orthodox Churches in Russia.

Internet source: Prof. Charles Ellis (University of Bristol). “Russian Calendar”. *The Literary Encyclopedia*. Published: September 25, 2008.

62 (Ancient) Byzantine Cretan Calendar

This lunisolar calendar was used in Crete beginning in the third century.

The names of the months:

1. θεσμοφοριών, Thesmophorion, 23 September–23 October (31 days)
2. ἑρμαῖος, Hermaios, 24 October–22 November (30 days)

3. Ειμαν Eiman, 23 November–23 December (31 days)
4. μετάρχιος, Metarchios, 24 December–23 January (31 days)
5. ἄγυιος, Agyios, 24 January–20 February (28 days)
6. Διοσκόριος, Dioskourios, 21 February–23 March (31 days)
7. θεοδόσιος, Theodosios, 24 March–22 April (30 days)
8. πόντος, Póntos, 23 April–23 May (31 days)
9. Ραβινθιος Rabinthios, 24 May–22 June (30 days)
10. Ὑπερβερεταῖος, Hyperberetios, 23 June–23 July (31 days)
11. Νεκύσιος, Nekysios, 24 July–22 August (30 days)
12. βασιλιός, Basilios, 23 August–22 September (31 days)

Main source: [GINZ]

63 Calendar of the Martyrs

See *Coptic calendar*.

64 Calendarium Tyrnaviense

See (Old) *Hungarian calendar*.

65 (Ancient) Cappadocian Calendar

This calendar was used in Cappadocia before the Roman conquest, from the time of King Archelaus (r. 34 BCE–17 CE) until that of King Epiphanius (during the late third century). As the month-names were clearly of Avestan origin, scholars often suggest that the calendar was introduced to Cappadocia during the Achaemenid period. It consisted of twelve 30-day months followed by 5 epagomenal days.

The names of the months:

1. Artana, 12 December–10 January (30 days)
2. Artēyeste, 11 January–9 February (30 days)
3. Aroatata, 10 February–11 March (30 days)
4. Teirei, 12 March–10 April (30 days)
5. Amartata, 11 April–10 May (30 days)
6. Xathriorē, 11 May–10 June (30 days)
7. Mithpē, 11 June–9 July (30 days)
8. Apomenapa, 10 July–8 August (30 days)
9. Athra, 9 August–7 September (30 days)
10. Dathousa, 8 September–7 October (30 days)
11. Osmana, 8 October–6 November (30 days)
12. Sondara, 7 November–6 December (30 days)

Five epagomenal days, 7 December–11 December

Main sources: [BELA], [DUCH], [GINZ2], and [STER]

66 Caspian Calendar

See *Tabarian calendar*.

67 Cebuano Calendar

This calendar is used by the Cebuano and Karay-a-speaking people in the Philippines.

The names of the months:

1. Ulalong (time for women to begin weaving), = January
2. Daghangkahoy (time to cut the trees you want to plant), = February
3. Dangangbulang (when women can spin thread in the light), = March
4. Kiling (month of lightning and thunder), = April
5. Himabuyan (when the worm called timbaboy is multiplied), = May
6. Kabay (when its time to wear a Kaba over the clothes to keep dry), = June
7. Hiladagdapon, = July
8. Lubad-lubad (when we only eat once, when the sun sets), = August

9. Kangurosol (month of regret for those who own money), = September
10. Bagyo-bagyo (harvest time), = October
11. Panglot nga Dyutay (when the cold weather begins), = November
12. Panglot nga Dako (very cold weather), = December

The names of the seasons:

1. Tingtugnaw, = winter
2. Tingpamulak, = spring
3. Ting-init, = summer
4. Tingdagdag, = autumn

The names of the weekdays:

1. Tagburukad, = Monday
2. Dumason, = Tuesday
3. Dukot-dukot, = Wednesday
4. Baylo-baylo, = Thursday
5. Danghus, = Friday
6. Hingot-hingot, = Saturday
7. Ligid-ligid, = Sunday

The names of the hours of a day:

1. Bantug adlaw, sunrise
2. Tig-ilitlog, forenoon (when the hen lays eggs)
3. Tupongtupong, noon (when one steps full shadows)
4. Huyug adlaw, 2 o'clock
5. Masirum, twilight, evening
6. Tigiyapon, 8 o'clock (dinner)
7. Tigbaranig, 10 o'clock (bed time)
8. Unang pamalo, midnight
9. Tigburugtaw, 4 o'clock in the morning
10. Paranugpo, 5:30 (when the chicken leaves the roost)

Main sources: Ayala Foundation. *Cebu—more than an island*. 1997 and Wolff, John U. A dictionary of Cebuano Visayan, Vol. 1. 1972.

68 (Ancient) Celtic Lunar Calendar

This lunar calendar was used among the Druids during the Middle Ages. The five last days of the year were generally not considered to be part of any month. In Wales, the Cyfraith Hywel Laws, codified during the reign of Hywel the Good in the mid-tenth century, referred to periods of 9 days. See also (Old) *Coligny calendar* and (Old) *Gaelic calendars*.

The names of the months in Irish Gaelic:

1. Maghieden (Birthing Month) = 11 October to 3 November
2. Oveanh (Sleeping Month) = 4 November to 2 December
3. Hunlidh (Dreaming Month) = 3 December to 31 December
4. Llianth (Quiet Month) = 1 January to 30 January
5. Carmoil (Month of Ice) = 31 January to 1 March
6. Haemgild (Planting Month) = 2 March to 30 March
7. Gidhet (Flower Month) = 31 March to 29 April
8. Duharkat (Cattle Month) = 30 April to 29 May
9. Rodlima (Bird Month) = 30 May to 27 June
10. Bemgusith (Battle month) = 28 June to 27 July
11. Culendom (Harvest month) = 28 July to 27 August
12. Alverci (Raining Month) = 28 August to 24 September
13. Shar'tanog (Dying Month) = 25 September to 23 October

Uenicar (Dead Month) = 25 October to 29 October

Main sources: [EBER2] and [WADE]

Internet source: angelfire.com/de2/newconcepts/wicca/druidmonths.html

69 (Ancient) Chaldean Calendar

This solar calendar was used at least before 2200 BCE. It consisted of 12 months of 30 days each, with an additional month once in 6 years. There was also an extra month added once in about 120 years. The 12 signs of the Zodiac gave names to the months. Each sign was divided into 30 degrees, and each degree into 60 minutes.

The sun, the moon and the five known planets, Mercury, Venus, Mars, Jupiter and Saturn, gave name to days in a 7-day cycle.

The 12 signs of the Zodiac that gave names to the months:

1. Aries (Ram), 15 April–15 May
2. Taurus (Bull), 16 May–15 June
3. Gemini (Twins), 16 June–15 July
4. Cancer (Crab), 16 July–15 August
5. Leo (Lion), 16 August–15 September
6. Virgo (Virgin), 16 September–15 October
7. Libra (Scales), 16 October–15 November
8. Scorpio (Scorpion), 16 November–15 December
9. Sagittarius (Archer), 16 December–14 January
10. Capricorn (Goat), 15 January–14 February
11. Aquarius (Water-carrier), 15 February–14 March
12. Pisces (Fishes), 15 March–14 April

Main source: [GINZ]

70 Cham Calendar

This lunar calendar is used by the Cham people of Vietnam and Cambodia. As in many other Asian cultures, a 12 year zodiac cycle is used.

The lunar Zodiac animal cycle:

1. kuh or tikuh (rat)
2. kabao or kubav (water buffalo)
3. rimong (tiger)
4. tapai (rabbit)
5. inưgirai (dragon)
6. ulan eh (snake)
7. athêh (horse)
8. pabê (goat)
9. kra (turtle)
10. mưnuk (chicken)
11. athau (dog)
12. pabuai (pig)

The names of the months:

1. Balan tha, = ~ January
2. Balan dua, = ~ February
3. Balan klau, = ~ March
4. Balan pak, = ~ April
5. Balan lima, = ~ May
6. Balan năm, = ~ June
7. Balan tajuh, = ~ July
8. Balan dalipăn, = ~ August
9. Balan thalipăn, = ~ September
10. Balan thapluh, = ~ October
11. Balan puis, = ~ November
12. Balan mak, = ~ December

The names of the weekdays:

1. Adit, = Sunday
2. thôm or sóm (in Cambodia), = Monday
3. Angar, = Tuesday
4. But, = Wednesday
5. Jip, = Thursday
6. shuk or suk (in Cambodia) = Friday
7. thanưchăn or sannachar (in Cambodia), = Saturday

Main source: [AYMO2]

71 Chamorro Calendar

This lunar calendar was used by the Chamorro society in Guam.

The names of the months:

1. Tumaiguini, = ~ early January-February
2. Maimu', = ~ February
3. Umatalaf, = ~ March
4. Lumuhu, = ~ April
5. Makmamao, = ~ May
6. Fananaf or Mananaf, = ~ June
7. Semu, = ~ July

8. Tenhos, = ~ August
9. Lumamlam, = ~ September
10. Fangualu or Fa'gualu, = ~ October
11. Sumongsong, = ~ November
12. Umayanggan, = ~ December
13. Umagahaf, = ~ late December-early January

Main source: [CUNN]

72 Charlemagne Calendar

Charlemagne (742–814) modified the established Julian calendar, and used some of the agricultural Old High German names of the months. The calendar reform did not last beyond Charlemagne's reign and was never widespread, but the names of the months were used in many regions until the fifteenth century, and continued with some modifications until the eighteenth century in parts of Germany and the Netherlands.

The names of the months until the eleventh century:

1. Wintarmanoth (winter month), = January
2. Hornune (the month when the male red deer sheds its antlers), = February
3. Lentzinmanoth (Lent month), = March
4. Ôstarmanoth (Easter month), = April
5. Wonnimanoth (love-making month), = May
6. Brachmanoth (plowing month), = June
7. Heuvimanoth (hay month), = July
8. Aranmanoth (harvest month), = August
9. Witumanoth (wood month), = September
10. Windumemanoth (vintage month), = October
11. Herbistmanoth (autumn month), = November
12. Heilagmanoth (holy month), = December

The names of the months until the late fourteenth century:

1. Wintermanoth, = January
2. Hornune, = February
3. Lentzinmanoth, = March
4. Ostermanoth, = April
5. Winnemanoth, = May
6. Bracmanoth, = June
7. Howimanoth, = July
8. Arnotmanoth, = August
9. Herbistmanoth, = September
10. Windemmanoth, = October
11. Wintermanoth, = November
12. Hertimanoth, = December

In 1473, Johann Küngsperger (1436–1476) changed the names in his Nürnberger Kalender.

The names of the months from 1473 until the mid-eighteenth century:

1. Jenner, = January
2. Hornung, = February
3. Merz, = March
4. April, = April
5. Mei, = May
6. Brachmond, = June
7. Heumond, = July
8. Augstmond, = August
9. Herbstmond, = September
10. Weinmond, = October
11. Wintermond, = November
12. Christmond, = December

The names of the months from the mid-eighteenth century:

1. Jenner, = January
2. Hornung, = February
3. Merz, = March
4. April, = April
5. Mai, = May
6. Brachmonat, = June
7. Heumonat, = July
8. Augustmonat, = August
9. Herbstmonat, = September
10. Weinmonat, = October
11. Wintermonat, = November
12. Christmonat, = December

Main sources: [EINH], [GINZ], and [SCHÜ]

73 Chehalis Calendar

This lunar calendar was used among the Chehalis people in western Washington. The year, consisting of ten lunar months, began at the arrival of spawning chinook salmon (*Oncorhynchus tshawytscha*) in September and/or October. After these 10 months, an uncounted period took place that did not belong to any month, ending at the next chinook salmon run.

Main source: [SUTT]

74 Cherokee Calendar

These lunar calendars were used by the Cherokee people in Southeastern North America.

The names of the months:

1. kawohni (flower Moon), = ~ April
2. ansgvti (planting Moon), = ~ May
3. dehaluyi (green corn Moon), = ~ June
4. kuyegwona (ripe corn Moon), = ~ July
5. galohni (end of the fruit or drying up Moon), = ~ August
6. dulisdi (nut or black butterfly Moon), = ~ September
7. duninhdi (harvest Moon), = ~ October
8. nvdadegwa (trading Moon), = ~ November
9. vskihyi (snow Moon), = ~ December
10. unolvtana (cold Moon), = ~ January
11. kagali (bony Moon), = ~ February
12. anvhyi (strawberry or windy Moon), = ~ March

The names of the months for Eastern Cherokees:

1. nvda atsilusgi (flower Moon), = ~ April
2. nvda gahlvsgi (planting Moon), = ~ May
3. nvda seluitseiyusdi (green corn Moon), = ~ June
4. nvda utsi'dsata' (corn in tassel Moon), = ~ July
5. nvda seluuwa'nûň'sa (ripe corn Moon), = ~ August
6. nvda udatanvagisdi ulisdv (end of the fruit Moon), = ~ September
7. nvda udatanûň (nut Moon), = ~ October
8. nvda tsiyahloha (harvest Moon), = ~ November
9. nvda ganohalidoha (hunting Moon), = ~ November
10. nvda gutiha (snow Moon), = ~ December
11. nvda kanawoga (cold Moon), = ~ late-December
12. nvda kola (bone Moon), = ~ late-January
13. nvda unole (wind Moon), = ~ February

The names of the weekdays:

1. ᎤᎾᏙᏓᏉᏅ Unadodaquonvi, = Monday
2. ᏔᎵᏁ ᎢᎦ Taline iga, = Tuesday
3. ᏦᎢᏁ ᎢᎦ Tsoine iga, = Wednesday
4. ᏅᎩᏁ ᎢᎦ Nvgine iga, = Thursday
5. ᏧᏅᎩᎶᏍᏗ Tsungilosdi, = Friday
6. ᎤᎾᏙᏓᏈᏕᎾ Unadodawidena, = Saturday
7. ᎤᎾᏙᏓᏆᏍᎬ Unododaquasgvi, = Sunday

Internet source: readtiger.com/americanindian.net/moons.html

75 Cheyenne Calendar

This lunar calendar was used by the Cheyenne people in the mid-northern parts of present-day U.S.A.

Some names of the months:

1. Moon when the wolves run together, = ~ December
2. Moon of the strong cold, = ~ January
3. ?
4. ?
5. Moon when the geese lay eggs, = ~ April
6. Moon when the horses get fat, = ~ May
7. ?
8. ?
9. ?
10. Moon of the drying grass, = ~ September
11. Moon when the water begins to freeze on the edge of the streams, = ~ October

12. Moon of deer rutting, = ~ November
13. ?

Later, the months were named:

1. Hohtséeše'he (Hoop Moon), = ~ January
2. Ma'xėhohtséeše'he (Big Hoop Moon), = ~ February
3. Pónoma'a'ėhasenéeše'he (Drying up Moon), = ~ March
4. Véhpotséeše'he (Leaf Moon), = ~ April
5. Matsé'oméeše'he (Spring Moon), = ~ May
6. Enano'éeše'he (Planting Moon), = ~ June
7. Méanéeše'he (Summer Moon), = ~ July
8. Oenenéeše'he (Harvest Moon), = ~ August
9. Tonóeveéše'he (Fall Moon), = ~ September
10. Sé'énéhe (Facing Moon), = ~ October
11. He'konéneéše'he (Hard face Moon), = ~ November
12. Ma'xêhe'konéneéše'he (Big hard face Moon), = ~ December

The names of the weekdays:

1. éénema'heóneéšeeve, (end of holy day) or nõ'ka éšeēva (first day), = Monday
2. nèxa éšeēva (second day), = Tuesday
3. na'ha éšeēva (third day), = Wednesday
4. nèva éšeēva (fourth day), = Thursday
5. nóhona éšeēva (fifth day), = Friday
6. tšėške'ma'heóneéšeēva (little Holy day), = Saturday
7. ma'heóneéšeēva (Holy day), = Sunday

Internet sources: www.snowwowl.com/moonnames.html and www.lamedeer.k12.mt.us.phtemp.com

76 Chinese Calendars

Before 1912, when the Gregorian calendar was officially adopted, one lunisolar and one solar calendar were in common use in China.

A lunisolar calendar, based on calculations of the positions of the Sun and Moon, was used in official records beginning in the middle years of the Shang dynasty (*c*. 1200–1045 BCE), but there are records from 2254 BCE when the Emperor Yao (*c*. 2356–2255 BCE) gave instructions to his astronomers to ascertain the solstices and equinoxes, and employ intercalary months so the calendar became consistent with the actual solar year. This calendar, also known as the *Yin calendar*, had 12 months, of 29 or 30 days each, and the year began on the first new moon after the winter solstice. An extra month (*runyue*) was added 22 times in every 60-year cycle. Around about 484 BCE, the *Sìfēn calendar* was in use. It used a solar year of 365¼ days along with a 19-year cycle. The year still began on the new moon preceding the winter solstice, and intercalary months were inserted at the end of the year.

Since 104 BCE, the year has been considered to begin on the second new moon after the winter solstice. Each of the 12 months began on days of astronomical new moons. To make up the difference between 12 lunations and the solar year, an intercalary month (runyue) was added 22 times in every 60-year cycle. An intercalary month takes the number of the previous month, but is called intercalary.

The Chinese calendar follows a 60-year cycle, pairing the names of a denary cycle, the Celestial Stems, and a duodenary cycle, the Earthly Branches. According to [SHUX, pp. 229–58], it may have been a combination of a pre-Shang 10-month solar calendar, with each month having 36 days, and a 12-month lunar calendar, with each month having 30 days.

The Celestial Stems (tiān gān, 天干, with corresponding element) are:

(1) jiǎ (甲)—wood, (2) yǐ (乙)—wood, (3) bǐng (丙)—fire, (4) dīng (丁)—fire, (5) wù (戊)—earth, (6) jǐ (己)—earth, (7) gēng (庚)—metal, (8) xīn (辛)—metal, (9) rén (壬)—water, and (10) guǐ (癸)—water,

and the Earthly Branches (dì zhī, 地支, with corresponding Chinese zodiac names) are:

(1) zǐ (子, rat), (2) chǒu (丑, ox), (3) yín (寅, tiger), (4) mǎo (卯, hare), (5) chén (辰, dragon), (6) sì (巳, snake), (7) wǔ (午, horse), (8) wèi (未, goat), (9) shēn (申, monkey), (10) yǒu (酉, chicken), (11) xū (戌, dog), and (12) hài (亥, pig or boar).

They are paired together in the Jiǎzǐ (甲子) sequence, cycling independently, as follows:

(1) jiǎzǐ (甲子), (2) yǐchǒu (乙丑), (3) bǐngyín (丙寅), (4) dīngmǎo (丁卯), (5) wùchén (戊辰), (6) jǐsì (己巳), (7) gēngwǔ (庚午), (8) xīnwèi (辛未), (9) rénshēn (壬申), (10) guǐyǒu (癸酉), (11) jiǎxū (甲戌), (12) yǐhài (乙亥), (13) bǐngzǐ (丙子), (14) dīngchǒu (丁丑), (15) wùyín (戊寅), (16) jǐmǎo (己卯), (17) gēngchén (庚辰), (18) xīnsì (辛巳), (19) rénwǔ (壬午), (20) guǐwèi (癸未), (21) jiǎshēn (甲申), (22) yǐyǒu (乙酉), (23) bǐngxū (丙戌), (24) dīnghài (丁亥), (25) wùzǐ (戊子), (26) jǐchǒu (己丑), (27) gēngyín (庚寅), (28) xīnmǎo (辛卯), (29) rénchén (壬辰), (30) guǐsì (癸巳), (31) jiǎwǔ (甲午), (32) yǐwèi (乙未), (33) bǐngshēn (丙申), (34) dīngyǒu (丁酉), (35) wùxū (戊戌), (36) jǐhài (己亥), (37) gēngzǐ (庚子), (38) xīnchǒu (辛丑), (39) rényín (壬寅), (40) guǐmǎo (癸卯), (41) jiǎchén (甲辰), (42) yǐsì (乙巳), (43) bǐngwǔ (丙午), (44) dīngwèi (丁未), (45) wùshēn (戊申), (46) jǐyǒu (己酉), (47) gēngxū (庚戌), (48) xīnhài (辛亥), (49) rénzǐ (壬子), (50) guǐchǒu (癸丑), (51) jiǎyín (甲寅), (52) yǐmǎo (乙卯), (53) bǐngchén (丙辰), (54) dīngsì (丁巳), (55) wùwǔ (戊午), (56) jǐwèi (己未), (57) gēngshēn (庚申), (58) xīnyǒu (辛酉), (59) rénxū (壬戌), and (60) guǐhài (癸亥).

As the Chinese months followed the phases of the moon, they did not accurately follow the seasons of the solar year. To assist farmers in deciding when to plant or harvest crops, a sequence of 24 seasonal markers (jiéqì or 節氣) that follow the solar year was also in use. These 24 seasonal markers correspond to the days on which the sun enters the 1st and 15th degree of each zodiacal sign. As there is a discrepancy between the 360 degrees of the zodiac and the 365¼ days of the solar year, the dates of the periods below are only approximate.

Spring was divided into:

1. lìchūn (start of spring), 5 February–18 February
2. yǔshuǐ (rain water), 19 February–5 March
3. qǐzhé (awakening of insects), 6 March–20 March
4. chūnfēn (vernal equinox), 21 March–4 April
5. qīngmíng (clear and bright), 5 April–19 April
6. gǔyù (grain rains), 20 April–5 May

Summer was divided into:

7. lìxià (start of summer), 6 May–20 May
8. xiǎomǎn (grain full), 21 May–5 June
9. mángzhǒng (grain in ear), 6 June–20 June
10. xiàzhì (summer solstice), 21 June–6 July
11. xiǎoshǔ (minor heat), 7 July–22 July
12. dàshǔ (major heat), 23 July–7 August

Autumn was divided into:

13. lìqiū (start of autumn), 8 August–22 August
14. chùshǔ (limit of heat), 23 August–7 September
15. báilù (white dew), 8 September–22 September
16. qiūfēn (autumn equinox), 23 September–7 October
17. hánlù (cold dew), 8 October–22 October
18. shuāngjiàng (descent of frost), 23 October–6 November

Winter was divided into:

19. lìdōng (start of winter), 7 November–21 November
20. xiǎoxuě (minor snow), 22 November–5 December

21. dàxuě (major snow), 6 December–21 December
22. dōngzhì (winter solstice), 22 December–4 January
23. xiǎohán (minor cold), 5 January–19 January
24. dàhán (major cold), 20 January–4 February

The first month was called *zhengyue*, and all other names were simply numbers. Months were also referred to by their place in the season. The first month of a season was called *mengchun*, and then came the *zhongchun* and *jichun*. Each month was divided into three *sanxun*, of 10 days each: *shangxun*, *zhongxun*, and *xiaxun*. There was also a lunar zodiac known as the Huang Tao, consisting of 28 constellations that served to subdivide the path of the moon.

In addition to the civil calendar, a calendar based on the solar year was also in common use among farmers. It divided the solar year into 12 parts, each about 30.44 days long.

The division of the day:

1. Hour of the Rat (11 pm–1 am)
2. Hour of the Ox (1 am–3 am)
3. Hour of the Tiger (3 am–5 am)
4. Hour of the Hare (5 am–7 am)
5. Hour of the Dragon (7 am–9 am)
6. Hour of the Snake (9 am–11 am)
7. Hour of the Horse (11 am–1 pm)
8. Hour of the Sheep (1 pm–3 pm)
9. Hour of the Monkey (3 pm–5 pm)
10. Hour of the Fowl (5 pm–7 pm)
11. Hour of the Dog (7 pm–9 pm)
12. Hour of the Pig (9 pm–11 pm)

Since ancient times, as described above, the day has also been divided into 12 parts that each bears the name of 1 of the 12 earthly branches with its corresponding animal.

Various planetary names were used, since antiquity, for naming the days of the week. The nomenclature of using the seven planets (the Sun, the Moon, Mars, Mercury, Jupiter, Venus, and Saturn) came overland from the West before the end of the first millennium, but these names largely disappeared in China during the sixteenth to seventeenth centuries. The Jesuits were active in China in the sixteenth to eighteenth centuries, and also introduced a system used by the Catholic Church.

The Chinese names of the Western weekdays:

1. 日曜日 Mandarin: rìyào-rì, = Sunday
2. 月曜日 Mandarin: yuèyào-rì, = Monday
3. 火曜日 Mandarin: huǒyào-rì, = Tuesday
4. 水曜日 Mandarin: shuǐyào-rì, = Wednesday
5. 木曜日 Mandarin: mùyào-rì, = Thursday
6. 金曜日 Mandarin: jīnyào-rì, = Friday
7. 土曜日 Mandarin:, tǔyào-rì, = Saturday

The Chinese names of the weekdays used by Chinese Catholics:

1. 主日 Mandarin: zhǔrì, = Sunday
2. 瞻禮二 Mandarin: zhānlǐ-èr, = Monday
3. 瞻禮三 Mandarin: zhānlǐ-sān, = Tuesday
4. 瞻禮四 Mandarin: zhānlǐ-sì, = Wednesday
5. 瞻禮五 Mandarin: zhānlǐ-wǔ, = Thursday
6. 瞻禮六 Mandarin: zhānlǐ-liù, = Friday
7. 瞻禮七 Mandarin: zhānlǐ-qī, = Saturday

In modern Mandarin Chinese, the weekdays are numbered from 1 to 6, except Sunday. In Cantonese, Hokkienese, Taiwanese, and other Chinese languages, the naming is almost the same, with the main differences being found in pronunciation. Anyhow, there are three different words for "week," and all three are still used in naming the weekdays. The official term since 1912 is 星期 (literally "star period"), while the common term in everyday speech, and the official term from the late nineteenth century until 1912, is 禮拜 ("worship"). The third term, 週 ("cycle"), may refer to the old Chinese zodiacal cycle, and entered Chinese from Japanese during the early twentieth century.

	禮拜 lǐbài-system	Mandarin	Cantonese	Hokkienese	Taiwanese
Sunday	禮拜日	lǐbàirì	láihbaaih yaht	le^2-bai^5-ngit^7	le^2-pai^3-jit^8
Monday	禮拜一	lǐbàiyī	láihbaaih yāt	bai^5-jit^3	pai^3-it
Tuesday	禮拜二	lǐbài'èr	láihbaaih yih	bai^5-ngi^5	pai^3-ji^7
Wednesday	禮拜三	lǐbàisān	láihbaaih sàam	bai^5-sam^1	pai^3-sa^n
Thursday	禮拜四	lǐbàisì	láihbaaih sei	bai^5-si^5	pai^3-si^3
Friday	禮拜五	lǐbàiwǔ	láihbaaih ńgh	bai^5-ng^3	pai^{3}go^o
Saturday	禮拜六	lǐbàiliù	láihbaaih luhk	bai^5-luk^7	pai^{3}lak^8

	星期 xīngqī-system	Mandarin	Cantonese
Sunday	星期日	xīngqīrì	sìngkèih yaht
Monday	星期一	xīngqīyī	sìngkèih yāt
Tuesday	星期二	xīngqī'èr	sìngkèih yih
Wednesday	星期三	xīngqīsān	sìngkèih sàam
Thursday	星期四	xīngqīsì	sìngkèih sei
Friday	星期五	xīngqīwǔ	sìngkèih ńgh
Saturday	星期六	xīngqīliù	sìngkèih luhk

	週 zhōu-system	Mandarin
Sunday	週日	zhōurì
Monday	週一	zhōuyī
Tuesday	週二	zhōu'èr
Wednesday	週三	zhōusān
Thursday	週四	zhōusì
Friday	週五	zhōuwǔ
Saturday	週六	zhōuliù

Main sources: [SHUX] and [WILK2]

77 Choctaw Calendars

These calendars were used by the Choctaw people in Mississippi and Louisiana.

Until the early nineteenth century, the year was divided into two seasons of 6 months each, namely, hvshtula or onafa (= winter) and tofa (= summer), and the year began in late September.

The names of the months:

1. chvfiskono (little hunger Moon), = ~ 22 September–
2. chvfo chito (big hunger Moon), = ~ November
3. hvsh koe chito (big lion month) or onafa hvshi (winter Moon), = ~ December
4. hvsh koinchus (lion's little brother Moon), = ~ January
5. hvsh watonlak (crane Moon) or hvshi kaposha (snow Moon), = ~ February
6. hvshi mahli (wind Moon), = ~ March–
7. tek i hvshi (women's Moon) or tash hvshi (corn Moon), = ~ 22 March–
8. hvshi bihi (mulberry Moon), = ~ May
9. hvsh bissa (blackberry Moon), = ~ June
10. hvshkvf (sassafras Moon), = ~ July
11. hvsh takkon (peach Moon), = ~ August
12. hvsh hoponi (cooking Moon), = ~ September

lvak mosholi (extinguishing fire), = intercalary month every 2 or 3 years to keep the months in harmony with the seasonal events.

A lunar calendar, in which the year began with the first frost, generally in mid-November, has also been reported. In this, the year consisted of 13 months of 28 days each.

The names of the months:

1. hash haponi (Moon of cooking), = ~ 15–20 November–mid December

2. hash haf (Moon of sassafras), = ~ December/January
3. hash chaf iskonono (Moon of little famine), = ~ January
4. hash chaf chito (Moon of big famine), = ~ February
5. hash mali (Moon of winds), = ~ March
6. hash bissi (Moon of blackberry), = ~ April
7. hash bihi (Moon of mulberry), = ~ May
8. hash takkon (Moon of peach), = ~ June
9. hash watallak (Moon of the crane), = ~ July
10. hash luak mosholi (Moon of the green corn festival), = ~ August
11. hash tek inhasi (Moon of courting time), = ~ September
12. hash koinchush (Moon of the wildcat), = ~ October
13. hash koichus (Moon of the panther), = ~ November

Internet source: mike-boucher.com

78 Chongzhen Calendar

This has also been called the *Shíxiàn calendar*.

This lunisolar calendar was developed by the German Jesuit scholars Johannes Schreck (1576–1630) and Johann Adam Schall von Bell (1592–1666) from 1624 to 1644. When Schall von Bell was appointed director of the National Astronomical Observatory in 1646, it was presented to the Chongzhen Emperor. The calendar was used from the early Qing period, when its name was changed to the Shíxiàn calendar, until the introduction of the Gregorian calendar in 1911. Anyhow, it is still referred to as an agricultural calendar and is equal to the Japanese lunar calendar.

Main source: 藪内清, 吉田光邦編 and 吉田光邦 藪内清. *明清時代の科学技術史*. 京都大学人文科学研究所, 1970.

79 (Old) Choresmian Calendar

This has also been called the **Khwarezmian calendar**.

This lunisolar calendar was used in Chorasmia beginning in the eighth century. The year consisted of 12 months of 30 days each, with five epagomenal days added after the last month.

The names of the months:

1. βrwrtn, = ~ January
2. ʾartywhšt, = ~ February
3. hrwtt, = ~ March
4. tyry, = ~ April
5. hmrt, = ~ May
6. ʾxštry(wr), = ~ June
7. mtr, = ~ July
8. yʾpʾxwn, = ~ August
9. ʾtrw, = ~ September
10. ʾhwrym, = ~ October
11. (whw)mn, = ~ November
12. ʾxšwm, = ~ December

Five epagomenal days

Main soures: [LIVS] and [YARS]

80 Chumash Calendar

This seasonal solar calendar was used by the Chumash people in western coastal North America.

The names of the months:

1. Month when the Sun's brilliance begins, = ~ December
2. Month of Datura (a sacred plant of the Chumash people), = ~ January
3. Month when things begin to grow, = ~ February
4. Month of spring, = ~ March
5. Month when flowers are in bloom, = ~ April
6. Month when Carrizo (a plant used for arrows and tobacco tubes) is abundant, = ~ May
7. Month when things are divided in half (the mid-point of the solar year), = ~ June
8. Month when everything blows away, = ~ July
9. Month of fiesta (a harvest festival), = ~ August

10. Month when those that are dry come down (creatures migrate from the high points to the coast), = ~ September
11. Month of the great canoe builder, = ~ October
12. Month when rain keeps us indoors, = ~ November

Main sources: [MCCA4] and [PENP]

81 Chuvash Calendar

This lunar calendar was used among the Chuvash people in the Volga Region.

The name of the months:

1. thank-offering Moon, = beginning in mid November
2. very steep Moon
3. Moon of little steepness
4. spring Moon
5. free Moon
6. sowing Moon
7. summer Moon
8. the maidens' Moon
9. hay Moon
10. sickle Moon
11. flax Moon
12. threshing-floor Moon
13. grave-post Moon

Main source: [NILS]

82 (Old) Coligny Calendar

This is the name used for the Gaulish lunisolar calendar found engraved on a bronze tablet in Coligny, France, in November 1897. [LAMB, p. 111] say it is dated to the end of the second century. The continental Celts did not divide the seasons at solstices and equinoxes. Seasons began and ended at the central points between the solar pivots. The bronze tablet inscribes five consecutive years of 12 lunar months that are 29 or 30 days in length. Every 30 months, an additional month, Mid Samonious of 30 days, was added to adapt the lunar year to the longer solar year. See also (Ancient) *Celtic Lunar calendar* and (Old) *Gaelic calendars*.

The names of the months:

1. Samonious, = ~ October/November (30 days)
2. Dvmannosios, = ~ November/December (29 days)
3. Rivros, = ~ December/January (30 days)
4. Anagantios, = ~ January/February (29 days)
5. Ogronios, = ~ February/March (30 days)
6. Cvtios, = ~ March/April (30 days)
7. Giamonios, = ~ April/May (29 days)
8. Simivisonnacos, = ~ May/June (30 days)
9. Eqvos, = ~ June/July (30 days)
10. Elemivios, = ~ July/August (29 days)
11. Edrinios, = ~ August/September (30 days)
12. Cantlos, = ~ September/October (29 days)

Main sources: [DELA4], [LAMB], and [LECO]

83 Comanche Calendar

This lunar calendar was used by the Comanche people in the Great Plains of America. An intercalary month was added at the end of the year.

The names of the months:

1. toh mua (year Moon) or ukurooma mua (middle Moon), = ~ January
2. positsu mua (sleet Moon), = ~ February
3. tahpooku mua (cottonball Moon) or nana'butituikatu mua (hot and cold Moon), = ~ March
4. tahma mua (new spring Moon), = ~ April
5. totsiyaa mua (flower Moon), = ~ May
6. puhi mua (leaf Moon), = ~ June
7. urui mua (hot Moon) or pia mua (large Moon), = ~ July

8. tahma mua (summer Moon) or ukuiyuba mua (new fall Moon), = ~ August
9. taboo mua (paperman Moon) or kwi'ena mua (back to school Moon), = ~ September
10. yuba mua (fall Moon), = ~ October
11. yubaubi mua (heading to winter Moon) or aho tabenihtu mua (thanking Moon), = ~ November
12. wahi mua (evergreen Moon) or pia utsu'i mua (big cold Moon), = ~ December
13. toh mua (year Moon)

Internet source: wwu.edu/skywise/indianmoons.html

84 (Ancient) Coptic Calendar

This calendar was used among people living in the areas around the Nile Valley, at least from the third to the twelfth centuries.

There were several dialects along the Nile Valley during the first centuries. The Fayyumic dialect was primarily spoken in the Faiyum region, and is attested to having existed from the third century. After the fifth century, the Sahidic dialect had become more dominant and was spoken in most areas in Upper Egypt. The Bohairic dialect, which originated in the western Nile delta, became more dominant from the ninth century and replaced the Sahidic dialect in the liturgical language of the Coptic Orthodox Church in the eleventh century.

The names of the months in Fayyumic:

1. Thôuth, 29 August–27 September
2. Paapi, 28 September–27 October
3. Hathôl, 28 October–26 November
4. Kiakh, 27 November–27 December
5. Tôbi, 28 December–26 January
6. Mekhil, 27 January–24 February
7. ?, 25 February–26 March
8. ?, 27 March–25 April
9. Pašans, 26 April–25 May
10. ?, 26 May–24 June
11. ?, 25 June–24 July
12. ?, 25 July–23 August

Five epagomenal days, 24 August–28 August

The names of the months in Sahidic:

1. Thôth, 29 August–27 September
2. Paape, 28 September–27 October
3. Hathôr, 28 October–26 November
4. Khiahk, 27 November–27 December
5. Tôbe, 28 December–26 January
6. Mšir, 27 January–24 February
7. Parmhotp, 25 February–26 March
8. Parmoute, 27 March–25 April
9. Pašôns, 26 April–25 May
10. Paône, 26 May–24 June
11. Epêph, 25 June–24 July
12. Mesorê, 25 July–23 August

Five epagomenal days, 24 August–28 August

The names of the months in Bohairic:

1. Thôout, 29 August–27 September
2. Paophi, 28 September–27 October
3. Athôr, 28 October–26 November
4. Khoiak, 27 November–27 December
5. Tôbi, 28 December–26 January
6. Mšir, 27 January–24 February
7. Phamenôth, 25 February–26 March
8. Pharmouti, 27 March–25 April
9. Pašôns, 26 April–25 May
10. Paôni, 26 May–24 June
11. Epêp, 25 June–24 July
12. Mesôrê, 25 July–23 August

Five epagomenal days, 24 August–28 August

Main sources: [ELME], [HORN2], and [MACN]

85 Coptic Calendar

This is also called the **Calendar of the Martyrs** and the **Alexandrian calendar**.

This calendar is used in the Coptic Orthodox Church. It consists of 12 months of 30 days each, and five epagomenal days (6 days in leap years).

The names of the months:

1. Twt or توت, 29 August–27 September
2. Bâbah or بابه, 28 September–27 October
3. Hatûr or هاتور ه, 28 October–26 November
4. Kyhak or كياك, 27 November–26 December
5. Twbah or طوبه, 27 December–25 January
6. Amchir or أمشير, 26 January–24 February
7. Baramhât or برمهات, 25 February–26 March
8. Barmûdeh or برموده, 27 March–25 April
9. Bechnes or بشنس, 26 April–25 May
10. Baou’wnah or بئونه, 26 May–24 June
11. Abîb or أبيب, 25 June–24 July
12. Misrâ or مسرا, 25 July–23 August

Nasy, 24 August–28 August (6 days in leap years).

The exact date of its origin is unknown. The Coptic Year is an extension of the ancient Egyptian civil year, retaining its subdivision into the three seasons, of 4 months each. This subdivision is maintained in the Coptic Calendar. See also *Ethiopian calendar*.

Main sources: [BIÉM], [KOSA2], and [REIN]

86 Creation Era of Constantinople

See *(Ancient) Byzantine calendar*.

87 Cree Calendars

These calendars were used by the Cree people in North America. See also *Muscokee calendar*.

The names of the months for the Cree people in Northern Great Plains, Canada:

1. gishepapiwatekimumpizun (the old fellow (late winter) spreads pine needles across the snow-Moon), = ~ January
2. cepizun (old Moon), = ~ February
3. migisupizun (eagle Moon), = ~ March
4. kiskipizun or misklpizun (gray goose Moon), = ~ April
5. aligipizun (frog Moon), = ~ May
6. sagipukawipizun (leaves come out Moon), = ~ June
7. opaskwuwipizun (ducks begin to moult Moon), = ~ July
8. opunhopizun (young ducks begin to fly Moon), = ~ August
9. weweoplzun (wavy or snow goose Moon), = ~ September
10. opinahamowipizun (when birds fly south Moon), = ~ October
11. kaskatinopizun (when rivers begin to freeze Moon), = ~ November
12. papiwatiginashispizun (the young fellow (early winter) spreads the brush across the snow-Moon), = ~ December

Alternative 13 Moon version:

1. apintapipunpicim or kicepicim (great Moon or midwinter Moon), = ~ January
2. mikiciwpicim (eagle Moon), = ~ February
3. kiskihpicim (goose Moon), = ~ March
4. ayikipicim (frog Moon), = ~ April
5. sakipakawpicim (leaves appear Moon), = ~ May
6. paskawehowlpicim or pinawewipicim (egg hatching or laying Moon), = ~ June
7. paskowrpicim (feather moulting Moon), = ~ July
8. ohpahowipicim (starts to fly Moon), = ~ August
9. no-tchiltopicim (breeding Moon), = ~ September
10. pinackopicim (leaves change color Moon), = ~ October
11. ? (falling leaves Moon), = ~ November
12. okaskatanopicim (frozen over Moon), ~ December

13. piwaktcakinacispicim (scattering Moon), ~ late December

Internet source: americanindian.net

88 (Old) Croatic Calendar

This lunar and agricultural calendar was used in Croatia. The names of the months depicted the evolution of the seasons in the natural world.

The names of the months:

1. travanj (the month of grass), = ~ April
2. svibanj (the month of roses), = ~ May
3. lipanj (the month of lime), = ~ June
4. srpanj (the month of harvesting), = ~ July
5. kolovoz (the month of carts), = ~ August
6. rujan (the month when nature turn red), = ~ September
7. listopad (the month when the leaves fall), = ~ October
8. studeni (the month when its getting cold), = ~ November
9. prosinac (the month for marriage proposals), = ~ December
10. siječanj (the month for wood cutting), = ~ January
11. veljača (the month when the days lengthen), = ~ February
12. ožujak (the month of freak weather), = ~ March

The names of the seasons:

1. proljeće, = spring
2. ljeto, = summer
3. jesen, = autumn
4. zima, = winter

Main source: [MAGN4]

89 (Ancient) Cyzicene Calendar

This calendar was used during ancient times in Cyzicus of Mysia.

The names of the months:

1. Βοηδρομιών, Boedromion, = ~ October
2. Κυανεψιών, Cyanepsion, = ~ November
3. Ἀπατουριών, Apaturion, = ~ December
4. Ποσειδεών, Poseideon, = ~ January
5. Ληναιών, Lenaion, = ~ February
6. Ἀνθεστηριών, Anthesterion, = ~ March
7. Ἀρτεμισιών, Artemision, = ~ April
8. Καλαμαιών, Calamaion, = ~ May
9. Πάνημος, Panemos, = ~ June
10. Ταυρεών, Taureon, = ~ July
11. ?
12. ?

Main sources: [GINZ] and [SMIT3]

90 (Old) Czech Calendar

This traditional calendar was mainly based on the phases of the moon in the sky, what was happening in the nature at that time and what type of work the people were engaged in during the specific period.

The names of the months:

1. Leden (the month of the ice), = ~ January
2. Únor (the month of the melting ice), = ~ February
3. Březen (the month of the sprouting birch), = ~ March
4. Duben (the month of the sprouting oaks), = ~ April
5. Květen (the month of the flowers), = ~ May
6. Červen (the month of the red fruits), = ~ June
7. Červenec (the small June), = ~ July
8. Srpen (the month when its possible to eat matured grain), = ~ August
9. Září (the month of the rut), = ~ September
10. Říjen (the month of the deer rut), = ~ October
11. Listopad (the month when beet and cabbage tops fall), = ~ November
12. Prosinec (the month when the sun only flashes between the clouds), = ~ December

The names of the seasons:

1. zima, = winter
2. jaro, = spring
3. léto, = summer
4. podzim, = autumn

The names of the weekdays (Czech, Slovak, and Serbian names):

1. pondělí / pondelok / póndźela, = Monday
2. úterý / utorok / wutora, = Tuesday
3. středa / streda / srjeda, = Wednesday
4. čtvrtek / štvrtok / srjeda, = Thursday
5. pátek / piatok / pjatk, = Friday
6. sobota / sobota / sobota, = Saturday
7. needle / nedel'a / njedźela, = Sunday

Main sources: [GINZ] and [KLÍM]

91 Dai Calendar

This is also called the **Thai lunar calendar** or **Patithin chanthrakhati calendar**. See also (Old) *Lao calendar* and *Thai solar calendar*.

This is a lunisolar Buddhist calendar. Normally, a year consists of 354 days. To keep the years in sync with the seasons, an extra day is added to the seventh month (making the year, referred to as อธิกวาร ("extra-day year), equal to 355 days) or the eighth month is repeated (making the year, referred to as อธิกมาส ("extra-month year"), equal to 384 days).

Each month is also divided into two periods designated by whether they are waxing or waning. ข้างขึ้น (*khang khuen*) is the period from new moon to full moon, and ข้างแรม (*khang raem*) is the period from full moon to new moon.

The names of the months:

1. เดือนอ้าย duean ai, = ~ January (29 days)
2. เดือนยี่ duean yi, = ~ February (30 days)
3. เดือน สาม duean 3, = ~ March (29 days)
4. เดือน สี่ duean 4, = ~ April (30 days)
5. เดือน ห้า duean 5, = ~ May (29 days)
6. เดือน หก duean 6, = ~ June (30 days)
7. เดือน เจ็ด duean 7, = ~ July (29 days)

Sometimes an extra day called อธิกวาร, athikawan, is added when required.

8. เดือน แปด duean 8, = ~ August (30 days)

Sometimes this month is repeated. Then, it is written as 8/8. The extra month is called อธิกมาส, athikamat.

9. เดือน เก้า duean 9, = ~ September (29 days)
10. เดือน สิบ duean 10, = ~ October (30 days)
11. เดือน สิบเอ็ด duean 11, = ~ November (29 days)
12. เดือน สิบสอง duean 12, = ~ December (30 days)

In 1888, this calendar was officially replaced by the Gregorian calendar for legal and commercial puposes. However, it is still used in Burma, Cambodia, Laos, and Thailand for calculating lunar-regulated holy days.

Main sources: [EADE] and [LOND]

92 (Old) Danish Calendar

This lunisolar and agricultural calendar was used by inhabitants of present-day Denmark until the late eighteenth century, and came to correspond to the Julian months.

The names of the months:

1. Glugmåned, = ~ January
2. Gyjemåned, Göjemåned or Blidemåned, = ~ February
3. Tordmåned, = ~ March
4. Fåremåned or Græsmåned, = ~ April
5. Mejmåned, = ~ May
6. Sommermåned or Skærsommer, = ~ June
7. Ormemåned, = ~ July
8. Høstmåned, = ~ August
9. Fiskemåned, = ~ September
10. Sædemåned or Ridmåned, = ~ October
11. Slagtemåned, = ~ November
12. Juulemåned or Kristmåned, = ~ December

The names of the weekdays:

1. søndag, = Sunday
2. mandag, = Monday
3. tirsdag, = Tuesday
4. onsdag, = Wednesday
5. tordag, = Thursday
6. fredag, = Friday
7. lørdag, = Saturday

Main source: [GINZ]

93 Darian Calendar for Mars

This system of time-keeping, created by the American aerospace engineer Thomas Gangale in 1985, was designed to serve the needs of any possible future human settlers on the planet Mars. The calendar was named for Gangale's son Darian. In early 1988, Thomas Gangale admitted that he got the idea of a Martian calendar from the American science fiction writer Robert A. Heinlein (1907–1988), who referred to a 24-month Martian calendar in his book *Red Planet* from 1949.

The basic time periods from which the Darian calendar is constructed are the Martian solar day (called a *sol*) and the Martian vernal equinox year, which is slightly different from the tropical year. The sol is 39 minutes, 35.244 seconds longer than the Terrestrial solar day, and the Martian vernal equinox year is 668.5907 sols. The year is divided into 24 months. The first 5 months in each quarter have 28 sols. The final month has 27 sols during common years, but 28 sols if the year is a leap year. Leap years are years that are either odd or else evenly divisible by 10. A later iteration of the calendar that devised years divisible by 100 common years, with years divisible by 500 staying leap years, gave an error of only about one sol per 12,000 Martian years. The calendar maintains a seven-sol week, but the week is restarted from its first sol at the start of each month. If a month has 27 sols, this causes the final sol of the week to be omitted.

In an initial version of the calendar, Gangales chose the epoch (year 0) as the northern hemisphere vernal equinox prior to the landing of the Viking 1 spacecraft in July 1976. Later, he changed the epoch to be the Martian vernal equinox occurring on March 11, 1609, to make it possible to express any recorded telescopic observations of Mars through positive year numbers (as Galileo Galilei first observered the phases of Mars in December 1610).

The names the of the weekdays:

1. Sol Solis
2. Sol Lunae
3. Sol Martius
4. Sol Mercurii
5. Sol Jovis
6. Sol Veneris
7. Sol Saturni

The names of the months:

1. Sagittarius (28 days)
2. Dhanus (28 days)
3. Capricornus (28 days)
4. Makara (28 days)
5. Aquarius (28 days)
6. Kumbha (27 days)
7. Pisces (28 days)
8. Mina (28 days)
9. Aries (28 days)
10. Mesh (28 days)
11. Taurus (28 days)
12. Rishabha (27 days)
13. Gemini (28 days)
14. Mithuna (28 days)
15. Cancer (28 days)
16. Karka (28 days)
17. Leo (28 days)
18. Simha (27 days)
19. Virgo (28 days)
20. Kanya (28 days)
21. Libra (28 days)
22. Tula (28 days)
23. Scorpius (28 days)
24. Vrishika (27 days or 28 days during leap years)

The Martian seasons:

1. spring, = 193.30 sols
2. summer, = 178.64 sols
3. autumn, = 142.70 sols
4. winter, = 153.95 sols

Main sources: [GANG] and [ZUBR]
Internet source: pweb.jps.net/~tgangale/mars/mst/darian.htm

94 Dayak Calendar

This agricultural calendar was used by the Dayak people in Borneo.

The names of the seasons:

1. i-na-na (when all fields are prepared), = ~ mid-February–early May
2. la-tub (the first harvest), = ~ May–early June
3. cho-ok (when most of the rice is harvested), = ~ early June–early July
4. li-pas (no more palay-harvest), = ~ early July–mid-July
5. ba-li-ling (planting of camotes), = ~ mid-July–late August
6. sa-gan-ma (when the seed-beds are put into condition), = ~ late August–early November
7. pa-chong (seed-sowing), = ~ early November–late December
8. sa-ma (the seedlings are transplanted from the seed-beds), = ~ late December–mid-February

Main source: [NILS]

95 (Ancient) Delian Calendar

This lunisolar calendar was used on the island of Delos during ancient times.

The names of the months:

1. Ἑκατομβαιών Hekatombaion, = ~ June–July
2. Μεταγείτνιος Metageitnion, = ~ July–August
3. Βουφονιών Bouphonion, = ~ August–September
4. Ἀπατουριών Apatourion, = ~ September–October
5. Ἀρησιών Aresion, = ~ October–November
6. Ποσειδεών Poseideon, = ~ November–December
7. Ληναιών Lenaion, = ~ December–January
8. Ἱερός Hieros, = ~ January–February
9. Ταλαξιών Talaxion, = ~ February–March
10. Ἀρτεμίσιον Artemision, = ~ March–April
11. Θαργήλιον Thargelion, = ~ April–May
12. Πάναμος Panamos, = ~ May–June

Main sources: [GINZ] and [HANN3]

96 (Ancient) Delphic Calendar

This calendar was used in ancient Delphi.

The names of the months:

1. Βουκάτιος, Bucatios (Month of harvesting grapes), ~ September
2. Ηραίος Heraios (Month of falling leaves), ~ October
3. Απελλαίος Apellaios (Cold Month), ~ November
4. Διόσθυος Diosthyos (Snowy month), ~ December
5. Δαδαφόριος Dadaphorios (Month of burning trunks), ~ January
6. Ποιτρόπιος Poitropios (Month of dreadful ice), ~ February
7. Βύσιος Bysios (Month of budding), ~ March
8. Ἀρτεμίσιος Artemisios (Month of grass), ~ April
9. Ηράκλειος Heracleios (Month of mowing), ~ May
10. Βοαθόος Boathous (Month of grain), ~ June
11. Ἰλαῖος Ilaios (Golden month), ~ July
12. Θεοξένιος Theoxenios (Month of harvesting), ~ August

Main sources: [GINZ] and [HANN3]

97 Discordian Calendar

See *Erisian calendar*.

98 Discworld Calendar

This fictional calendar is defined in the fantasy books about *Discworld* by Terry Pratchett (1948–2015). The calendar is based on a Great Year, equal to 800 days. There is also an Agricultural Year, divided into 13 months, equal to 400 days.

The names of the months:

1. Ick (16 days)
2. Offle (32 days)
3. February (32 days)
4. March (32 days)
5. April (32 days)
6. May (32 days)
7. June (32 days)
8. Grune (32 days)
9. August (32 days)
10. Spune (32 days)
11. Sektober (32 days)
12. Ember (32 days)
13. December (32 days)

The names of the days in the 8-day week:

1. Sunday
2. Monday
3. Tuesday
4. Wednesday
5. Thursday
6. Friday
7. Saturday
8. Octeday

Main sources: [PRAT3] and [PRAT4]

99 (Ancient) Dorian Calendar

This calendar was used in Dorian Hexapolis during ancient times.

The names of the months:

1. Ξανδικός Xanthikos, = ~ mid-February–mid-March

Ξανδικός ἐμβόλιμος Xanthikos Embolimos, intercalated six times over a 19-year cycle

2. Ἀρτεμίσιος Artemisios, = ~ mid-March–mid-April
3. Δαίσιος Daisios, = ~ mid-April–mid-May
4. Πάνημος Panemos, = ~ mid-May–mid-June
5. Λῷος Loos or Ὁμολώϊος Homolōios, = ~ mid-June–mid-July
6. Γορπιαῖος Gorpiaios, = ~ mid-July–mid-August
7. Ὑπερβερεταῖος Hyperberetaios, = ~ mid-August–mid-September

Ὑπερβερεταῖος ἐμβόλιμος Hyperberetaios Embolimos, intercalated once over a 19-year cycle

8. Δῖος Dios, = ~ mid-September–mid-October
9. Ἀπελλαῖος Apellaios, = ~ mid-October–mid-November
10. Αὐδυναῖος Audynaios, = ~ mid-November–mid-December
11. Περίτιος Peritios, = ~ mid-December–mid-January
12. Δύστρος Dystros, = ~ mid-January–mid-February

Main sources: [GINZ] and [HANN3]

100 (Old) Drefu Calendar

This calendar was used on the Loyalty Islands in New Caledonia. The concept of naming the days of the week was introduced by the missionaries during the early nineteenth century.

The names of the weekdays:

1. Thupene hmi (after the holy day), = Monday
2. Drai ange dic (day devoted to training teachers), = Tuesday
3. Drai menu (ordinary day, without any religious education), = Wednesday
4. Drai kaco (day devoted to the religious education of the young), = Thursday

5. Drai katru (day devoted to the religious education of the adults), = Friday
6. Drai meci xen (day for fasting in preparation for the Sabbath), = Saturday
7. Drai hmitrötr (holy/sacred day), = Sunday

Main source: [SIMP2]

101 (Old) Dutch Calendar

This agricultural calendar was used in Dutch-speaking regions. In the early ninth century, Charlemagne introduced alternative names for the commonly-used month names in the national calendar. These names were even made compulsory in official documents starting in 1809.

1. lauwmaand, louwmaand, hardmaand, ijsmaand, or wolfsmaand, = ~ January
2. sprokkelmaand, kortemaand, regenmaand, schrikkelmaand, slijkmaand, or sprokkelmaand, = ~ February
3. lentemaand, snoeimaand or windmaand, = ~ March
4. grasmaand, eiermaand, kiemmaand, or paasmaand, = ~ April
5. bloeimaand, = ~ May
6. zomermaand, rozenmaand, wiedemaand, = ~ June
7. hooimaand or oogstmaand, = ~ July
8. oogstmaand or hittemaand, = ~ August
9. herfstmaand, gerstmaand, or vruchtmaand, = ~ September
10. wijnmaand, oogstmaand, or zaaimaand, = ~ October
11. slachtmaand, bloedmaand, herfstmaand, or nevelmaand, = ~ November
12. wintermaand, feestmaand, kerstmaand, sinterklaasmaand, or sneeuwmaand, = ~ December

The names of the seasons:

1. winter, = winter
2. lente, = spring
3. zomer, = summer
4. herfst, = autumn

When the Duke of Anjou tried to introduce the Gregorian calendar in the Netherlands, only Holland and Zeeland saw the political necessity of the new calendar and accepted it. In Brabant and Zeeland, December 14, 1582 was followed by December 15, 1582, and in Holland, January 1, 1583 was followed by January 12, 1583. During the early 1700s, some Dutch provinces switched to a so-called "Improved Julian calendar" which was identical to the Gregorian calendar, with the exception of the calculation of Easter. Hence, in Gelderland, June 30, 1700 was followed by July 12, 1700, in Overijssel and Utrecht, November 30, 1700 was followed by December 12, 1700, in Friesland and Groningen, December 31, 1700 was followed by January 12, 1701, and in Drenthe, April 30, 1701 was followed by May 12, 1701.

Main sources: [GINZ] and [WEIN]

102 (Old) Dyulan Calendar

This islamic calendar was used by the Dyula people in West Africa.

The names of the months and related months in the Islamic calendar:

1. gjo-mbende or moharamu, المحرّم, Muharram, (30 days)
2. do-mba-ma-kono, صفر, Safar, (29 days)
3. do-mba, الأوّل ربيع, Rabi' al-awwal, (30 days)
4. do-mba-koro-ko, الثاني ربيع or الآخ ربيع, Rabī' al-Thānī, (29 days)
5. koro-ko-fila-na, الأولى جمادى, Jumada al-Oola, (30 days)
6. kamu-do-ma-kono, الثانية جمادى or جمادى الآخرة, Jumada al-Thani, (29 days)
7. kamu-do or radzaba, رجب, Rajab, (30 days)
8. su-ngari-ma-kono, شعبان, Sha'aban, (29 days)
9. su-ngari, رمضان, Ramadan, (30 days)
10. mi-ngari, شوّال, Shawwāl, (29 days)
11. do-ngi-ma-kono, ذو القعدة, Dhu al-Qa'dah, (30 days)
12. do-ngi or djuliagidati, ذو الحجّة, Dhu al-Hijjah, (29 days and 30 days in leap year)

Main source: [GINZ]

103 Ecclesiastical Calendar

This is a calendar of the Christian year indicating the dates of fasts and festivals. Prior to 325 CE, Christian churches in different regions celebrated Easter on different dates. The Council of Nicea, in 325 CE, stated that Easter would be celebrated on Sundays, but there were still different methods of calculating the date. In 532 CE, Dionysius Exiguus defined a method for calculating the date for Easter. This method was described in 725 CE by Venerable Bede in his De temporum ratione.

During the late sixteenth century, Aloisius Lilius (1576) published tables that would be used to determine the date of Easter. These tables were slightly modified in 1583 by Christoph Clavius.

104 (Ancient) Egyptian Calendars

These were ancient calendars with two different mutually shifting years and festivals. In the third millennium BC, Egyptian priests introduced a lunar calendar for the purpose of planning religious rituals. It is believed that Imhotep, the supreme official of King Djoser (*c.* 2670 BCE), had a great impact on the construction of the calendar.

The year was called (*renpet*), and was composed of 12 months (*ȝbd*) of 30 days (*hru*) each. The months were named after various gods and goddesses in the Egyptian pantheon. There were also three seasons, each composed of 4 months. This was, of course, not ideal, as the actual lunar month is only 29½ days long, and some years would contain 13 new moons.

The names of the seasons and the months (during Middle Kingdom, during New Kingdom and in Greek):

The first season, when the Nile overflows: (Akhet)

1. Tekh/ Dhwt/Thot, ~ 21 July–19 August
2. Menhet/Pa-n-ip.t/Phaophi, ~ 20 August–18 September
3. Ḥwt-ḥwr/Ḥwt-ḥwr/Athyr, ~ 19 September–18 October
4. Ka-ḥr-ka/Ka-ḥr-ka/Khoiak, ~ 19 October–17 November

The second season, which corresponds to seed-time: Peret

5. Sf-bdt/Ta-'b/Tybi, ~ 18 November–17 December
6. Rekh wer/Mẖyr/Mekhir, ~ 18 December–16 January
7. Rekh neds/Pa-n-amn-htp.w/Phamenoth, ~ 17 January–15 February
8. Renwet/Pa-n-rnn.t/Pharmouthi, ~ 16 February–

The third season, when the harvesting was done: Shemou

9. Hnsw/Pa-n-ẖns.w/Pakhon
10. Hnt-htj/Pa-n-in.t/Payni
11. Ipt-hmt/Ipip/Epiph
12. Wep-renpet/Msw-r'/Mesorê

The calendar had 365 days, which included five additional feast days. These five epagomenal days were added to the end of each year and dedicated to the five children of Nut.

The epagomenal days:

1. wsir (Osiris's birthday)
2. ḥr.w (Horus's birthday)
3. swtẖ (Seth's birthday)
4. ỉs.t or ȝs.t (Isis's birthday)
5. nebt-het (Nephthys's birthday)

Each year was also divided into three periods of 10 days, , usually just called decans. The first decan was called , the second and the third .

The actual date of the inundation, the most important natural phenomenon to the ancient Egyptian civilization, could vary by as much as 8 days, making it a very inaccurate marker for the beginning of the year. Luckily, the ancient

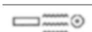
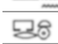
Egyptians had noticed that the brightest star in the sky,  Spdt or Sothis (the Greek name for Sirius), reappeared after an absence of 70 days and heralded the Nile River flood. They also realized that the helical rising of this star coincides with the new year's day of the civil calendar precisely every 1460 years. This so-called *Sothic Year* of 365¼ days was adopted and used as the marker of their year. This was later also called the *Canicular Year* (Sirius is known as the "dog star" and dog in Latin is *canis*).

The day was further divided into hours and parts of hours according to the table below.

	*see below*					Corresponding
rnp.t[a]						1 year
3	***ꜣḫt***, ***prt***, and ***šmu***[b]					1 season
12	4	***ꜣbd***[c]				1 month
360	120	30	***hru***[d]			1 day
8640	2880	720	24	***unu.t***[e]		1 h
15,552,000	5,184,000	1,296,000	43,200	1800	***ꜣ.t***[f]	2 s

[a]The *rnp.t* = 1 year is usually written as **renpet** by scholars
[b]The *ꜣḫt* is usually written as **ajet**, the *prt* as **peret**, and the *šmu* as **shemu**
[c]The *ꜣbd* is usually written as **abed** by scholars
[d]The *hru* is usually written as **heru** by scholars
[e]The *unu.t* is usually written as **unut** by scholars
[f]The *ꜣ.t* is usually written as **at** by scholars

Hieroglyphs

	*šmu*
	*prt*
	*ꜣḫt*

The practical needs of an agrarian society demanded a more season-stable calendar. In 286 BCE, Ptolemy III Euergetes tried to introduce an extra day every 4 years to correct the calendar according to the seasons, but this was not fully adopted until Egypt had been conquered by the Roman Empire, and Augustus introduced the "leap year." The old Egyptian calendars officially gave way to the Roman calendar. Despite this, the archaic calendar continued to be used for religious purposes by priests for several more centuries.

Main sources: [BOMH], [CLAG], [DEPU], [DRAC], [FURL], [MORG], and [PARK7]

105 (Ancient) Elamite Calendar

This calendar was used in the ancient Near East by Elamites until *c*. 330 BCE.

The names of the months:

1. Zikli or Hadukannaš, ~ March-April
2. Zarpakim or Turmar, ~ April-May
3. Hadar or Sākurriziš, ~ May-June
4. Hallime or Karmabataš, ~ June-July
5. Zillatam or Turnabaziš, ~ July-August
6. Belilit or Karbašiyaš, ~ August-September
7. Manšarki or Bakeyatiš, ~ September-October
8. Lankelli or Markašanaš, ~ October-November
9. Šibari or Hašiyatiš, ~ November-December
10. Šermi or Hanamakaš, ~ December-January
11. Kutmama or Samiyamaš, ~ January-February
12. Aššetukpi or Miyakannaš, ~ February-March

Main sources: [POEB] and [YARS]

106 (Ancient) Enoch Calendar

This ancient calendar is described in the pseudepigraphal Book of Enoch. The 364-day year was divided into four seasons, equal to 13 weeks each. Each season consisted of two 30-day months followed by one 31-day month.

Main source: [PRAT2]

107 (Ancient) Ephesian Calendar

This calendar was used during ancient times in Ephesus on the coast of Ionia. Later, the Ephesians adopted the month names used in the Macedonian calendar, and began their year with the month of Dios on the 24th of September.

The names of the months:

1. Neokaisareon, = ~ September
2. Kyanopsion, = ~ October
3. Ἀπατουρεών, Apaturion or Maimakterion, = ~ November
4. Ποσειδεών, Poseidion, = ~ December
5. Ληναιών, Lenaion, = ~ January
6. Anthesterion, = February
7. Ἀρτεμισιών, Artemision, = ~ March
8. Καλαμαιών, Calamaion or Ταυρεών, Taureon, = ~ April
9. Thargelion, = ~ May
10. Hagnaion, = ~ June
11. Hekatombaion, = ~ July
12. Metageitonion, = ~ August

Main sources: [GINZ] and [SMIT3]

108 (Ancient) Epidaurian Calendar

This calendar was used in ancient Epidaurus on the Sauronic Gulf.

The names of the months:

1. Ερμαίος Hermaios, = ~ September–October
2. Γάμιος Gamios, = ~ October–November
3. Τέλεος Teleos, = ~ November–December
4. Ποσίδαιος Posidaios, = ~ December–January
5. Αρταμίτιος Artamitios, = ~ January–February
6. Αριάνιος Agrianios, = ~ February–March
7. Πάναμος Panamos, = ~ March–April
8. Κύκλιος Kyklios, = ~ April–May
9. Απελλαίος Apellaios, = ~ May–June
10. Αζόσιος Azosios, = ~ June–July
11. Καρνείος Karneios, = ~ July–August
12. Προράτιος Proratios, = ~ August–September

The order of the months according to [GINZ]:

1. Αζόσιος Azosios, = ~ June–July
2. Καρνείος Karneios, = ~ July–August
3. Προράτιος Proratios, = ~ August–September
4. Ερμαίος Hermaios, = ~ September–October
5. Γάμιος Gamios, = ~ October–November
6. Τέλεος Teleos, = ~ November–December
7. Ποσίδαιος Posidaios, = ~ December–January
8. Αρταμίτιος Artamitios, = ~ January–February
9. Αριάνιος Agrianios, = ~ February–March
10. Πάναμος Panamos, = ~ March–April
11. Κύκλιος Kyklios, = ~ April–May
12. Απελλαίος Apellaios, = ~ May–June

Main sources: [GINZ] and [HANN3]

109 Era of the World

See *(Ancient) Byzantine calendar*.

110 Erisian Calendar

This is also called the **Discordian calendar**.

This is a calendar used by some adherents of Discordianism. The numbering of years is the same as that of Anno Domini years plus 1166. The year is aligned with the Gregorian calendar and begins on January 1.

The names of the seasons:

1. Chaos (73 days)
2. Discord (73 days)
3. Confusion (73 days)
4. Bureaucracy (73 days)
5. Aftermath (73 days)

The names of the days in the 5-day week:

1. Sweetmorn
2. Boomtime
3. Pungenday
4. Prickle-Prickle
5. Setting Orange

Main source: [HILL6]

111 Eskaleutic Calendars

These lunar calendars were used by Eskimos in Alaska.

The Central Eskimos in Alaska used a calendar with 13 months. The names of the months varied a great deal, according to the tribes and the latitude of the place. One month, *siringilang*, was of indefinite duration and denoted the entire portion of the year when the sun does not rise and there were scarcely any dawns. The difference from the solar year was balanced by leaving out this month every few years, when the new moon and the winter solstice coincided. One part of a month, *qaumartenga*, denoted the days which were without sun but had twilight, while the rest of the month was called *siriniktenga*.

The Northern Eskimos in Kawerauk used a calendar with 12 months, and each month was designated by something to remember.

The names of the 12 months used by the Northern Eskimos in Kawerauk:

1. nowaitoivick (when caribou fawns are born), = ~ April
2. ouchninick (when the snow is melting), = ~ May
3. naisearseavick (when baby seals are born), = ~ June
4. omeitoavick (when people begin to use boats), = ~ July
5. naloseivick (when caribou is driven into the lake to kill), = ~ August
6. segkuitoavick (when the ice forming begins), = ~ September
7. nicheiatoavick (rabbit snaring time), = ~ October
8. powtoavick (when the ptarmigan is caught with nets), = ~ November
9. sainatovick (carving time), = ~ December
10. onaitovick (short days), = ~ January
11. cawnick (when the days are getting long in daylight),= ~ February
12. sainotoavick (when people are building with wood and carving boats, bows and arrows for hunting), = ~ March

Main sources: [BOAS] and [OQUI]

112 Essene Calendar

See (Ancient) *Qumran calendar*.

113 (Old) Estonian Calendar

This lunisolar calendar was used in Estonia.

The names of the months in Dorpat, Pernau and Reval:

1. neäri (new year month), = ~ January
2. küünlakuu (kyndilsmässomånad), = ~ February
3. paastokuu (fastemånad), = ~ March
4. jürikuu or mahlakuu (georgsdagsmånad), = ~ April
5. lehtkuu or lehekuu (leaf month), = ~ May
6. jaanikuu (johannesdagsmånad), = ~ June
7. heinakuu (hay month), = ~ July
8. leikusekuu (harvest month), = ~ August
9. mihklikuu (mikaelismånad) or sügisekuu (autumn month), = ~ September
10. viinakuu (brännvinsmånad), = ~ October
11. talvekuu (winter month), = ~ November
12. jõulokuu (christmas month), = ~ December

Older names of the months in southern Estonia and among the Võro-speaking people:

1. vastse ajastaja kuu or vahtsõaastakuu (the month of the new year), = ~ January
2. hu´ndikuu (the month of the wolf) or radokuu, = ~ February
3. annekuu (the month of snow crust), linnukuu (the month of the birds), helmekuu (the month of the gem) or urbõkuu, = ~ March
4. mahlakuu (the month of Georgs' Day), = ~ April
5. lehekuu (the month of the leaves), = ~ May
6. piimäkuu, = ~ June
7. hainakuu (the month of the grass), = ~ July
8. põimukuu, = ~ August
9. süküskuu (the month of autumn), = ~ September
10. rehekuu, = ~ October
11. märtekuu, = ~ November
12. joulukuu (the month of Christmas), = ~ December

The names of the seasons:

1. talv, = winter
2. kevad, = spring
3. suvi, = summer
4. sügis, = autumn

The names of the weekdays:

1. pühapäev, = Sunday
2. esmaspäev, = Monday
3. teisipäev, = Tuesday
4. kolmapäev, = Wednesday
5. neljapäev, = Thursday
6. reede, = Friday
7. laupäev, = Saturday

Main source: [VASE]

114 Ethiopian Calendar

This was also called the **Ge'ez calendar**.

This calendar is identical to the Coptic calendar, except that the names of the months are different. The year consists of 12 months of 30 days each, to which is added a 5-day period (6 days in leap years).

The names of the months (leap-year-days in parentheses):

Amharic	Tigrinya	
መስከረም (mäskäräm)	መስከረም (mäsəkärämə)	11 September–10 October
ጥቅምት (ṭəqəmt)	ጥቅምቲ (t'əqəməti)	11 October–9 November
ኅዳር (hədar)	ኅዳር (hədarə)	10 November–9 December
ታኅሣሥ (taḫśaś)	ታኅሣሥ (tahəsasə)	10 December–8 January
ጥር (ṭərr)	ትሪ (təri)	9 January–7 February
የካቲት (yäkatit)	ለካቲት (läkatitə)	8 February–9 March
መጋቢት (mägabit)	መጋቢት (mägabitə)	10 March–8April (9 March–7 April)
ሚያዝያ (miyazya)	ሚያዝያ (miyazəya)	9 April–8 May (8 April–7 May)
ግንቦት) (gənbot)	ግንቦት (gənəbotə)	9 May–7 June (8 May–6 June)
ሰኔ (säne)	ሰነ (sänä)	8 June–7 July (7 June–6 July)
ሐምሌ (ḥamle)	ሐምለ (hamələ)	8 July–6 August (7 July–5 August)
ነሐሴ (nähase)	ነሐሰ (nähasä)	7 August–5 September (6 August–5 September)
ጳጕሜን (p̣agʷəmen)		6 September–10 September (5 September–10 September)

The leap year was called Kadis Yojannis. The era of the Ethiopian calendar begins 7 years and 8 months after the beginning of the Christian era.

The days of the week:

1. እሑድ əhus, = Sunday
2. ሰኞ seunyo, = Monday
3. ማክሰኞ makseunyo, = Thuesday
4. ረቡዕ rob, = Wednesday
5. ሐሙስ hamus, = Thursday
6. ዓርብ arb, = Friday
7. ቅዳሜ kədame, = Saturday

Main sources: [ALVA2], [GINZ], [REIN], and [YAEQ]

115 Evenk Calendar

This lunar calendar was used among the Evenks in Kamchatka Krai.

The names of the months:

1. ilaga (month when the leaves and the early blossoms come out)
2. ilkun (month of the proper flowering)
3. irin (month when the wild fruit grows ripe)
4. serula saum (month when the red deer pair)
5. hukterbi (month when the red deer get new hair)
6. okti (month when the first snow falls)
7. mira (month when the days are short)
8. giraun (month when the days are increasing)
9. okton kira (month when the sables are covered)
10. tura (month when the coromants come)
11. schonka (month when the ice becomes porous)
12. tukun (month when the rivers become clear)

Epagomenal days

Main source: [NILS]

116 Ewe Calendar

This lunisolar calendar is used by the Ewe-speaking people in southeastern Ghana and southern Togo.

The names of the months:

1. Dzove, = ~ January
2. Dzodze, = ~ February
3. Tedoxe, = ~ March
4. Afɔfiɛ, = ~ April
5. Damɛ, = ~ May
6. Masa, = ~ June
7. Siamlɔm, = ~ July
8. Dasiamime, = ~ August
9. Anyɔnyɔ, = ~ September
10. Kele, = ~ October
11. Adeɛmekpɔxe, = ~ November
12. Dzome, = ~ December

The names of the weekdays:

1. Dzoɖa, = Monday
2. Braɖa, = Tuesday
3. Kuɖa, = Wednesday
4. Yawoɖa, = Thursday
5. Fiɖa, = Friday
6. Memleɖa, = Saturday
7. Kɔsiɖa, = Sunday

The names of the seasons:

1. adame, = Tedoxe–Masa
2. keleme, = Siamlɔm–Kele
3. pepi, = Adeɛmekpɔxe–Dzodze

Main sources: [NILS] and [WEST4]

117 Faṣlī Calendar

This lunisolar calendar was devised by the Mughal emperor Akbar the Great for land revenue and records purposes in Bengal and northern India. It was formated in 1556 CE, Akbar's accession year. Thereafter, the Faṣlī era proceeded according to the Vikram Samvat calendar. The year had 12 months from July to June. See also *Vikram Samvat calendar*.

Main source: [LEWI9]

118 Filianic Calendar

This is also known as the **Aristasian calendar**.

This calendar is used by Filianists. The year, beginning at the spring equinox, consists of thirteen 28 day months grouped into five seasons plus an intercalary day (*hiatus*). Every 4 years, an extra intercalary day is added at the end of the year. The common 7-day week is used, but the first day of every month is Wednesday (Sai Mati's day).

The names of the months:

1. Culverine or Columbina (the dove month), 21 March–17 April
2. Maia (the month of Maia), 18 April–15 May
3. Hera or Hela (the heroine month), 16 May–12 June
4. Rosea or Roismond (the rose month), 13 June–10 July
5. Kerea (the corn month), 11 July–7 August
6. Vaskaras or Hesperia (the evening month), 8 August–4 September
7. Abolan or Mala (the apple month), 5 September–2 October
8. Voiś or Hadora (the month of the cow and of butter), 3 October–30 October
9. Werde (the month of Werde), 31 October–27 November
10. Astraea or Estrelle (the star month), 28 November–25 December
11. Herthe or Hertha (the month of Hertha), 26 December–22 January
12. Brighe (the month of Brighe), 23 January–19 February
13. Moura or Kala (the month of death), 20 February–19 March (18 March on a leap year)

Hiatus, an intercalary day, 20 March (during leap years: 19 March–20 March)

The names of the seasons:

1. Culverine-Hera, spring
2. Rosea-Vaskaras, summer
3. Abolan-Werde, autumn
4. Astraea-Brighe, winter
5. Moura

Main source: [SINC3]

119 (Old) Finnish Calendar

This lunar and agricultural calendar was used in ancient times in Finland.

The names of the lunar months:

1. esimmäinen sydänkuu, = ~ January
2. toinen sydänkuu
3. vaahtokuu
4. huuhtikuu
5. toukokuu
6. kesäkuu
7. heinäkuu
8. matäkuu
9. elokuu
10. syyskuu
11. likakuu
12. routakuu
13. joulukuu, = ~ December

Later, the names of the lunisolar months were reported as:

	Finnish	Veps	Võro
January	tammikuu	viluku	vahtsõaastakuu
February	helmikuu or kaimala	uhoku	radokuu
March	maaliskuu	keväz'ku	urbõkuu
April	huhtikuu	sulaku	mahlakuu
May	sulamakuu or toukokuu	semendku	lehekuu
June	kesäkuu	kezaku	piimäkuu
July	heinäkuu	heinku	hainakuu
August	elokuu	eloku	põimukuu
September	syyskuu	sügüz'ku	süküskuu
October	lokakuu	reduku	rehekuu
November	marraskuu	kül'mku	märtekuu
December	joulukuu	tal'vku	joulukuu

The names of the seasons:

1. talvi, = winter
2. kevät, = spring
3. kesä, = summer
4. syksy, = autumn

The names of the weekdays;

1. sunnuntai, = Sunday
2. maanantai, = Monday
3. tiistai, = Tuesday
4. keskiviikko, = Wednesday
5. torstai, = Thursday
6. perjantai, = Friday
7. lauantai, = Saturday

Main source: [GINZ]

120 Florentine Calendar

This calendar was used in Florence and Siena from about the twelfth century until the sixteenth century. The era began on March 25 (the feast of the Annunciation) in the year of Jesus' incarnation, thus in year 1 according to the Julian calendar. This made the calendar "1 year ahead of the Julian calendar" from January 1 until March 25. In this system (*calculus florentinus*), the new day began at sunset.

Main source: [JANS6]

121 French Republic Calendar

See *French Revolutionary calendar*.

122 French Revolutionary Calendar

This is also called the **French Republic calendar**.

This calendar was introduced on October 5, 1793, but antedated to November 24, 1793, and abolished on January 1, 1806, when Napoleon Bonaparte made France revert to the Gregorian calendar. The basic pattern of the calendar had been proposed by the essayist and philosopher Sylvain Maréchal (1750–1803) in 1788. The year was divided into 12 months of 30 days each followed by five (or six in leap years) extra days. This period was first called *Jours Complément*, then *Sanculottides*, after the most revolutionary of the revolutionaries. When the sans-culottes fell from power in 1795, it was once again named *Jours Complément*. The 5 days were to be devoted to national celebration. Periods of 4 years were to be called a *Franciade*.

Most of the names of the months were made up by the poet and actor Fabre d'Églantine (1750–1794).

Autumn:

1. Vendémiaire (vintage month), starting 22, 23 or 24 September
2. Brumaire (foggy month), starting 22, 23 or 24 October
3. Frimaire (freezing month), starting 21, 22 or 23 November

Winter:

4. Nivose (snowing month), starting 21, 22 or 23 December
5. Pluviôse (rainy month), starting 20, 21 or 22 January
6. Ventôse (windy month), starting 19, 20 or 21 February

Spring:

7. Germinal (budding month), starting on 20 or 21 March
8. Floréal (flowery month), starting 20 or 21 April
9. Prairial (meadows month), starting 20 or 21 May

Summer:

10. Messidor (harvest month), starting 19 or 20 June
11. Thermidor (heat month), starting 19 or 20 July
12. Fructidor (fruitful month), starting 18 or 19 August

Each month was divided into three décades, each of 10 days. The days of the décade were designated by numbers: Primidi, Duodi, Tridi, Quartidi, Quintidi, Sextidi, Septtidi, Octtidi, Nontidi, and Decadi. The last day of the decade, décadi, was to be a day of rest and rejoicing. This was the main source of discontent among the people who now had to work for 9 days before having a break.

The additional days were known as:

1. Jour de le vertu—Virtue Day
2. Jour de génie—Genius Day
3. Jour de travail—Labour Day
4. Jour de l'opinio—Reason Day
5. Jour des récompenses—Rewards Day
6. Jour de révolution—Revolution Day (the extra day for leap years)

The decades were abandoned in April 1802. It was also necessary to provide a "rational" substitute for the saints' days, and here d'Églantine and his colleagues, faced with the need for 366 names, fell from the sublime to the ludicrous. Every *quintide* was given the name of a domestic animal and every *décadi* the name of a tool.

As the calendar was introduced on November 24, 1793, it was decided that the calendar would retrospectively start on September 22, 1792. This was the autumnal equinox and "almost" the day the French Republic was founded (actually September 21). The Convention adopted the calendar by decrees of October 5, 1793 and 4 Frimaire II (November 24, 1793) and made décadi the day off for public officials. Leap years were intended to be as in the Gregorian calendar, with the addition of Herschel's rule that years divisible by 4000 should not be leap years. Leap years actually occurred in years 3, 7, and 11. Year 15 would have been a leap year, but the calendar ended in year 14. There was also an attempt to introduce a metric day which had 10 hours. Each hour had 100 minutes and each minute 100 seconds. As time passed, the events of the Revolution tempered its anticlericism, removing a major reason for the calendar's existence. Napoleon established good relations with the pope, leading to the restoration of the Roman Catholic religion in France The senatus-consult of 22 Fructidor XIII (September 9, 1805) moved the officials' day off back to Sunday and restored the Gregorian calendar effective January 1, 1806.

Main source: [REIN]

123 (Old) Frisian Calendar

This agricultural calendar was used among Frisians in Germany, the Netherlands and southern Denmark from the seventh century until the sixteenth century. See also (Old) *North Frisian calendar* and (Old) *West Frisian calendar*.

The names of the months:

1. Giuli, = ~ December/January
2. Solmonath, = ~ February
3. Hredmonath, = ~ March
4. Costurmonath, = ~ April
5. Thrimilki, = ~ May
6. Aerra lida, = ~ June
7. Äftera lida, = ~ July
8. Veodmonath, = ~ August
9. Halegmonath, = ~ September
10. Vinterfyllith, = ~ October
11. Blotmonath, = ~ November

Later:

1. Giuli, = ~ January
2. Solmonath, = ~ February
3. Hlydmonath, = ~ March
4. Ostermonath, = ~ April
5. Thrimilki, = ~ May
6. Aerra lida, = ~ June
7. Äftera lida, = ~ July
8. Veodmonath, = ~ August
9. Hearfestmonath, = ~ September
10. Vinterfyllith, = ~ October
11. Blotmonath, = ~ November
12. Aerra giuli, = ~ December

Main source: [GINZ]

124 (Old) Futunan Calendar

This seasonal stellar calendar was used on the Futuna island in the Pacific Ocean.

The names of the months:

1. ualoa (three stars in line), = ~ April
2. tutalupe (four stars representing a pigeon roosting), = ~ May
3. mataliki (the Pleiades), = ~ June
4. tolu (the Belt of Irion), = ~ July
5. palolo mua (Sirius), = ~ August
6. palolo muli (Regulus), = ~ September
7. munifa (four stars forming a little square), = ~ October
8. tauafu (the lesser rains), = ~ November
9. vai mua (first great rains)
10. vai muli (second great rains)
11. lisa mua (first great winds), = ~ December
12. lisa muli (second great winds), = ~ January
13. fakaafuola (lessening winds), = ~ February
14. fakaafumate (last winds), = ~ March

The names of various periods of the day:

1. pongipongiusu, = morning
2. laalaatea, = midday
3. afiafi, = evening
4. pouli, = night

Main source: [WILL8]

125 (Old) Gaelic Calendars

These calendars centred the seasons on the solstices and equinoxes. The seasons began at the approximate halfway points between solstice and equinox. The calendars were used in present-day Britain during the Middle Ages. See also (Ancient) *Celtic Lunar calendar* and (Old) *Coligny calendar*.

The names of the months:

	Irish-Gaelic	Gaeltachtaí-Gaelic	Scottish-Gaelic	Mapping to English
November	Mí na Samhna or Samhain	Mí na Samhna	an t-Samh uinn	the sleeping month
December	Mí na Nollag or Nollaig	Mí na Nollag	an Dùbhlachd	the dark month
January	Enáir	Mí Eanáir	am Faoilteach	the wolf month
February	Feabhra	Mí na bhFaoilleach	an Gearran	the rabbit month
March	An Márta	Mí an Mhárta	am Màrt	the cow month
April	An t-Aibreán	Mí Aibreáin	an Giblean	the scraps month
May	An Bealtaine	Mí na Bealtaine	an Cèitean	the showers month
June	An Meitheamh	Mí na Féile Eoin	an t-Òg-mhios	the young month
July	Iúil	Mí na Súl Buí	an t-Iuchar	the keys month
August	Lúnasa	Mí Lúnasna	an Lùnastal	the lynx month
September	Meán Fómhair	Mí Mheán Fómhair	an t-Sult uine	the eye month
October	Deireadh Fómhair	Mí Dheireadh Fómhair	an Dàmhair	the stag month

The names of the months:

	Manx	Welsh	Cornish	Breton
November	Mee Houney	Tachwedd	Du	Miz Du
December	Mee Ny Nollick	Rhagfyr	Kevardu	Kerzu
January	Jerrey Gheuree	Ionawr	Genver	Genver
February	Toshiaght Arree	Chwefror	Hwevrer	C'hwevrer
March	Mayrnt	Mawrth	Maurth	Meurzh
April	Averil	Ebrill	Ebryl	Ebrel
May	Boaldyn	Mai	Me	Mae
June	Mean Souree	Mehefin	Metheven	Mezheven
July	Jerrey Souree	Gorffennaf	Gorteren	Gouere
August	Luanistyn	Awst	Est	Eost
September	Mean Fouyir	Medi	Gwynngala	Gwengolo
October	Jerrey Fouyir	Hydref	Hedra	Here

The names of the seasons*:*

Mapping to English	Irish-Gaelic	Scotish-Gaelic	Manx	Welsh	Cornish	Breton
Winter (November–January)	geimhreadh	an Gheimhreadh	geurey	gaeaf	gwaf	goañv
Spring (February–April)	earrach	an t-Earrach	arree	gwanwyn	gwaynten	nevez-amzer
Summer (May–July)	samhradh	an Samhradh	sourey	haf	haf	hañv
Autumn (August–October)	fómhar	am Fóghar	fouyr	hydref	kynyaf	diskar-amzer

During ancient times, the Gaelic-Irish society measured time in 1-, 3-, 5-, 10-, and 15-day periods. When the country was Christianized, the 7-day week became common.

The names of the weekdays in Old Irish:

1. Diu scroll, = Sunday
2. Diu luna, = Monday
3. Diu mart, = Tuesday
4. Diu iath, = Wednesday
5. Diu eathamon, = Thursday
6. Diu triach, = Friday
7. Diu satur, = Saturday

Later the weekdays were named as below:

	Irish-Gaelic	Scottish-Gaelic	Manx	Welsh	Cornish	Breton
Sunday	An Domhnach or Dé Domhnaigh	Di-Dòmhnaich	Jedoonee	Dydd Sul	Dy' Sul	Disul
Monday	An Luain or Dé Luain	Di-Luain	Jelune	Dydd Llun	Dy' Lun	Dilun
Tuesday	An Mháirt or Dé Máirt	Di-Màirt	Jemayrt	Dydd Mawrth	Dy' Meurth	Dimeurtzh
Wednesday	An Chéadaoin or De Céandaoin	Di-Ciadain	Jecrean	Dydd Mercher	Dy' Mergher	Dimerc'her
Thursday	An Déardaoin or Déardaoin	Di-Ardaoin	Jerdein	Dydd Iau	Dy' Yow	Diriaou
Friday	An Aoine or Dé hAoine	Di h-Aione	Jeheiney	Dydd Gwener	Dy' Gwener	Digwener
Saturday	An Satharn or Dé Sathairn	Di-Sàthairne	Jesarn	Dydd Sadwrn	Dy' Sadorn	Disadorn

Other measures in Irish-Gaelic:

1 aeis = an aeon
1 saegal = a speculum
1 bliadain = a year
1 tréimse = a season
1 ráithe = 3 months
1 mi = a month
1 coictiges = a fortnight
1 sennight or sechtman = a week
1 oídhche (night) was also used as a measure in preference to a day

Main sources: [BAMM], [KOCH, pp. 330–2], [ODON], and [ROBE5]

126 Gaurabda Calendar

This is also called the **Vaiṣṇava calendar**. See also *Hindu calendars*.

This calendar is used by Gaudiya Vaishnavas and the International Society for Krishna Consciousness. The years are counted from the appearance of Krishna's incarnation, ording to the Bhavishya Purana, as Lord Sri Caitanya Mahaprabhu in 1486. Each month is known by a name of Visnu.

The names of the months:

1. Vishnu, = ~ mid-March–mid April
2. Madhusudana, = ~ mid-April–mid-May
3. Trivikrama, = ~ mid-May–mid-June
4. Vamana, = ~ mid-June–mid-July
5. Sridhara, = ~ mid-July–mid-August
6. Hrsikesa, = ~ mid-August–mid-September
7. Padmanabha, = ~ mid-September–mid-October
8. Damodara, = ~ mid-October–mid-November
9. Kesava, = ~ mid-November–mid-December
10. Narayana, = ~ mid-December–mid-January
11. Madhava, = ~ mid-January–mid-February
12. Govinda, = ~ mid-February–mid-March

Purusottama, = intercalary month

Internet source: www.vaisnavacalendar.com

127 (Ancient) Gazan Calendar

This lunisolar calendar was used in the Gaza area.

The names of the months:

1. Δῖος Dios, 28 October–26 November (30 days)
2. Ἀπελλαῖος Apellaios, 27 November–26 December (30 days)

3. Αὐδυναῖος Audynaios, 27 December–25 January (30 days)
4. Περίτιος Peritios, 26 January–24 February (30 days)
5. Δύστρος Dystros, 25 February–26 March (30 days)
6. Ξανδικός Xanthikos, 27 March–25 April (30 days)
7. Ἀρτεμίσιος Artemisios, 26 April–25 May (30 days)
8. Δαίσιος Daisios, 26 May–24 June (30 days)
9. Πάνημος Panemos, 25 June–24 July (30 days)
10. Λῷος Loos, 25 July–24 August (30 days)

Epagomenal days, 25 August–28 August (5 days)

11. Γορπιαῖος Gorpiaios, 29 August–27 September (30 days)
12. Ὑπερβερεταῖος Hyperberetaios, 28 September–27 October (30 days)

Main sources: [GINZ] and [HANN3]

128 Ge’ez Calendar

See *Ethiopian calendar*.

129 Genka Calendar

See also *Japanese calendars*.

This was also known as the **Yuan-chia li**.

This lunisolar calendar was used in Japan from 604 until 680.

Main source: [NUSS]

130 (Old) Georgian Calendar

This calendar was used in Georgia.

The names of the months:

1. ახალწლისა ენკენისთვე Akhaltslisa Enkenistve, = ~ September
2. ღვინობისთვე Gvinobistve, = ~ October
3. გიორგობისთვე Giorgobistve, = ~ November
4. ქრისტეშობისთვე Kristeshobistve, = ~ December
5. აპნისი Apnisi, = ~ January
6. სურწყუნისი Surtskunisi, = ~ February
7. მირკანი Mirkani, = ~ March
8. იგრიკა Igrika, = ~ April
9. ვარდობისთვე Vardobistve, = ~ May
10. თიბათვე Tibatve, = ~ June
11. მკათათვე Mkatatve, = ~ July
12. მარიამობისთვე Mariamobistve, = ~ August

The names of the seasons:

1. ზამთარი zamtari, = winter
2. გაზაფხული gazapkhili, = spring
3. ზაფხული zapkhuli, = summer
4. შემოდგომა shemodgoma, = autumn

The names of the weekdays:

1. კვირა kvira, = Sunday
2. ორშაბათი oršabat’i, = Monday
3. სამშაბათი samšabat’i, = Tuesday
4. ოთხშაბათი ot’xšabat’i, = Wednesday
5. ხუთშაბათი xut’šabat’i, = Thursday
6. პარასკევი paraskevi, = Friday
7. შაბათი šabat’i, = Saturday

131 (Ancient) Gezer Calendar

In 1908, the Irish archaeologist R.A.S. Macalistair discovered a clay tablet, dated to the second half of the tenth century BCE, on which was inscribed a poem mentioning the months of the year with their agricultural tasks. Only the summer months could be seen on what remained of the plate, the second half of the plate presumably giving the winter months. The remaining text, written in vertical and in seven lines, may give the names of months as presented below.

1. yrḥw ’sp yrḥw z (2 months of harvest and 2 months from seed)

2. r3 yrḥw lqš (2 months for renewal)
3. yrḥ 3ṣd pšt (the month of picking flax)
4. yrḥ qṣr š3r[ym (the month of barley harvest)
5. yrḥ qṣr wkl (the month of harvest and survey)
6. yrḥw zmr (2 months of pruning)
7. yrḥ qṣ (the summer month)
8. ?
9. ?
10. ?
11. ?
12. ?

Main sources: [MACA], [MCCA3], and [WIRG]

132 Gihō Calendar

See also *Japanese calendars*.

This lunisolar calendar was introduced in Japan during the Yi-feng era (676–678).

Main sources: [MONB] and [NUSS]

133 Goki Calendar

See also *Japanese calendars*.

This was also called the **Wuji li**.

This lunisolar calendar was used in Japan from 858 to 862.

Main source: [NUSS]

134 Goddess Lunar Calendar

This arithmetic lunar calendar was proposed by the American software developer Peter Meyer in 2012 as an improved version of a Goddess lunar calendar, proposed by the American philosopher and author Terence McKenna (1946–2000) in 1987. In this calendar, every year has exactly 13 months and every year cycle has exactly 470 years. Odd-numbered months have 30 days and even-numbered months have 29 days, except in years whose numbers are divisible by either 10 or 235, or both. In these cases, the short years, the 13th month only has 29 days. According to this, the total number of days in 470 years would be 180,432 days, and the average length of a month would be 29.5306056 days. As this only differs from the current value of the synodic month by 0.0000168 days, it would take about 4579 calendar years before the calendar would be out of sync with the lunar cycle by 1 day.

A date is written as cycle-year-month-day, with "MMG" appended to indicate that it is a date in the" McKenna-Meyer Goddess" calendar.

The proposed names of the months:

1. Athena (30 days)
2. Brigid (29 days)
3. Cerridwen (30 days)
4. Diana (29 days)
5. Epona (30 days)
6. Freya (29 days)
7. Gaea (30 days)
8. Hathor (29 days)
9. Inanna (30 days)
10. Juno (29 days)
11. Kore (30 days)
12. Lilith (29 days)
13. Maria (30 days in common years, or 29 days in short years)

Peter Meyer earlier devised another Goddess lunar calendar. This calendar consisted of 25 months named after goddesses of the Greek, Hindu, Roman, Egyptian, Yoruba, Celtic, Phrygian, Maya, Aztec, Shinto, Chinese Buddhist, Indian Buddhist, German, and Sumerian cultures.

The months alternated between 29 and 30 days, with odd-numbered months having 30 days and even-numbered months having 29 days. They were numbered from 1 to 25 and were given names which began, in sequence, with the first 25 letters of the English alphabet.

The names of the months:

1. Artemis (30 days)
2. Bast (29 days)
3. Cybele (30 days)
4. Durga (29 days)
5. Eris (30 days)
6. Freya (29 days)

7. Gaea (30 days)
8. Hathor (29 days)
9. Ix Chel (30 days)
10. Juno (29 days)
11. Kali (30 days)
12. Luna (29 days)
13. Maat (30 days)
14. Nisaba (29 days)
15. Oya (30 days)
16. Persephone (29 days)
17. Quan Yin (30 days)
18. Rhiannon (29 days)
19. Saraswati (30 days)
20. Tara (29 days)
21. Usha (30 days)
22. Venus (29 days)
23. Waka-Hiru-Me (30 days)
24. Xochiquetzal (29 days, or 30 days in leap years)
25. Yemaya (30 days)

Leap years were years divisible by 4 or by 51. In a leap year, the 24th month, Xochiquetzal, was given an extra day. This was chosen because the Aztecs held a festival in honor of the goddess Xochiquetzal every 8 years, and the duration of 8 years according to the Tonalpohualli Calendar approximately corresponded to the 4 years of this Goddess calendar.

Main source: [LATH]

Internet source: www.fractal-timewave.com

135 (Old) Gothic Calendar

This calendar was used by the Goths in East Germany until at least the sixth century.

Reconstruction of the names of the months:

1. 𐌰𐌸𐌰𐍂 𐌾𐌹𐌿𐌻𐌴𐌹𐍃 aþar jiuleis, = December
2. 𐍃𐌿𐌻𐌰𐌼𐌴𐌽𐍉𐌸𐍃 sulamenoþs, = January
3. 𐌷𐍂𐍉𐌸𐌹𐌼𐌴𐌽𐍉𐌸𐍃 hroþimenoþs, = February
4. 𐌰𐌿𐍃𐍄𐍂𐌰𐌼𐌴𐌽𐍉𐌸𐍃 austramenoþs, = March
5. 𐌸𐍂𐌹𐌼𐌿𐌻𐌺𐌹𐌼𐌴𐌽𐍉𐌸𐍃 þrimulkimenoþs, = April
6. 𐍆𐍂𐌿𐌼𐌰 𐌻𐌹𐌽𐌸𐌾𐌰 fruma linþja, = May
7. 𐌰𐌸 𐌰 𐌻𐌹𐌽𐌸𐌾𐌰 aþar linþja, = June
8. 𐍅𐌹𐌿𐌳𐌰𐌼𐌴𐌽𐍉𐌸𐍃 wiudamenoþs, = July
9. 𐌷𐌰𐌹𐌻𐌰𐌲𐌰𐌼𐌴𐌽𐍉𐌸𐍃 or 𐌰𐍃𐌰𐌽𐌰𐌼𐌴𐌽𐍉𐌸 𐍃 hailagamenoþs or asanamenoþs, = August
10. 𐍅𐌹𐌽𐍄𐍂𐌿𐍆𐌿𐌻𐌻𐌴𐌹𐌸𐍃 wintrufulleiþs, = September
11. 𐌱𐌻𐍉𐍄𐌰𐌼𐌴𐌽𐍉𐌸𐍃 blotamenoþs, = October
12. 𐍆𐍂𐌿𐌼𐌰 𐌾𐌹𐌿𐌻𐌴𐌹𐍃 fruma jiuleis, = November

Internet source: www.oe.eclipse.co.uk and scripts from Wikicommons.

136 (Ancient) Greek Calendars

See also (Ancient) *Aetolian calendar*, (Ancient) *Amphissan calendar*, (Ancient) *Attic calendar*, (Ancient) *Boeotian calendar*, (Ancient) *Byzantine Cretan calendar*, (Ancient) *Cyzicene calendar*, (Ancient) *Delian calendar*, (Ancient) *Delphic calendar*, (Ancient) *Dorian calendar*, (Ancient) *Ephesian calendar*, (Ancient) *Epidaurian calendar*, (Ancient) *Halosian calendar*, (Ancient) *Lacedaemonian calendar*, (Ancient) *Lamian calendar*, (Ancient) *Paphosian calendar*, (Ancient) *Perrhaebian calendar*, (Ancient) *Rhodian calendar*, (Ancient) *Samosian calendar*, (Ancient) *Taorminian calendar*, and (Ancient) *Thessalian calendar*.

These calendars were used by the early Greeks. The year usually began in October, and each month had a combination of astronomical and natural cues, which helped keep the timing of human and natural activities synchronized. Each of the different Greek city-states had different month names, and separate priests decided when an intercalary month was needed based on stellar observations. In addition to the calendars listed above, several isolated months of other ancient Greek states are known, but as it has not been possible to determine what place they occupied in the calendar and with which of our months they correspond, I have chosen to omit these.

The Greek days were numbered from 1 to 30, and included auspicious days for various activities, such as "planting," "giving birth to boys" and "worshipping gods."

The weekdays were named after Sun, Moon, Ares, Hermes, Zeus, Aphrodite, and Cronos.

The names of the weekdays:

1. ἡμέρα Ἡλίου hêméra Hêlíou, = Sunday
2. ἡμέρα Σελήνης hêméra Selễnês, = Monday
3. ἡμέρα Ἄρεως hêméra Áreôs, = Tuesday
4. ἡμέρα Ἑρμοῦ hêméra Hermoú, = Wednesday
5. ἡμέρα Διός hêméra Diós, = Thursday
6. ἡμέρα Ἀφροδίτης hêméra Aphrodítês, = Friday
7. ἡμέρα Κρόνου hêméra Krónou, = Saturday

Main source: [GINZ]

137 Gregorian Calendar

This is slso called the **Western calendar**, **New Style calendar**, **Christian calendar**, or, in its early years, **Lilian calendar**.

This is the most common modern calendar. It was a modification of the Julian calendar, undertaken because the Julian calendar year averaged 11 minutes and 14 seconds longer than the solar year, causing a discrepancy that accumulated over the centuries.

The Julian calendar was introduced in 46 BC, but by the eighth century, people were already noticing that the vernal equinox was coming too early. By the thirteenth century, the error was more than a week, and Roger Bacon was urging calendar reform on the Pope. Nothing was done about it until Pope Gregory XIII (1502–1585; elected 1572) introduced it by papal bull *Inter gravissimas*, dated February 24, 1582.

The reform was mainly based on a proposal made by Luigi Giglio (latinized as Aloysius Lilius, *c*. 1510–1576), a lecturer in medicine at the University of Perugia, who wrote a manuscript titled *Compendiuem novae rationis restituendi kalendarium*. The proposal included reducing the number of leap years in four centuries from 100 to 97. After his death, his brother Antonio presented this manuscript to Pope Gregory XIII, who forwarded it to the calendar reform commission he had created. The commission, which included the noted German Jesuit astronomer Christopher Clavius (1538–1612), made minor modifications to the proposal.

The Gregorian reform modified the Julian calendar as follows:

1. Ten days of the accumulated error were removed by making the day follwing Thursday, October 4, 1582, Friday October 15.
   This change was not enough to return the vernal equinox to March 25, the date it had fallen on in Ceasar's time, but rather to March 21, the date it had occupied during the First Council of Nicea in 325 CE.
2. To prevent the equinoxes from drifting in the future, a century year must be evenly divisible by 400 to be a leap year. This rule made the calendar agree with earth's revolution about the sun within 1 day in 3323 years.

An additional rule has been suggested in modern times, specifically that years divisible by 4000 not be leap years. This change would make the calendar correct to 1 day in about 20,000 years.

In Christian religious contexts, dates according to the Gregorian Calendar are preceded by AD (for "*anno Domini*," [the year of the Lord]) or followed by BC (for "before Christ"); in other contexts, the dates are followed, respectively, with CE (for "Common [or Christian] Era") or BCE (for "Before the Common [or Christian] Era"). In English, AD is often replaced—especially in speaking—with the phrase, "The Year of Our Lord." In referring to centuries, AD and BC come after the reference. There is no year 0, 1 AD immediately follows 1 BC.

Because the Julian calendar uses the same AD/BC/CE/BCE designators as the Gregorian calendar, various systems are employed for distinguishing between the two. Most commonly, Gregorian calendar dates are preceded by the abbreviation NS (New Style), and Julian calendar dates are preceded by the abbreviation OS (Old Style). Alternatively, dates in the Gregorian Calendar are distinguished from the Julian Calendar by dropping the designators altogether and using positive year numbers for CE and negative year numbers for BCE; for example, the Gregorian Calendar dates *NS November 12, 1963 CE* and *NS July 6, 65 BCE* would be *November 12, 1963*, and *July 6, −65* respectively.

The names of the months in English:

1. January (31 days)
2. February (28 days, 29 days in leap years)
3. March (31 days)
4. April (30 days)
5. May (31 days)
6. June (30 days)
7. July (31 days)
8. August (31 days)
9. September (30 days)
10. October (31 days)
11. November (30 days)
12. December (31 days)

The months of the Gregorian calendar are differently named in different languages.

	Afrikaans	Albanian	Alsatian	Aranese	Aromanian	Asturian	Azerbaijani
January	Januarie	janár	Janner	Gèr	gulugeu or yinar	xineru	Yanvar
February	Februarie	shkurt	Hornig	Hereuèr	flivrar or shcurtu	febreru	Fevral
March	Maart	mars	März	Març	martsu	marzu	Mart
April	Apri	prill	April	Abriu	aprir	abril	Aprel
May	Mei	maj	Mäi	Mai	maiu	mayu	May
June	Junie	qershór	Jüni	Junh	cirishar	xunu	İyun
July	Julie	korrik	Jüli	junhsèga	alunar or iuliu	xunetu	İyul
August	Augustus	gusht	Äugscht	Agost	agustu or avgustu	agostu	Avqust
September	September	shtatór	Septamber	Seteme	ghismãciuni or septemvriu	setiembre	Sentyabr
October	Oktober	tetór	Oktower	Octobre	sãmedru	ochobre	Oktyabr
November	November	nëntór	Novamber	noveme	brumar	payares	Noyabr
December	Desember	dhjetór	Dezamber	Deseme	dechemvriu	avietnu	Dekabr

	Basque	Bulgarian	Catalan	Corsican	Danish	Dgèrnésiais (spoken in Guernsey)
January	urtarrila	януари	gener	ghjennaghju	januar	janvier
February	otsaila	февруари	febrer	ferraghju	februar	févérier
March	martxoa	март	març	Marzu	marts	mar
April	apirila	април	abril	Aprile	april	avril
May	maiatza	май	maig	Maghju	maj	mai
June	ekaina	юни	juny	Ghjugnu	juni	juin
July	uztaila	юли	juliol	Lugliu	juli	juillet
August	abuztua	август	agost	Aostu	august	avout
September	iraila	септември	setembre	sittembre	september	séptembre
October	urria	октомври	octubre	Uttobre	oktober	octobre
November	hazaroa	ноември	novembre	nuvembre	november	novembre
December	abendua	декември	desembre	dicembre	december	décembre

	Dutch	Elfdalian	Erzya	Estonian	Faroese
January	januari	januari	Якшамков (jakšamkov)	jaanuar	januar
February	februari	februari	Даволков (davolkov)	veebruar	febrer
March	maart	mass	Эйзюрков (ėjzjurkov)	märts	mars
April	april	aprill	Чадыков (čadykov)	aprill	apríl
May	mei	maj	Панжиков (panžikov)	mai	mai
June	juni	juni	Аштемков (aštemkov)	juuni	juni
July	juli	juli	Медьков (med’kov)	juuli	juli
August	augustus	agusti	Умарьков (umar’kov)	august	august
September	september	september	Таштамков (taštamkov)	september	september
October	oktober	oktober	Ожоков (ožokov)	oktoober	oktober
November	november	november	Сундерьков (sunder’kov)	november	november
December	december	desember	Ацамков (acamkov)	detsember	desember

	Figuig Berber	Fijian	French
January	yennaïr	Jaanueri	janvier
February	fubraïr	Feperueri	février
March	mars	Maji	mars
April	ibrîr	Epereli	avril
May	mâyû	Mee	mai
June	yûlyû	Junee	juin
July	yûlyûz	Julai	juillet
August	r’usht	Okosita	août
September	shutânbir	Sepiteba	septembre
October	ktûber	Okotova	oktoober
November	nuwânbir	Nooveba	novembre
December	diwânbir	Tiiseba	décembre

	North Frisian	West Frisian	Saterland Frisian
January	januuar	Jannewaris	Januoar
February	februaar	Febrewaris	Februoar
March	märts	Maart	Meerte
April	april	April	April
May	moi	Maaie	Moai
June	juuni	Juny	Juni
July	juuli	July	Kuli
August	august	Augustus	August
September	septämber	Septimber	September
October	oktoober	Oktober	Oktober
November	nowämber	Novimber	November
December	detsämber	Desimber	Dezember

	Friulian	Galician	Gascon (in Béarn and Gascony)
January	genâr	xaneiro	Gèr
February	fevrâr	febreiro	Heurèr
March	març	marzo	Març
April	avrîl	abril	Abriu
May	mai	maio	Mai
June	jugn	xuño	Junh
July	lui	xullo	Julh
August	avost	agosto	Agóst
September	setembar	setembro	Seteme
October	otubar	outubro	Octobre
November	novembar	novembro	Noveme
December	decembar	decembro	Deceme

	German	Swiss German	Pennsylvania German
January	Januar	Januar	Yenner
February	Februar	Februar	Hanning
March	März	Merz	Matz
April	April	April	Abril
May	Mai	Mai	Moi
June	Juni	Juni	Tschuun
July	Juli	Juli	Tschulei
August	August	Auguscht	Aagscht or Auguscht
September	September	Septämber	September
October	Oktober	Oktober	Oktower
November	November	Novämber	Nowember
December	Dezember	Dezämber	Disember

	Greek	Greenlandic	Haitian creole	Hungarian	Icelandic	Indonesian
January	Ιανουάριος	januari	janvye	január	janúar	Januari
February	Φεβρουάριος	februari	fevriye	február	febrúar	Februari
March	Μάρτιος	martsi	mas	március	mars	Maret
April	Αρίλιος	aprili	avril	április	apríl	April
May	Μάιος	maji	me	május	maí	Mei
June	Ιούνιος	juni	jen	június	júní	Juni
July	Ιούλιος	juli	jiyè	július	júlí	Juli
August	Αύγουστος	augustusi	out	augusztus	ágúst	Agustus
September	Σεπτέμβριος	septemberi	septanm	szeptember	september	September
October	Οκτώβριος	oktoberi	oktòb	október	október	Oktober
November	Νοέμβριος	novemberi	novanm	november	nóvember	November
December	Δεκέμβριος	decemberi	desanm	december	desember	Desember

	Italian	Jèrriais (spoken in Jersey)	Kapampangan	Ladino	Latin	Latvian
January	gennaio	Janvyi	Enero	Jenero	Iānuārius	janvāris
February	febbraio	Févri	Pebrero	Fevrero	Februārius	februāris
March	marzo	Mar	Marso	Marso	Martius	marts
April	aprile	Avri	Abril	Avril	Aprīlis	aprīlis
May	maggio	Mai	Mayo	Mayo	Māius	maijs
June	giugno	Juîn	Hunio	Junio	Iūnius	jūnijs
July	luglio	Juilet	Hulio	Djulio	Iūlius	jūlijs
August	agosto	Août	Agosto	Agosto	Augustus	augusts
September	settembre	Septembre	Septiembre	Sietembre	September	septembris
October	ottobre	Octobre	Octubre	Oktubre	Octōber	oktobris
November	novembre	Novembre	Nobiembre	Noviembre	November	novembris
December	dicembre	Dézembre	Diciembre	Disiembre	December	decembris

	Ligurian	Low German	Luxembourgish	Macedonian	Malay	Maldivian	Maltese
January	zenná	Januor	Januar	јануари	Januari	ޖެނުއަރީ (jenuarī)	Jannar
February	frevá	Februor	Februar	февруари	Februari	ފެބުރުއަރީ (feburuarī)	Frar
March	marsu	Moaz	Mäerz	март	Mac	މާޗް (māč)	Marzu
April	arví	April	Abrëll	април	April	އެޕްރިލް (epril)	April
May	mazzu	Mai	Mee	мај	Mei	މެއި (mei)	Mejju
June	zûgnu	Juni	Juni	јуни	Jun	ޖޫން (jūn)	Ġunju
July	lûggiu	Juli	Juli	јули	Julai	ޖުލައި (julai)	Lulju
August	agustu	Agosto	August	август	Ogos	އޯގަސްޓް (ōgasṫ)	Awissu
September	settembre	September	September	септември	September	ސެޕްޓެމްބަރު (sepṫembaru)	Settembru
October	ottubre	Oktober	Oktouber	октомври	Oktober	އޮކްޓޯބަރު (okṫōbaru)	Ottubru
November	nuvembre	November	November	ноември	November	ނޮވެމްބަރު (novembaru)	Novembru
December	dexembre	Dezember	Dezember	декември	Disember	ޑިސެމްބަރު (ḋisembaru)	Diċembru

	Mauritius creole	Melanau	Mirandese	Moksha
January	zanvye	Januari	Janeiro	Январьгов (janvar'gov)
February	fevriye	Februari	Febreiro	Февральков (fevral'kov)
March	mars	Mac	Márcio	Марков (markov)
April	avril	April	Abril	Апрельков (aprel'kov)
May	me	Mei	Maio	Майгов (majgov)
June	zin	Jun	Junho	Июньков (ijun'kov)
July	ziyet	Julai	Julho	Июльков (ijul'kov)
August	ut	Ogos	Agosto	Августков (avgustkov)
September	septam	September	Setembre	Сентябрьков (sentjabr'kov)
October	oktob	Oktober	Outubre	Октябрьков (oktjabr'kov)
November	novam	November	Nobembre	Ноябрьков (nojabr'kov)
December	desam	Disember	Dezembre	Декабрьков (dekabr'kov)

	Ndebele	Neapolitan	Niuean	Normand	Northern Soto	Norweigan
January	uTjhirhweni	jennaro	Ianuali	jaunvyi	Janaware	januar
February	uMhlolanja	frevaro	Fepuali	févryi	Feberware	februar
March	iNtaka	màrzo	Mati	mâr	Matšhe	mars
April	iSihlabantangana	abbrile	Apelila	avri	Aprele	april
May	uMrhayili	maggio	Me	mouai	Mei	mai
June	uMgwengweni	giùgno	Iuni	juin	June	juni
July	uVelabahlinze	luglio	Iulai	juilet	Julae	juli
August	uRhoboyi	aùsto	Aokuso	âot	Agostose	august
September	uKhukhulamungu	settembre	Sepetema	s'tembre	Setemere	september
October	iSewula	ottovre	Oketopa	octobe	Oktobere	oktober
November	uSikinyikhaba	nuvembre	Novema	novembe	Nofembere	november
December	uNobayeni	dicembre	Tesemo	décembe	Desemere	desember

	Occitan	Papiamento (spoken on Aruba and Curaçao)	Plautdietsch	Poitevin	Portuguese	Provençal
January	genièr	yanuari	Jaunwoa	jhanvràe	janeiro	janvié
February	febrièr	febrüari	Febawoa	fouvràe	fevereiro	febrié
March	març	mart	Moaz	mar	março	mars
April	abriu	aprel	Aprel	avrell	abril	abriéu
May	mai	mei	Mai	mae	maio	mai
June	junh	yüni	Jüni	jhén	junho	jun
July	julhet	yüli	Jüli	jhullét	julho	juliet
August	agóst	ougùstùs	August	àut	agosto	avoust
September	setembre	sèptèmber	Septamba	sébtenbre	setembro	sètembre
October	octòbre	òktober	Oktoba	octoubre	outubro	óutobre
November	novembre	novèmber	Novamba	nouvenbre	novembro	nouvèmbre
December	decembre	desèmber	Dezamba	décenbre	dezembro	desèmbre

	Romanian	Romansch	Russian	Sardinian	Saint Lucia creole
January	ianuarie	schaner	январь	gennarju	janvyé
February	februarie	fevrer	февраль	friarju	févwiyé
March	martie	marz	март	martzu	mas
April	aprilie	avrigl	апрель	abrili	avwi
May	mai	mai	май	mayu	mé
June	iunie	zarcladour	июнь	lámpadas	jen
July	iulie	fanadour	июль	trèulas	jwiyèt
August	august	avuost	август	austu	awou
September	septembrie	satember	сентябрь	cabudanni	sèptanm
October	octombrie	otgover	октябрь	ladàmini	òktòb
November	noiembrie	november	ноябрь	donniasantu	novanm
December	decembrie	dezember	декабрь	paskixedda	désanm

	Scots	Serbian	Seychelles creole	Sicilian	Sinhalese
January	Januar	јануар	zanvye	jinnaru	ජනවාරි (janavāri)
February	Februar	фебруар	fevriye	frivaru	පෙබරවාරි (pebaravāri)
March	Mairch	март	mars	marzu	මාර්තු (mārtu)
April	Apryle	април	avril	aprili	අප්රේල් (aprēl)
May	Mey	мај	me	maiu	මැයි (mæyi)
June	Juin	јуни	zen	giugnu	ජූනි (jūni)
July	Julie	јули	zilyet	giugnettu	ජූලි (jūli)
August	Augist	август	out	austu	අගෝස්තු (agōstu)
September	September	септембар	septanm	sittèmmiru	සැප්තැම්බර් (sæptæmbar)
October	October	октобар	oktob	uttùviru	ඔක්තෝබර් (oktōbar)
November	November	новембар	novanm	nuvèmmiru	නොවැම්බර් (novæmbar)
December	Dizember	децембар	desanm	dicèmmiru	දෙසැම්බර් (desæmbar)

	Slovak	Slovenian	Somali	Spanish	Swahili	Swedish	Tagalog	Tarantino	Tok Pisin
January	január	januar	Janaayo	enero	januari	januari	enero	scennáre	Janueri
February	február	februar	Febraayo	febrero	februari	februari	pebrero	febbráre	Februeri
March	marec	marec	Maarso	marzo	machi	mars	marso	màrze	Mas
April	apríl	april	Abriil	abril	aprili	april	abril	abbrile	Epril
May	máj	maj	Maajo	mayo	mei	maj	mayo	másce	Me
June	jún	junij	Juun	junio	juni	juni	hunyo	sciúgne	Jun
July	júl	julij	Luuliyo	julio	julai	juli	hulyo	luglie	Julai
August	august	avgust	Agoosto	agosto	agosti	augusti	agosto	agúste	Ogas
September	september	september	Sebteembar	septiembre	septemba	september	setyembre	setembre	Septemba
October	október	oktober	Oktoobar	octubre	oktoba	oktober	oktubre	ottòmmre	Oktoba
November	november	november	Nofeembar	noviembre	novemba	november	nobyembre	novembre	Novemba
December	december	december	Diseembar	diciembre	desemba	december	disyembre	decèmmre	Disemba

	Tsonga	Tswana	Turkish	Tuvaluan	Walloon	Wolof	Xhosa	Zulu
January	Sanguti	Ferikgong	ocak	Ianuali	djanvî	Samwie	EyoMqungu	UMasingana or uJanuwari
February	Nyenyenyana	Tlhakole	şubat	Fepuali	fevrî	Fewirie	EyoMdumba	UNhlolanja or uFebruwari
March	Nyenyankulu	Mopitlwe	mart	Māti	måss	Maars	EyoKwindla	UNbasa or uMashi
April	Dzivamisoko	Moranang	nisan	Apelila	avri	Awril	UTshazimpunzi	UMdasa or uApreli
May	Mudyaxihi	Motsheganong	mayıs	Mē	may	Mee	UCanzile	UNhlaba or uMeyi
June	Khotavuxika	Seetebogiso	haziran	Iuni	djun	Suwe	EyeSilimela	UNhlangulana or uJuni
July	Mawuwani	Phukwi	temmuz	Iulai	djulete	Sulet	EyeKhala	UNtulikazi or uJulayi
August	Mhawuri	Phatwe	ağustos	Aokuso	awousse	Ut	EyeThupha	UNcwaba or uAgasti
September	Mdzati	Lweetse	eylül	Sētema	setimbe	Sattumbar	EyoMsintsi	UMandulo or uSebutemba
October	Nhlangula	Diphalane	ekim	Oketopa	octôbe	Oktoobar	EyeDwarha	UMfumfu or uOkthoba
November	Hukuri	Ngwanatsela	kasım	Nōvema	nôvimbe	Nowemar	EyeKanga	ULwezi or uNovemba
December	N'wendamhala	Sedimonthole	aralık	Tēsema	decimbe	Disambar	EyeMnga	Uzibandlela or uDisemba

Below, the names in Arabic and Arabic related scripts as used in various countries:

	Egypt, Sudan, and Yemen	Algeria and Tunisia	Iran (Persian)	India and Pakistan (Urdu)
January	ينـــاير (yanāyir)	جـــانفي (Jānfī)	ژانویه (žânviye)	جنوری (janvarī)
February	فـــبراير (fibrāyir)	فيفـــري (Fīfrī)	فوریه (fevriye)	فروری (farvarī)
March	مارس (māris)	مارس (Mārs)	مارس (mârs)	مارچ (mārč)
April	أبريـــل (abrīl)	أفريـــل (Afrīl)	آوریل (âvril)	اپریل (aprīl)
May	مــايو (māyū)	ماي (Māy)	مه (me)	مئی (maʾi)
June	يونيـــو (yūniyū)	جوان (Juwān)	ژوئن (žuan)	جون (jūn)
July	يوليـــه (yūlia)	جويليـــة (Juwīlyâ)	ژوئیه or ژوییه (žuiye or žuye)	جولائی (jūlāʾī)
August	أغسطس (aġustus)	أوت (Ūt)	اوت (ut)	اگست (agast)
September	سبتمبر (sibtambar)	سبتمبر (Sibtambir)	سپتامبر (septâmbr)	ستمبر (sitambar)
October	أكتوبر (uktūbar)	أكتوبر (Uktūbir)	اكتبر (oktobr)	اكتوبر (aktūbar)
November	نوفمبر (nūfambar)	نوفمبر (Nūfambir)	نوامبر (novâmbr)	نومبر (navambar)
December	ديسمبر (dīsambar)	ديسمبر (Dīsambir)	دسامبر (desâmbr)	دسمبر (disambar)

	Afghanistan (Dari)	Afghanistan and Tajikistan (Tajik)	Afghanistan and Pakistan (Pashto)
January	جنوری (janvarī)	نوری (janvar) or январ	جنوري (janwarī)
February	فبرری (febrarī)	فیورل (fevral) or феврал	فبروري (fabruwarī)
March	مارچ (mārč)	مرت (mart) or март	مارچ (mārč)
April	اپریل (aprīl)	اپریل (aprel) or апрел	اپریل (aprīl)
May	مئ (maʾi)	می (maj) or май	می or مې (me or məy)
June	جون (jūn)	ایون (ijun) or июн	جون (jūn)
July	جولای (jūlāy)	ایول (ijul) or июл	جولاي (jūlāy)
August	اگست (agast)	اوگست (avgust) or август	اګست (agəst)
September	سپتمبر (septambar)	سنتیبر (sentjabr) or сентябр	سپتمبر (siptambər)
October	آکتوبر (āktōbar)	آکتیبر (oktjabr) or октябр	اکتوبر (aktōbər)
November	نومبر (novambar)	نایبر (nojabr) or ноябр	نومبر (nuwambər)
December	دسمبر (desambar)	دیکبر (dekabr) or декабр	دسمبر (disambər)

	Cyprus, Israel, Jordan, Lebanon and the Palestinian territories	Libya	Morocco	Kashmir
January	كـانون الثـــاني (kānūn al-thānī)	أيـن النــار (aynu n-nār)	ينـــاير (yanāyər)	جَنوَری (janvarī)
February	شـباط (shubāṭ)	النــوار (an-nuwwār)	فـــبراير (fibrāyər)	پھَروَری (pʰarvarī)
March	آذار (’athār)	الـــربيع (ar-rabī)	مارس (mārs)	مارٕچ (mārụč)
April	نيســـان (nīsān)	الطـــير (al-tayr)	أبريـــل (abrīl)	اَپریل (april)
May	أيــار (’ayyār)	المــاء (al-mā’)	ماي (māy)	مے (mē)
June	حـــزيران (ḥzīrān)	الصـــيف (al-sayf)	يونيـــو (yūnyū)	جوُن (jūn)
July	تمــوز (tammūz)	ناصـــر (nāsir)	يوليـــوز (yūlyūz)	جُلَے (julay)
August	آب (’āb)	هانيبـــال (hānībāl)	غشـت (ġušt)	اَگست (agast)
September	أيلـــول (aylūl)	الفـــاتح (al-fātieh)	شـــتنبر (šutanbir)	سِتَمبَر (sitambar)
October	تشـــرين الأول (tishrīn al-awwal)	التمـــور، الثمـــور (at-tumūr)	أكتوبـــر (uktūbər)	اۆکتۆبَر (oktōbar)
November	تشـــرين الثـــاني (tishrīn al-thānī)	الحـرث (al-harth)	نونـــبر (nuwanbir)	نَومبَر (navambar)
December	كـانون الأول (kānūn al-awwal)	الكـــانون (al-kānūn)	دجنـــبر (dužanbir)	دِسَمبَر (disambar)

Below, the names in Hebrew and Hebrew related scripts as used in various countries:

	Hebrew	Yiddish	Bukhori	Juhuri
January	ינואר	יאַנואַר	יאַנבאַר (yanvar)	יאַנבאַר (janvar) or январь
February	פברואר	פֿעברואַר	פיֵבראַל (fevral)	פיבראַל (fevral) or февраль
March	מרץ	מאַרץ	מאַרט (mart)	מאַרת (mart) or март
April	אפריל	אַפּריל	אַפּריֵל (aprel)	אַפּריל (aprel) or апрель
May	מאי	מיַי	מאַי (may)	מאַי (maj) or май
June	יוני	יוני	איִיוּן (iyun)	איִוּן (ijun) or июнь
July	יולי	יוני	איִיוּל (iyul)	איִוּל (ijul) or июль
August	אוגוסט	אויגוסט	אַבגוּסט (avgust)	אַבגוּסת (avgust) or август
September	ספטמבר	סעפּטעמבער	סיֵנטיאַבּר (sentyabr)	סינתיאַבּר (sentjabr) or сентябрь
October	אוקטובר	אָקטאָבער	אָכּטיאַבּר (oktyabr)	אָכּתיאַבּר (oktjabr) or октябрь
November	נובמבר	נאָוועמבער	נאָיאַבּר (noyabr)	נאָיאַבּר (nojabr) or ноябрь
December	דצמבר	דעצעמבער	דיֵכּאַבּר (dekabr)	דיכּאַבּר (dekabr) or декабрь

Below, the names in various scripts as used in various languages in India:

	Sanskrit	Assamese	Bengali	Marathi	Dogri
January	जनवरी (janvarī)	জানুৱাৰী (jānuwārī)	জানুয়ারি (jānuyāri)	जानेवारी (jānevārī)	जनवरी (janvarī)
February	फरवरी (p^{h}arvarī)	ফেব্ৰুৱাৰী (p^{h}ebruwārī)	ফেব্রুয়ারি (p^{h}ebruyāri)	फेब्रुवारी (febravārī)	फरवरी (p^{h}arvarī)
March	मार्च (mārč)	মাৰ্চ (mārč)	মার্চ (mārč)	मार्च (mārč)	मार्च (mārč)
April	अप्रैल (apræl)	এপ্ৰিল (epril)	এপ্রিল (epril)	एप्रिल (epril)	अप्रैल (apræl)
May	मई (maī)	মে (me)	মে (me)	मे (me)	मेई (meī)
June	जून (jūn)	জুন (jun)	জুন (jun)	जून (jūn)	जून (jūn)
July	जुलाई (julāī)	জুলাই (julāi)	জুলাই (julāi)	जुलै (julæ)	जुलाई (julāī)
August	अगस्त (agast)	আগষ্ট (āgôčṭ)	আগস্ট (āgôsṭ)	ऑगस्ट (ogasṭ)	अगस्त (agast)
September	सितम्बर (sitambar)	চেপ্টেম্বৰ (čepṭembôr)	সেপ্টেম্বর (sepṭembôr)	सप्टेंबर (sepṭeṃbar)	सतम्बर (satambar)
October	अक्तूबर (aktūbar)	অক্টোবৰ (ôkṭobôr)	অক্টোবর (ôkṭobôr)	ऑक्टोबर (okṭobar)	अक्तूबर (aktūbar)
November	नवम्बर (navambar)	নৱেম্বৰ (nôwembôr)	নভেম্বর (nôb^{h}embôr)	नोव्हेंबर (nov^{h}eṃbar)	नवम्बर (navambar)
December	दिसम्बर (disambar)	ডিচেম্বৰ (ḍičembôr)	ডিসেম্বর (ḍisembôr)	डिसेंबर (ḍiseṃbar)	दसम्बर (dasambar)

	Gujarati	Kannada	Oriya	Punjabi
January	જાન્યુઆરી (jānyuārī)	ಜನವರಿ (janvari)	ଜାନୁଆରି (jānuāri)	ਜਨਵਰੀ (janvarī)
February	ફેબ્રુઆરી (pʰebruārī)	ಫೆಬ್ರುವರಿ (pʰebruvari)	ଫେବ୍ରୁଆରି (pʰebruāri)	ਫ਼ਰਵਰੀ (farvarī)
March	માર્ચ (mārč)	ಮಾರ್ಚ್ (mārč)	ମାର୍ଚ୍ଚ (mārčč)	ਮਾਰਚ (mārč)
April	એપ્રિલ (epril)	ಏಪ್ರಿಲ್ (ēpril)	ଏପ୍ରିଲ (epril)	ਅਪ੍ਰੈਲ (apræl)
May	મે (me)	ಮೇ (mē)	ମେ (me)	ਮਈ (maī)
June	જૂન (jūn)	ಜೂನ್ (jūn)	ଜୁନ (jun)	ਜੂਨ (jūn)
July	જુલાઈ (julāī)	ಜುಲೈ (julai)	ଜୁଲାଇ (julāi)	ਜੁਲਾਈ (julāī)
August	ઑગસ્ટ (ogasṭ)	ಆಗಸ್ಟ್ (āgasṭ)	ଅଗଷ୍ଟ (ôgôṣṭ)	ਅਗਸਤ (agast)
September	સપ્ટેમ્બર (sapṭembar)	ಸೆಪ್ಟೆಂಬರ್ (sepṭeṃbar)	ସେପ୍ଟେମ୍ବର (sepṭembôr)	ਸਤੰਬਰ (satãbar)
October	ઑક્ટોબર (okṭobar)	ಅಕ್ಟೋಬರ್ (akṭōbar)	ଅକ୍ଟୋବର (ôkṭobôr)	ਅਕਤੂਬਰ (aktūbar)
November	નવેમ્બર (navembar)	ನವೆಂಬರ್ (naveṃbar)	ନଭେମ୍ବର (nôbʰembôr)	ਨਵੰਬਰ (navãbar)
December	ડિસેમ્બર (ḍisembar)	ಡಿಸೆಂಬರ್ (ḍiseṃbar)	ଡିସେମ୍ବର (ḍisembôr)	ਦਸੰਬਰ (dasãbar)

	Malayalam	Tamil	Telugu
January	ജനുവരി (januvari)	ஜனவரி (jaṉavari)	జనవరి (janvari)
February	ഫെബ്രുവരി (pʰebruvari)	பெப்ரவரி (pepravari)	ఫిబ్రవరి (pʰibravari)
March	മാർച്ച് (mārčč)	மார்ச் (mārc)	మార్చి (mārči)
April	ഏപ്രിൽ (ēpril)	ஏப்ரல் (ēpral)	ఏప్రిల్ (ēpril)
May	മേയ് (mēy)	மே (mē)	మే (mē)
June	ജൂൺ (jūṇ)	ஜூன் (jūṉ)	జూన్ (jūn)
July	ജൂലൈ (jūlai)	ஜூலை (jūlai)	జూలై (jūlai)
August	ആഗസ്റ്റ് (āgasr̲r̲)	ஆகஸ்டு (ākasṭu)	ఆగస్టు (āgasṭu)
September	സെപ്റ്റംബർ (seprr̲aṃbar)	செப்டம்பர் (cepṭampar)	సెప్టెంబర్ (sepṭeṃbar)
October	ഒക്ടോബർ (okṭōbar)	அக்டோபர் (akṭōpar)	అక్టోబర్ (akṭōbar)
November	നവംബർ (navaṃbar)	நவம்பர் (navampar)	నవంబర్ (navaṃbar)
December	ഡിസംബർ (ḍisaṃbar)	டிசம்பர் (ṭicampar)	డిసెంబర్ (ḍisaṃbar)

When using the Gregorian calendar, some countries refer to the months by their numbers, e.g., January = the first month.

	Chinese	Cantonese	Mandarin	Taiwanese	Japanese	Korean	Vietnamese
January	一月	yātyuht	yīyuè	it-goeh^{8}	ichigatsu	일월 (ilweol)	Tháng một
February	二月	yihyuht	èryuè	ji^{7}-goeh^{8}	nigatsu	이월(iweol)	Tháng hai
March	三月	sàamyuht	sānyuè	sa^{n}-goeh^{8}	sangatsu	삼월 (samweol)	Tháng ba
April	四月	seiyuht	sìyuè	si^{3}-goeh^{8}	shigatsu	사월 (saweol)	Tháng tư
May	五月	ńghyuht	wǔyuè	go$^{\bullet 7}$-goeh^{8}	gogatsu	오월 (oweol)	Tháng năm
June	六月	luhkyuht	liùyuè	lak^{8}-goeh^{8}	rokugatsu	유월 (yuweol)	Tháng sáu
July	七月	chātyuht	qīyuè	chhit-goeh^{8}	shichigatsu	칠월 (chilweol)	Tháng bảy
August	八月	baatyuht	bāyuè	peh-goeh^{8}	hachigatsu	팔월 (palweol)	Tháng tám
September	九月	gáuyuht	jiǔyuè	kau^{2}-goeh^{8}	kugatsu	구월 (guweol)	Tháng chín
October	十月	sahpyuht	shíyuè	chap^{8}-goeh^{8}	jūgatsu	시월 (siweol)	Tháng mười

(continued)

	Chinese	Cantonese	Mandarin	Taiwanese	Japanese	Korean	Vietnamese
November	十一月	sahpyātyuht	shíyīyuè	chap[8]-it-goeh[8]	jūichigatsu	십일월 (sipilweol)	Tháng mười một
December	十二月	sahpyihyuht	shí'èryuè	chap[8]-ji[7]-goeh[8]	jūnigatsu	십이월 (sipiweol)	Tháng mười hai

The Gregorian calendar was adopted immediately upon the promulgation of Pope Gregory's decree in the Catholic countries of Italy, Poland, Portugal, and Spain. Shortly thereafter, many other European countries followed suit. In many countries, the Julian calendar was used by the general population long after the official introduction of the Gregorian calendar. Below is a compilation of the days of adoption in some localities.

Locality	The day after	became
States in present-day Italian: Genoa, Lodi, Lucca, Pisa, Savona, Sicily, Sienna, Treviso, Tuscany, and Venice	4 October 1582	15 October 1582
Portugal	4 October 1582	15 October 1582
Spain	4 October 1582	15 October 1582
France	9 December 1582	20 December 1582
Province of present-day Belgium: Brabant	14 December 1582	25 December 1582
Province of the Netherlands: Zeeland	14 December 1582	25 December 1582
Luxembourg	14 December 1582	25 December 1582
Province of present-day Belgium: Limburg	20 December 1582	31 December 1582
Province of present-day Belgium: Flanders	21 December 1582	1 January 1583
Region in France: Savoy	21 December 1582	1 January 1583
Provinces of the Netherlands: South Holland and North Holland	1 January 1583	12 January 1583
Groningen (reverted to the Julian calendar in the summer of 1584)	10 February 1583	21 February 1583
States in present-day Austria: Salzburg, and Tyrol	5 October 1583	16 October 1583
State in present-day Germany: Bavaria	5 October 1583	16 October 1583
States in present-day Austria: Carinthia and Styria	14 December 1583	25 December 1583
The Czech lands: Bohemia and Moravia	6 January 1584	17 January 1584
States in present-day Switzerland: Fribourg, Lucern, Schwyz, Solothurn, Unterwalden, Uri, and Zug	11 January 1584	22 January 1584
Poland	21 December 1585	1 January 1586
Hungary	21 October 1587	1 November 1587
State in present-day Switzerland: Appenzel	6 January 1597	17 January 1597
State in present-day Germany:Prussia	22 August 1620	2 September 1610
State in present-day Switzerland: Valais (30%)	20 December 1621	1 January 1622
State in present-day Switzerland:Valais (the rest)	18 February 1622	1 March 1622
Region in France: Alsace	5 February 1682	16 February 1682
State in present-day Germany:Strasbourg	18 February 1682	1 March 1682
States in present-day Germany: Brandenburg, Hesse, Nuremburg, and Ulm	23 September 1699	3 October 1699
States in present-day Germany:Saxony	4 November 1699	15 November 1699
Denmark and Norway	18 February 1700	1 March 1700

(continued)

Locality	The day after	became
Province of the Netherlands: Gelderland	30 June 1700	12 July 1700
Augsburg, Overyssel, Rhenish Palatinate, and Utrecht (parts)	30 November 1700	12 December 1700
Provinces of the Netherlands: Friesland and Groningen	1 January 1701	12 January 1701
States and cities in present-day Switzerland: Basel, Bern, Biel, Cargous, Geneva, Neuchatel, Schaffhausen, Thurgan, and Zurich	1 January 1701	12 January 1701
Province of the Netherlands: Drenthe	30 April 1701	12 May 1701
States and cities in present-day Switzerland: Appenzell, Glarus, and St Gallen	21 December 1723	1 January 1724
Great Britain, colonies in Canada and present-day U.S.A.	2 September 1752	14 September 1752
Finland	17 February 1753	1 March 1753
Region in France: Lorraine	16 February 1760	28 February 1760
France (reverted officially to the Gregorian calendar)		1 January 1806
Canton in present-day Switzerland: Grisons	17 February 1812	1 March 1812
Alaska	7 October 1867	18 October 1867
Japan (The Gregorian calendar became permissible)		1 January 1873
Egypt		1875
Siam (present-day Thailand; The former lunar calendar became based on the Gregorian solar calendar) April 1, 1889 was named 1 Masayon 108		1 April 1889
China		12 February 1912
Albania		1 December 1912
Latvia and Lithuania (during German occupation)		1915
Bulgaria (some parts)	1 March 1916	14 April 1916
Greece (some parts)	17 July 1916	28 July 1916
Russia and Estonia	31 January 1918	14 February 1918
Yugoslavia	21 February 1919	5 March 1919
Romania	31 March 1919	14 April 1919
Greece (the rest)	7 March 1920	18 March 1920
Bulgaria (some parts)	6 September 1920	17 September 1920
Greece	9 March 1924	23 March 1924
Iran		1925
Turkey		1 January 1927
Vietnam		1954

Main sources: [ARCH2], [COYN], [HOPE], and [MOYE]

138 Greyhawk Calendar

This fictional calendar is used in the World of Greyhawk campaign setting for the Dungeons and Dragons role-playing game. The year is divided into 12 months of 28 days each, and four 7-day festivals, making a total of 364 days. Different cultures (e.g., elven and nomads) have different names for the months.

The common names of the months and intercalary days:

Needfest (7 days)

1. Fireseek
2. Readying
3. Coldeven

Growfest (7 days)

4. Planting
5. Flocktime
6. Wealsun

Richfest (7 days)

7. Reaping
8. Goodmonth
9. Harvester

Brewfest (7 days)

10. Patchwall
11. Ready'reat
12. Sunsebb

The names of the months as used by the Eleven:

Needfest (7 days)

1. Diamondice
2. Yellowillow
3. Snowflowers

Growfest (7 days)

4. Blossom
5. Violets
6. Berrytime

Richfest (7 days)

7. Goldfields
8. Sunflowers
9. Fruitfall

Brewfest (7 days)

10. Brightleaf
11. Tinklingice
12. Lacysnows

The names of the weekdays:

1. Starday
2. Sunday
3. Moonday
4. Godsday
5. Waterday
6. Earthday
7. Freeday

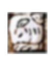
Internet source: weirdscifi.ratiosemper.com

139 Haab' Calendar

This was a secular solar calendar used in the pre-Columbian cultures of Mesoamerica. The year consisted of 18 uinals, which is a period of 20 days. The five nameless days left to complete a 365-day period represented an annual unlucky period called Uayeb or Wayeb'. The first day of the uinal was 0, and the last was 19, followed by day 0 of the next uinal.

It has been estimated that the Haab' was first used around 500 BCE.

The names of the months:

1.  or  Pop, 11 August–30 August
2.  or  Wo' or Uo, 31 August–19 September
3.  or  Sip or Zip, 20 September–9 October
4.  or  Sotz' or Zotz, 10 October–29 October
5.  or  Sek or Tzec, 30 October–18 November
6.  or  Xul, 19 November–9 December
7.  or  Yaxk'in', 10 December–28 December
8.  or  Mol, 29 December–17 January
9.  or  Ch'en, 18 January–6 February

10.  or  Yax, 7 February–26 February
11.  or  Sak' or Zac, 27 February–17 March
12.  or  Keh or Ceh, 18 March–6 April
13.  or  Mak or Mac, 7 April–26 April
14.  or  K'ank'in, 27 April–16 May
15.  or  Muwan' or Muan, 17 May–5 June
16.  or  Pax, 6 June–25 June
17.  or  K'ayab, 26 June–15 July
18.  or  Kumk'u, 16 July–4 August
19.  or  Wayeb', 5 August–10 August

Main sources: [COHN] and [HAUG2]
Glyphs from Wiki Commons

140 Haida Calendar

This lunar calendar was used by the Haida people in northwestern North America. The names of the months were associated with the full moons. Expeditions to the Haida Gwaii Islands, an archipelago on the North Coast of British Columbia in Canada, during the late nineteenth century, reported the use of a lunar calendar that divided the year into two periods of 6 months with an intercalary thirtheenth month between them. This made a complete cycle of 25 Moons every 2 years, or 100 Moons every 8 years. Each month started 2 days after the new moon. Different names were used in the northern areas around Masset of Haida Gwaii and the southern areas around Skidegate of Graham Island. Below, I have written various transcriptions used in Haida texts.

The names of the months at Masset:

1. $^{\varepsilon}$A'nsga-i la'qoña's or Gansgee ilaa kongaas (Moon when the berries are forming), = ~ April/May
2. Wa'ajgwalga-i or Wa.aay gwaalgee (Moon when the weather is still somewhat cold), = ~ May/early June
3. Qoñqō'ns or Kong koaans (Great Moon), =~ June/July
4. S$^{\varepsilon}$ān gias or Sgaana gyaas (Killer whale Moon), = ~ July/August
5. K!î's'als, K'iijaas, or K'iit'aas Kungáay (Moon when animals begin to grow fat), = ~ August/September
6. Qa'lga qoña's, K'algyaa kongaas, or Kálk Kungáay (Ice Moon), = ~ September/October
7. Q!e'daq!edas or K'eed adii (Between Moon; intercalary month between the summer and the winter series), = ~ October/November
8. Dja qoña's or Jid kongaas (Digging Moon), = ~ November/December
9. Qo'ao gia'ñas or Kong gyaangaas (Standing to defecate Moon), = ~ December/January
10. Hlgitu'n qoña's, Hlgidguun kongaas, or Hlgit'ún Kungáay (Goose Moon), = ~ January/February
11. Tān qoña's, Taan kongaas, or Táan Kungáay (Black-bear Moon or Bear hunting Moon), = ~ February/March
12. Xīt gias, Xiid gyaas, or Xitgáas Kungáay (Laughing-goose Moon), = ~ March
13. Wīt gias or Wiid gyaas (Russet-back thrush Moon or salmonberry-bird Moon), = ~ April

The names of the months at Skidegate:

1. Tā'xet gias (Sockeye Moon), = ~ March
2. Gē'tga q!ā'idas (between Moon; intercalary month), = ~ April
3. Wīt gias (Russet-bak trush Moon or Salmonberry-bird Mon), = ~ May
4. Gān galā'ñ qoans (Many ripe berries Moon), = ~ June
5. Wa'jgal qoans (Many potlatches Moon), = ~ July
6. Hajwa'l qoans (Many salmons dried Moon), = ~ August
7. Xo'lgao qoans (Salmons jerk about in the creeks Moon), = ~ September
8. Q!ā'gana gias (Many halibuts Moon), = ~ October
9. K!is'als (Empty entrails Moon), = ~ November

10. Qoñgiā'di ga'das (Food almost gone Moon), = ~ December
11. Sqajgō'ñ gida's (Young fish Moon), = ~ January
12. Sqajgō'ñ q!ā'-ias (Old fish Moon), = ~ February

Main source: [SWAN]

141 (Ancient) Halosian Calendar

This calendar was used in Halos during ancient time.

The names of the months:

1. Adromios, = October
2. Euonios, = November
3. Pythoios, = December
4. Hagnaios, = January
5. Dionysiosm, = February
6. Genetios, = March
7. Megalartios, = April
8. Themistios, = May
9. Dematros, = June
10. Hekatombios, = July
11. Homoloios, = August
12. Thyios, = September

Main source: [GINZ]

142 Ḫamšâtum Calendar

See (Ancient) *Pentecontad calendar*.

143 (Old) Hausa Calendar

This Islamic calendar was used by the Hausa people in Southern Africa.

The names of the months and related months in the Islamic calendar:

1. wota-n wâs-n wutâ ŝine wota-n tshika-n šekara, المحرّم, Mùharràm, (30 days)
2. wota baki, صـــفر, Safàr, (29 days)
3. wota-n ar-rabi rabi, ربيـــع الأوّل, Rabi' al-awwal or Ràbi'ù Lawwàl, (30 days)
4. wota-n tago-n fari, ربيـــع الثـــاني or ربيـــع الآخ, Rabī' al-Thānī or Ràbi'ù Lahìr, (29 days)
5. wota-n tagoi na-biu, جمادى الأولـــى, Jumada al-Oola or Jìmādā Lawwàl, (30 days)
6. wota-n gambo, جمادى الثانيـــــة or جمادى الآخرة, Jumada al-Thani or Jìmādā Lahìr, (29 days)
7. wota-n azumi-n tofofi, رجب, Rajàb, (30 days)
8. wota-n yayi-n zana, شـــعبان, Shà'àbân, (29 days)
9. wota-n azumi-n duka gari, رمضـان, Ràmàdàn, (30 days)
10. wota-n sala karama, شوّال, Shàwwâl, (29 days)
11. wota-n gani, ذو القعـــدة, Dhu al-Qa'dah or Zùlƙidà, (30 days)
12. wota-n sala baba, ذو الحجّة, Dhu al-Hijjah or Zulhajjì, (29 days and 30 days in leap year)

The names of the weekdays:

1. Lahàdì, = Sunday
2. Lītìnin, = Monday
3. Tàlātȁ, = Tuesday
4. Lȁrrȁbā, = Wednesday
5. Àlhàmis, = Thursday
6. Jumma'ȁ, = Friday
7. Àsabàrr, = Saturday

Nowadays, the Hausa people also use the Western Calendar:

1. Jànairù = January
2. Fàbrrairù = February
3. Mārrìs = March
4. Àfrrīlù = April
5. Māyù = May
6. Yūnì = June
7. Yūlì = July
8. Àgustà = August
9. Sàtumbà = September
10. Òktōbà = October
11. Nùwambà = November
12. Disambà = December

Main source: [GINZ]

144 (Old) Hawaiian Calendars

These lunistellar calendars were used by native Hawaiians on the island of Hawaii. The year, *makahiki*, was divided into 12 months, and the lunar calendar was synchronized with the Pleiades star cluster. The Hawaiian year began in late October or November, and was marked by the rising of the Pleiades in the east after the sunset. After this, 12 sets (months) of 30 days were counted until the end of the year. Sometimes, an intercalary month was added to reconcile the annual cycle of the Pleiades with the lunar calendar.

The names of the months:

1. Moakali'I or Hui-hui, = ~ November
2. Ka'elo, = ~ December
3. Ka'ulua, = ~ January
4. Nana, = ~ February
5. Welo, = ~ March
6. Ikiiki, = ~ April
7. Ka'aona, = ~ May
8. Hinaia-'ele'ele, = ~ June
9. Hili-na-ehu, = ~ July
10. Wehewehe, = ~ August
11. Hili-na-ma, = ~ September
12. Ikuwa, = ~ October
13. Welehu, an intercalary month used to compensate for the rising of the Pleiades when it comes late in the year

The inhabitants of Oahu and Kauai islands used another system.

Ho'oplo seasons:

1. Ikiiki, = ~ October
2. Ka'aona, = ~ November
3. Hinaia'ele'ele, = ~ December
4. Hilina, = ~ January
5. Hilinehu, = ~ February
6. Ikuwa, = ~ March

Mahali'i seasons:

7. Welehu, = ~ April
8. Makali'I, = ~ May
9. Ka'elo, = ~ June
10. Ka'ulua, = ~ July
11. Nana, = ~ August
12. Welo, = ~ September

The lunar days were given specific names as listed below:

1. hilo (marks the first appearance of the crescent moon)
2. hoaka
3. ku-kahi
4. hu-lua
5. hu-kolu
6. hu-pau
7. ole-ku-kahi (this is the first quarter moon)
8. ole-ku-lua
9. ole-ku-kolu
10. ole-ku-pau
11. huna
12. mohalu
13. hua
14. akua (this is the full moon)
15. hoku
16. mahealani
17. kulu
18. laau-ku-kahi
19. laau-ku-lua
20. laau-pau
21. ole-ku-kahi (this is the last quarter moon)
22. ole-ku-lua
23. ole-pau
24. kaloa-ku-kahi
25. kaloa-ku-lua
26. kaloa-pau
27. kane
28. lono
29. mauli
30. muku

Main sources: [BEST2] and [KAMA]

145 Hebrew Calendar

This is also called the **Jewish calendar**. See also *Samaritan-Israelite calendar*.

(Since the ninth century, the years in this calendar have been styled as **A.M.** (*anno mundi*))

This lunisolar calendar was adopted by the Jews after the Babylonians exerted influence over Judah in 605 BCE. It may be seen as a hybrid of the earlier Canaanite calendar and the Babylonian. The names of the months are quite similar to the Babylonian names, but shifted by 6 months, as the Canaanite calendar started soon after the fall equinox instead of after the vernal equinox.

Today, the Hebrew calendar is used worldwide by Jews for religious observances and is the official calendar of Israel. The calendar was established by Hillel II in 359 CE. The era is that of the biblical Creation, which is placed in 3761 BCE.

The year features 12 lunar months of 29 days (*chaser*, a defective month) or 30 days (*maleh*, a full month), with an intercalary month added seven times (in the 3rd, 6th, 8th, 11th, 14th, 17th, and 19th years) of a 19 year cycle to synchronize the 12 lunar months with the longer solar year. In these leap years, an additional month, Adar I (30 days), is added between Shvat and Adar. The Adar month is then referred to as Adar II or Veadar.

To ensure that Yom Kippur (the Day of Atonement; the holiest day of the Jewish year) does not fall on a Friday or on a Shabbat (the seventh day of the week = the day of rest) and that Hoshana Rabbah (a special day in the Sukkot holiday) is not on a Shabbat, the Kislev month may lose a day (and become a chaser) or the Marcheshvan month may acquire an additional day (and become a maleh).

The names of the months (according to the Tiberian vocalization and the Academy of the Hebrew Language):

1. תִּשְׁרִי Tišrī/Tishri, = September/October (30 days)
2. מַרְחֶשְׁוָן or מרחשוון Marḥešwān/Marcheshvan, = October/November (29 days, but 30 days in a *maleh*)
3. כסליו or כִּסְלֵו Kislēw/Kislev, = November/December (30 days, but 29 days in a *chaser*)
4. טֵבֵת Ṭēḇēṯ/Tevet, = December/January (29 days)
5. שְׁבָט Šəḇāṭ/Shvat, = January/February (30 days)
6. אֲדָר ’Ăḏār/Adar, = February/March (29 days)
7. נִיסָן Nīsān/Nissan, = March/April (30 days)
8. אייר or אִיָּר ’Iyyār/Iyyar, = April/May (29 days)
9. סיוון or סִיוָן Sīwān/Sivan, = May/June (30 days)
10. תַּמּוּז Tammūz/Tammuz, = June/July (29 days)
11. אָב ’Āḇ/Av, = July/August(30 days)
12. אֱלוּל ’Ĕlūl/Elul, = August/September (29 days)

The week contains 7 days, six of which have names based on numbers. The seventh day is the Sabbath. Days begin at sunset, but for the purpose of the calendar at 6 pm.

The names of the weekdays:

1. יום ראשון Yom Rishon, = Sunday (starting at preceding sunset of Saturday)
2. יום שני Yom Sheni, = Monday
3. יום שלישי Yom Shlishi, = Tuesday
4. יום רביעי Yom Revi‘i, = Wednesday
5. יום חמישי Yom Chamishi, = Thursday
6. יום ששי Yom Shishi, = Friday
7. יום שבת Yom Shabbat, = Saturday

Main sources: [BECK3], [BUSH2], and [REIN]

146 (Ancient) Heliopolisan Calendar

This lunisolar calendar was used in Heliopolis (present-day Baalbek in Lebanon) after the third century BCE.

The names of the months:

1. ΑΓ Ag, 22 November–22 December (31 days)
2. ΘΟΡΙΝ Thorin, 23 December–21 January (30 days)
3. ΓΕΛΩΝ Gelon, 22 January–20 February (30 days)

4. ΧΑΝΟΥ Chanu, 21 February–23 March (31 days)
5. ΣΟΒΑΘ Sobath, 24 March–22 April (30 days)
6. ΑΔΑΔ Adad, 23 April–23 May (31 days)
7. ΝΕΙΣΑΝ Neisan, 24 May–23 June (31 days)
8. ΪΑΡΑΡ Iarar, 24 June–23 July (30 days)
9. ΕΖΗΡ Ezer, 24 July–22 August (30 days)
10. ΘΑΜΙΖΑ Thamiza, 23 August–22 September (31 days)
11. ΑΒ Ab, 23 September–22 October (30 days)
12. ΪΛΟΥΛ Ilul, 23 October–21 November (30 days)

Main source: [GINZ]

147 Hereron Calendar

This calendar was used by the Herero people in Southern Africa.

The names of the months:

1. edindi etengarindi (month of the Vley water), = ~ January
2. katyose (month of the Springbok (*Antidorcas marsupialis*)), = ~ February
3. esenina rindi (month of the last Vley water), = ~ March
4. oseninani (month of the last rain), = ~ April
5. ongaranne (month of cold days), = ~ May
6. suramaseva (dry month), = ~ June
7. otyekukutu (month of dry trees), = ~ July
8. kosondu (month of sheep shearing), = ~ August
9. kosonianga (month when the lily begins to bud), = ~ September
10. ombundu (month when the milk bushes become green), = ~ October
11. oni (month when the rain begins), = ~ November
12. otyitazu (wet month), = ~ December

Main source: [GINZ]

148 Hermetic Zodiac Calendar

This calendar, ζῳδιακὸς κύκλος, was used by Hellenistic Theosophists in Greece.

The names of the months:

1. Ἑστία Hestia, 21 September–20 October (Libra or Zygos)
2. Ἄρης Ares, 21 October–20 November (Scorpio or Skorpios)
3. Ἄρτεμις Artemis, 21 November–20 December (Sagittarius or Toxotis)
4. Ἥφαιστος Hephaistos, 21 December–20 January (Capricorn, Aigokæros, or Brumalis)
5. Ἥρα Hera, 21 January–20 February (Aquarius or Ydrokhoos)
6. Ποσειδῶν Poseidon, 21 February–20 March (Pisces or Ikhtys)
7. Ἀθηνᾶ Athena, 21 March–20 April (Aries or Krios)
8. Ἀφροδίτη Aphrodite, 21 April–20 May (Taurus or Tauros)
9. Ἀπόλλων Apollo, 21 May–20 June (Gemini or Didoumi)
10. Ἑρμῆς Hermes, 21 June–20 July (Cancer or Karkinos)
11. Ζεύς Zeus, 21 August–20 September (Leo or Læon)
12. Δημήτηρ Demeter, 21 September–20 October (Virgo, Stakhous, or Spica)

149 (Old) High German Calendar

This lunisolar calendar was used until the ninth century in present-day southern Germany, as well as parts of Austria and Switzerland.

The names of the months:

1. Harti-mánód, = ~ January
2. Hornung, = ~ February
3. Lenzin-mánód, = ~ March
4. Óstar-mánód, = ~ April
5. Winni-mánód or Drímilki, = ~ May
6. Bráh-mánód, = ~ June

7. Hewi-mánód, = ~ July
8. Aran-mánód, = ~ August
9. Witu-mánód, = ~ September
10. Herbist-mānōd, = ~ October
11. Windume-mánód, = ~ November
12. Wintar-mánód, = ~ December

The names of the weekdays:

1. Sunnûntag, = Sunday
2. Mânetag, = Monday
3. Zîestag, = Tuesday
4. Wôdanstag, = Wednesday
5. Donarestag, = Thursday
6. Frîjatag, = Friday
7. Sunnûnâband or Sambaztag, = Saturday

150 Hijri Calendar

See *Islamic calendar*.

151 Himba Calendar

This calendar is used by the Himba people in Ekambu, Namibia.

"'When the thunderstorms start and the leaves grow from the ground, that's how we know it's the New Year,' said Maverihepisa Koruhama, one of the villagers in Ekambu. They measure time by the shifting sun and mark the coming of the New Year with the arrival of seasonal rains that transform the parched red soil into a carpet of green. In their Herero language, the word for 'day' is the same as the word for 'sun,' and the word for "year" means 'rain.'"

Internet source: webexhibits.org/calendars

152 Hindu Calendars

See also *Bikram Samwat*, *Saka calendar*, and *Vikram Samvat*.

These were also called **Indian calendars** or **Indian religious calendars**.

These lunisolar calendars have been traditionally used in India, standardized in the Surya Siddhanta during the third century, and subsequently reformed by astronomers such as Aryabhata (476–550), Varahamihira (505–587), and Bhaskara II (1114–1185). In 1952, the Indian Calendar Reform Committee identified more than 30 calendar variants of the Surya Siddhanta calendar in use, e.g., the *Assamese calendar*, *Bengali calendar*, *Kannada calendar*, *Malayalam calendar*, *Nepali calendar*, *Tamil calendar*, and *Telugu calendar*.

Calculations were done based on the movements of the Sun, the Moon, the planets and the stars. This rather complex calendaric system resulted in the growth of an entire science of Vedic astronomy, called *Vedāṅga Jyotiṣa*.

The oldest part of the Hindu calendars, well known since at least the second millennium BC, is the moon's cycle against the fixed stars. The ecliptic, equal to 27 days and 7¾ hours, is here divided into 27 nakshatras and an intercalary 28th nakshatra.

The names of the Nakshatras in Sanskrit and their corresponding regions of sky:

1. अश्विनी Ashvinī (β and γ Arietis)
2. भरणी Bharanī (35, 39, and 41 Arietis)
3. कृत्तिका Krittikā (Pleiades)
4. रोहिणी Rohinī (Aldebaran)
5. मृगशीर्षा Mrigashīrsha (λ, φ Orionis)
6. आर्द्रा Ārdrā (Betelgeuse)
7. पुनर्वसु Punarvasu (Castor and Pollux)
8. पुष्य Pushya (γ, δ and θ Cancri)
9. आश्ळेषा Āshleshā (δ, ε, η, ρ, and σ Hydrae)
10. मघा Maghā (Regulus)
11. पूर्व फाल्गुनी Pūrva Phalgunī (δ and θ Leonis)

12. उत्तर फाल्गुनी Uttara Phalgunī (Denebola)
13. हस्त Hasta (α to ε Corvi)
14. चित्रा Chitrā (Spica)
15. स्वाती Svātī (Arcturus)
16. विशाखा Vishākhā (α, β, γ and ι Librae)
17. अनुराधा Anurādhā (β, δ and π Scorpionis)
18. ज्येष्ठा Jyeshtha (α, σ, and τ Scorpionis)
19. मूल Mūla (ε, ζ, η, θ, ι, κ, λ, μ and ν Scorpionis)
20. पूर्वाषाढा Pūrva Ashādhā (δ and ε Sagittarii)
21. उत्तराषाढा Uttara Ashādhā (ζ and σ Sagittarii) (28. Abhijit (α, ε , and ζ Lyrae), intercalary nakshatra)
22. श्रवण Shravana (α, β and γ Aquilae)
23. धनिष्ठा Dhanishthā (α to δ Delphinis)
24. शतभिषा Shatabhishā (γ Aquarii)
25. पूर्वभाद्रपदा Pūrva Bhādrapada (α and β Pegasi)
26. उत्तरभाद्रपदा Uttara Bhādrapada (γ Pegasi and α Andromedae)
27. रेवती Revatī (ζ Piscium)

The solar year was divided into 12 solar months. The 12 solar months, known as *Saur Maas*, correspond to the entry of the Sun into the signs of the Zodiac (*Rashi*).

The names of the solar months and the 12 Rashi in Sanskrit:

1. मेष Meṣa (Aries) the Ram, = mid-March–mid-April
2. वृषभ Vṛṣabha (Taurus) the Bull, = mid-April–mid-May
3. नृमिथुन Mithuna (Gemini) the Twins, = mid-May–mid-June
4. कर्कट Karkaṭa (Cancer) the Crab, = mid-June–mid-August
5. सिंह Siṃha (Leo) the Lion, = mid-July–mid-August
6. कन्या Kanyā (Virgo) the Maiden, = mid-August–mid-September
7. तुल Tulā (Libra) the Scales, = mid-September–mid-October
8. वृश्चिक Vrścika (Scorpio) the Scorpion, = mid-October–mid-November
9. धनुस् Dhanus (Sagittarius) the Bow, = mid-November–mid-December
10. मकरराशि Makara (Capricorn) the Capricorn, = mid-December–mid-January
11. कुम्भ Kumbha (Aquarius) the Pot, = mid-January–mid-February
12. मीन Mīna (Pisces) the Fish, = mid-February–mid-March

A lunar calendar, based on the phases of the moon, is also still in common use. It consists of 12 months of 29 or 30 days. Each month is divided into two fortnights (*paksha*). Shukla Paksha ends with a *Poornimaa* (full moon), and Krushna Paksha ends with an *Amaayasyaa* (new moon).

There is significant regional variation in which lunar month is reckoned as the first month of the year. The most common sequence is presented below.

The names of the lunar months in Sanskrit:

1. चैत्र Chaitra (353°15'), ~ 14 March–12 April (30.3 days)
2. वैशाख Vaiśākha (23°15'), ~ 13 April–13 May (30.9 days)
3. ज्येष्ठ Jyaiṣṭha (53°15'), ~ 14 May–13 June (31.3 days)
4. आषाढ Āṣāḍha (83°15'), ~ 14 June–15 July (31.5 days)
5. श्रावण Śrāvaṇa (113°15'), ~ 16 July–15 August (31.4 days)
6. भाद्रपद Bhādrapada (143°15'), ~ 16 August–15 September (31.0 days)
7. आश्विन Āśvina or अश्वयुज Aśvayuja (173°15'), ~ 16 September–16 October (30.5 days)
8. कार्तिक Kārtika (203°15'), ~ 17 October–15 November (30.0 days)
9. अग्रहायण Mārgaśīrṣa (233°15'), ~ 16 November–14 December (29.6 days)
10. पौष Pauśa (263°15'), ~ 15 December–14 January (29.4 days)
11. माघ Māgha (293°15'), ~ 14 January–11 February (29.5 days)
12. फाल्गुन Phālguna (323°15'), ~ 12 February–13 March (29.9 days)

Owing to the fact that the lunar year, equal to about 354 days, 8 hours and 34.28 seconds, differs by about 10 days, 21 hours and 35.16 seconds from the solar year, necessary adjustments were made to bring the two into consonance. Usually, the lunar month in which no *sankranti* (apparent movement of the sun from one constellation to the next, as seen from the earth) occurs is called *adhikamāsa*. Then, an intercalary month (Adhika Maas), which carries the name of the previous or the subsequent month, is added. This month is also called *ś uddha* or *prākrta*, to distinguish it from the former. A lunar year in which adhikamāsa has been included will then have 13 months. As adhikamāsa was considered inauspicious, it was sometimes called aṃhaspati ("the lord of sins"), malamāsa ("a dirty month"), or malimluca ("a thief"). Normally, seven such intercalary months occur during a 19-year cycle.

On rare occasions, a short solar month will not contain a new moon, and the name of that month is dropped from the calendar for that year. This will, however, result in two new moons in a later month, so the calendar will remain at 12 months. These lost months are referred to as *kṣayamāsa*. As few as 19 years, and as many as 141 years, may pass between two kṣayamāsa.

In parts of southern India, such as Tamil Nadu, Kerala and Karnataka, a month begins and ends at a new moon (this is called the *amāvāsyanta* or *ukhya mana* system), while in parts of northern India, such as Bihar, Uttar Pradesh, Madhya Pradesh, Orissa, Punjab, Rajasthan, Haryana and Kashmir, a month begins and ends with a full moon (this is called the *pūrṇimānta, śuklānta māsa*, or *gauna mana* system).

The months are divided into 30 *tithis*. Each tithi is described as the time required for the moon to increase by 12° over the longitude of the sun. They may last for between ~20 hours and ~27 hours. The first 15 tithis are referred to as *suddha* (or *sukla*) ("bright" or "waxing") and are counted 1–15, while the last 15 are referred to as *bahula* (or *krsna*) ("dark" or "waning") and are also counted 1–15.

The months are also divided into *karanas*, in which a karana is half of a tithi, or the time required for the angular distance between the sun and the moon to increase in steps of 6° starting from 0°. There are four "fixed" karanas (1, 58, 59, and 60) and seven "repeating" karanas.

The names of the karanas in Sanskrit:

1. किंस्तुघ्न Kimstughna,
2. बव Bava, 3. बालव Bālava, 4. कौलव Kaulava, 5. तैतिल Taitula, 6. गरज Garaja, 7. वणिज Vaṇija, 8. भद्रा Viṣṭi, 9. बव Bava, 10. बालव Bālava, 11. कौलव Kaulava, 12. तैतिल Taitula, 13. गरज Garaja, 14. वणिज Vaṇija, 15. भद्रा Viṣṭi, 16. बव Bava, 17. बालव Bālava, 18. कौलव Kaulava, 19. तैतिल Taitula, 20. गरज Garaja, 21. वणिज Vaṇija, 22. भद्रा Viṣṭi, 23. बव Bava, 24. बालव Bālava, 25. कौलव Kaulava, 26. तैतिल Taitula, 27. गरज Garaja, 28. वणिज Vaṇija, 29. भद्रा Viṣṭi, 30. बव Bava, 31. बालव Bālava, 32. कौलव Kaulava, 33. तैतिल Taitula, 34. गरज Garaja, 35. वणिज Vaṇija, 36. भद्रा Viṣṭi, 37. बव Bava, 38. बालव Bālava, 39. कौलव Kaulava, 40. तैतिल Taitula, 41. गरज Garaja, 42. वणिज Vaṇija, 43. भद्रा Viṣṭi, 44. बव Bava, 45. बालव Bālava, 46. कौलव Kaulava, 47. तैतिल Taitula, 48. गरज Garaja, 49. वणिज Vaṇija, 50. भद्रा Viṣṭi, 51. बव Bava, 52. बालव Bālava, 53. कौलव Kaulava, 54. तैतिल Taitula, 55. गरज Garaja, 56. वणिज Vaṇija, 57. भद्रा Viṣṭi,
58. शकुनि Shakuni,
59. चतुष्पाद Catuṣpāda,
60. नाग Nāga

The year is also divided into six seasons (ऋतु *ritu*), generally ascribed to 2 months each as below, but how these seasons are described varies from one region to another.

The names of the seasons in Sanskrit, and mapping to English names:

1. वसन्त Vasanta (Chaitra and Vaishakha), = spring
2. ग्रीष्म Grīṣma (Jyeshtha and Ashadha), = summer
3. वर्षा Varṣā (Shraavana and Bhadrapada), = monsoon
4. शरद् Śarad (Ashwin and Kartika), = autumn

5. हेमन्त Hemanta (Maargashirsha and Pausha), = winter
6. शिशिर Śiśira (Magh and Phalguna),= prevernal

The names of the weekdays in Sanskrit:

1. रविवासर Ravi vāsara, = Sunday
2. सोमवासर Soma vāsara, = Monday
3. मंगलवासर Mangala vāsara, = Tuesday
4. बुधवासर Budha vāsara, = Wednesday
5. गुरुवासर Guru vāsara, = Thursday
6. शुक्रवासर Shukra vāsara, = Friday
7. शनिवासर Shani vāsara, = Saturday

Main sources: [BASH], [CHAT], and [REIN]

153 Hindu Civil Calendar

See *Saka calendar*.

154 (Ancient) Hittite Calendar

See (Ancient) *Assyrian calendar*.

155 Holocene Calendar

[holocene = "entirely recent"]

(Abbreviated as **HE**)

This calendar starts in 10000 BCE, a first approximation of the start of the current geologic epoch, e.g., 2015 CE = 12015 HE. The motivation for this is that human civilization (e.g., the first settlements) is believed to have arisen around this time. The calendar was originally proposed by the Italian-American geologist and micropaleontologist Cesare Emiliani (1922–1995), the founder of paleoceanography.

Main source: [DUNC4]

156 Hopi Calendar

This is the traditional lunar calendar used by the Hopi people.

The names of the months:

1. Uyismuya or Wukouyis (Moon of Planting), = ~ mid-May–mid-June
2. Nimanmuya or Kelmuya (Moon of the Homedance/Month of Fledgling Hawk), = ~ mid-June–mid-July
3. Taalapamuya or Paamuya (Moon of Life at its Height/Month of Joyful), = ~ mid-July–mid-August
4. Nasanmuya (Moon of Plenty or Full Harvest), = ~ mid-August–mid-September
5. Tuho'osmuya or Angaqmuyaw (Moon of Harvesting/Month of Long Hair), = ~ mid-September–mid-October
6. Kelmuya (Moon of the Fledgling Hawk), = ~ mid-October–mid-November
7. Kyaamuya (Moon of Respect), ~ mid-November–mid-December
8. Paamuya (Moon of Life at its Height), = ~ mid-December–mid-January
9. Powamuya (Moon of Purification and Renewal), = ~ mid-January–mid-February
10. Osomuyaw (Moon of the Whispering Wind), = ~ mid-February–mid-March
11. Kwiyamuyaw (Moon of Windbreak), = ~ mid-March–mid-April
12. Hakitonmuyaw (Moon of Waiting), = ~ mid-April–mid-May

Main source: [WHIT5]

157 Hōreki Kōjutsu Gen

See *Hōryaku calendar*.

158 Hōryaku Calendar

This was also called the **Hōreki Kōjutsu Gen**. See also *Japanese calendars*.

This lunisolar calendar was used in Japan from 1754 to 1797.

Main source: [NUSS]

159 (Old) Hungarian Calendar

This was also called the **Calendarium Tyrnaviense** or **Nagyszombati kalendárium**.

This lunisolar calendar was used beginning in 1579 in Hungary.

The names of the months:

1. Boldogasszony hava (month of the happy/blessed lady), = January
2. Böjtelő hava (month of early fasting/Lent or month before fasting), = February
3. Böjtmás hava (second month of fasting), = March
4. Szent György hava (month of Saint George), = April
5. Pünkösd hava (Pentecost month), = May
6. Szent Iván hava (Saint John's month), = June
7. Szent Jakab hava (Saint James' month), = July
8. Kisasszony hava (month of the Virgin), = August
9. Szent Mihály hava (Saint Michael's month), = September
10. Mindszent hava (All saints' month), = October
11. Szent András hava (Saint Andrew's month), = November
12. Karácsony hava (month of Christmas), = December

The names of the seasons:

1. tél, = winter
2. tavasz, = spring
3. nyár, = summer
4. ősz, = autumn

The names of the weekdays:

1. vasárnap, = Sunday
2. hétfő, = Monday
3. kedd, = Tuesday
4. szerda, = Wednesday
5. csütörtök, = Thursday
6. péntek, = Friday
7. szombat, = Saturday

Main source: [BÁN]

160 (Old) Icelandic Calendar

This calendar was used in pre-Gregorian Iceland. It had 12 months, each month starting on the same day of the week, instead of the same date. The year was also divided into two seasons, the"short day" season (skammdegi) and the" nightless day" season (náttleysi).

The names of the weekdays were a combination of numbered days, names linked to pious or domestic routines (föstudagur ("Fasting day") and laugardagur ("Washing day")), and names linked to the Sun and Moon (sunnudagur and mánudagur, respectively).

Skammdegi:

1. Gormánuður, 11–18 October to 9–16 November
2. Ýlir or Frermánuður, 10–17 November to 9–16 December
3. Mọrsúgr, Jólmánuðr, or Hrutmánuður, 10–17 December to 8–15 January
4. Þorri or Miðvinter, 9–16 January to 7–14 February
5. Gói, 8–15 February to 9–15 March
6. Einmánuður, 10–16 March to 8–14 April

Náttleysi:

7. Harpa or Gaukmánuður, 9–15 April to 8–14 May
8. Eggtið, Stekktið, or Skerpla, 9–15 May to 7–13 June
9. Sólmánuður, 8–14 June to 12–19 July
10. Heyannir, 13–20 July to 11–18 August
11. Tvímánuður, 12–19 August to 10–17 September
12. Haustmánuður or Kornskurdarmánuður, 11–18 September to 10–17 October

The names of the weekdays:

1. sunnudagur, = Sunday
2. mánudagur, = Monday
3. þriðjudagur, = Tuesday
4. miðvikudagur, = Wednesday
5. fimmtudagur, = Thursday
6. föstudagur, = Friday
7. laugardagur, = Saturday

Main sources: [GINZ], [LAGU] and *Almanak um ár eptir krists faeðing*.

161 Igbo Calendar

This traditional calendar is used by the Igbo people in the eastern states of Abia, Anambra, Delta, Ebonyi, Enugu, and Imo in Nigeria.

A 4-day market week is the basic measurement of the calendar. The names of these market days are Afọ, Nkwọ, Eke, and Orie. In the old days, a child was named after a market day to denote the day on which he or she was born.

Seven market weeks make 1 month (in Igbo: Ọnwa), and there are 13 months in a year. In the last month, an extra day is added.

The names of the months:

1. Ọnwa Mbụ, = 3rd week of February
2. Ọnwa Abụo, = March
3. Ọnwa Ife Eke, = April
4. Ọnwa Anọ, = May
5. Ọnwa Agwụ, = June
6. Ọnwa Ifejiọkụ, = July
7. Ọnwa Alọm Chi, = August to early September
8. Ọnwa Ilo Mmụọ, = Late September
9. Ọnwa Ana, = October
10. Ọnwa Okike, = Early November
11. Ọnwa Ajana, = Late November
12. Ọnwa Ede Ajana, = Late November to December
13. Ọnwa Ụzọ Alụsị, = January to Early February

Main sources: [DENC], [IBEN], [ONWU], and [UDEA]

162 Calendar of Imladris

This fictional calendar was constructed by Professor John Ronald Reuel Tolkien (1892–1973) for his book *The Lord of the Rings*. It was used by the Elves of Rivendell. The base of the calendar was 1 year (yén) that was defined as 144 coránari (sing. coránar; solar years) or 144 loa (= growth) = 8766 enqueir (sing. enquië; 6-day weeks) = 52,596 days = about 144 human years.

The names of the seasons in Quenya/Sindarin:

1. tuilé/ethuil (spring) (54 days)
2. lairë/laer (summer) (72 days)
3. yàvië/lavas (autumn) (54 days)
4. quellë/firith (fading) (54 days)
5. hrivë/rhiw (winter) (72 days)
6. coirë/echuir (stirring) (54 days)

Three enderí (middle-days) were inserted between yávië and quellë. These middle-days were also doubled every 12 years. There were also 2 days inserted between coirë and tuilë.

Each week (enquië) has 6 days:

1. orgilion (for the Stars)
2. anarya/oranor (for the Sun)
3. isilya/orithil (for the Moon)
4. aldúya/orgaladhad (for the Two Threes)
5. menelya/ormenel (for the Heavens)
6. valanya/orbelain or tárion/rodyn (for the Valars or Powers)

Main source: [DROU]
Internet source: glyphweb.com

163 (Old) Inca Calendars

These calendars were used in the Incan Empire during the fourteenth to sixteenth centuries. The Incas essentially used two calendars in parallel, one lunar and one solar. The 12 lunar months were not grouped into seasons and weeks, but each was marked with specific festivals and rituals. The lunar month was closer to the 27.3 day sidereal period for the Moon, describing the period when the Moon returns to the same position against the stars, instead of the 29.5 day lunar synodic period, describing the time between full moons, used by most cultures. The 12 lunar sideal months created a period of 328 days. The Inca year also included a group of about 37 uncounted days, used as a time to rest and a period outside the religious calendar. The new year began when the Pleiades were observed again at dawn, near the summer solstice. The duration of the uncounted days would vary slightly from one year to another.

The position of the Sun on the horizon and in the sky moved between landmarks used to mark time. The Pleiades were close to the Sun during the June solstice sunrise, and the star constellation known as atoq (“fox”) was close to the Sun during the December solstice sunrise. These landmarks, and a corresponding pair of sunset markers, formed two axes of space, known as the atoq and collca axes, which divided the sky into quadrants.

The Incas had extensive daily rituals during which religious worship took place at precise times and spatial locations. Worship sites rotated through the city to various shrines (huacas) on a daily cycle. A ritual calendar linked all of the 328 huacas, one for each of the 328 named days in the Inca lunar year.

164 Indian Calendar

See *Hindu calendars* and *Saka calendar*.

165 Indian Civil Calendar

See *Saka calendar*.

166 Indian National Calendar

See *Saka calendar*.

167 Indian Religious Calendar

See *Hindu calendars*.

168 International Calendar

This calendar was proposed by *The International Calendar Association* in October 1931, and put before the *League of Nations*. The proposal is for a year made up of five quintals, each 73 days long. A quintal has 12 six-day weeks, the last day of the week and of the quintal being rest days, making 300 work and 65 rest days in the year. The day has 12 hours, the hour 100 minutes, and the minute 100 seconds. Leap years are created by adding another day every fourth year unless the year number is a multiple of 128.

Main sources: [RICH2]

169 Inuit Calendars

These calendars were used by the Inuit peoples in the Arctic area. There were traditionally 8 seasons and 13 lunar months. If the winter solstice coincided with the first day of the 13th month, this month was skipped. This simple rule gave a natural alternating pattern of 12 and 13 lunar months.

At any rate, there were many calendars in use with different names for the months, as well as various corresponding cues from the sky or animals. Below, three calendars are described.

Ukiuq (winter)

1. kaitvitjuitk (rejoice and dance), = ~ December
2. avunniviayik (dwarf seals give birth), = ~ January
3. avunnivik (miscarriage Moon), = ~ February

Upimgakajaaq (late winter)

4. amaolikkervik (little snow birds (amaolikat) arrive from the south), = ~ March

Upimgak-saaq (early spring)

5. kriblalikvik (the sun has melted the top of the snow), = ~ April

Upimgaaq (spring)

6. tigmiyikvik (ducks and geese return from the south), = ~ May
7. nuertorvik (muskrats in rivers and lakes), = ~ June

Aujaq (summer)

8. padlersersivik (the dry Moon), = ~ July
9. krugyuat tingiviat (young swans take their flight), = ~ August

Ukiaksajaaq (early autumn)

10. aklikarniarvik (harpoon seal Moon), = ~ September

Ukiaksaaq (autumn)

11. tugluvik (the cold is forming thin ice (tuglu)), = ~ October

Ukiaq (early winter)

12. itartoryuk (white mist fills the igloo), = ~ November

Ukiuq (winter)

1. siqinnaarut (Aaguuk star is seen at dawn), = ~ January/February
2. qangattaasan (Walrus migrate toward the land-fast ice), = ~ February/March

Upirngak-saaq (early spring)

3. avunniit (premature seals born and spring equinox), = ~ March/April
4. nattian (seal pups are born), = ~ April/May

Upirngaaq (spring)

5. tirigluit (bearded seal pups are born), = ~ May/June
6. nurrait (summer solstice, caribou calving and bird migration arrival), = ~ June
7. manniit (migratory birds nest), = ~ June/July

Aujaq (summer)

8. sagguruut (caribou skin sheds), = ~ July/August
9. akullirut (seeds uncoil on malikkaan plant), = ~ August/September

Ukiaksajaaq (early autumn)

10. amirailaut (utumnal equinox and shedding of velvet from caribou antlers), = ~ September/October

Ukiaksaaq (autumn)

11. ukiuirut (sea ice starts forming), = ~ October/November

Ukiaq (early winter)

12. tusartuut (sea freezes over), = ~ November/December
13. tauvikjauq (sunless period), = ~ December/January

The names of the months in the Inuit Nunangat calendar:

1. ᑕᖅᑮᓐᓇᕐᔪᐊᖅ taqqiinarjuaq (great plain Moon), = ~ January
2. ᐊᕗᓐᓂᕕᒃ avunnivik (miscarriage Moon), = ~ February

3. ᓇᑦᓯᐊᑦ natsiat (seal pups Moon), = ~ March
4. ᑎᕆᒡᓗᐃᑦ tirigluit (bearded seal pups Moon), = ~ April
5. ᐃᕝᓚᐅᓖᑦ iblauliit or ivlauliit (pregnant caribou Moon; caribou give birth to their fawns), = ~ May
6. ᒪᓐᓃᑦ manniit (eggs Moon; birds begin laying eggs (manniit)), = ~ June
7. ᓴᒡᒋᕆᕝᕕᒃ ᓴᒡᒑᕉᑦ ᔦᓚᐃ saggirivvik or saggaruut (thin hair Moon; the caribou got new thin hair), = ~ July
8. ᐊᑯᓪᓕᕈᕐᕕᒃ ᐊᑯᓪᓕᕉᑦ ᐊᐅᒡᒎᓯᑎ akullirurvik (mid-season Moon), = ~ August
9. ᐊᒥᕋᐃᕐᕕᒃ ᐊᒥᕋᐃᔭᐅᑦ ᓯᑎᐱᓯ amiraijarvik or amiraijaut (peeling Moon; the velvet of caribou antlers starts to peel off), = ~ September
10. ᓯᑯᕝᕕᒃ ᓄᓕᐊᕐᑕᐊᔦᑦ ᐅᒃᑑᐱᓯ sikuvvik (freeze-up Moon; bodies of water begin to freeze), = ~ October
11. ᑲᑕᒑᓯᕝᕕᒃ ᑐᓴᕐᒃ ᑑᑦ ᓄᕕᐱᓯ katagaarivvik (falling-off Moon; the antlers of bull caribou begin to fall off), = ~ November
12. ᐋᒡᔪᓕᕐᕕᒃ ᑕᐅᕕᒡᔪᐊᕐᒃ ᑎᓯᐱᓯ aagjulirvik (appearing Moon; two stars, called Aagjuuk, appear at dawn), = ~ December

Some Inuit tribes used star constellations to indicate the seasons. Altair and Tarazed, two stars that formed the Inuit constellation Aagjuuk, first became visible in late spring and were used to indicate the end of the long winter night. Betelgeuse and Bellatrix, two stars that were known as Akuttujuuk, were used to indicate the middle of the winter.

The names of the weekdays in Greenlandic:

1. sapaat, = Sunday
2. ataasinngorneq, = Monday
3. marlunngorneq, = Tuesday
4. pingasunngorneq, = Wednesday
5. sisamanngorneq, = Thursday
6. tallimanngorneq, = Friday
7. arfininngorneq, = Saturday

Main source: [MACD2]

170 Invariable Calendar

This has also been called the **New Era calendar** and **Normal calendar**. See also *World calendar*.

This perennial calendar was proposed by Professor L. A. Grosclaude of Geneva in April 1900. The 12-month year was divided into four quarters of exactly 13 seven-day weeks. An intercalary day, called New Year's Day, was added between December 31 and January 1, and yet another intercalary day was inserted between June 31 and July 1 in leap years.

Main source: [SOMN]

171 Iranian Calendar

This is sometimes called the **Solar Hijri calendar**. See also *Jalāli calendar* and *Solar Hijri calendar*.

(Abbreviated **SH**.)

This calendar was legally adopted in present-day Iran on March 31, 1925, under the reign of Reza Shah Pahlavi (1925–1941). The law stated that the year begins on March 21 of the Gregorian calendar. Each year begins on the vernal equinox for the Iran Standard Time meridian (52.5°E).

Years are numbered by the years since the Hegira of Muhammad from Mecca to Medina took place in 622, so the Iranian year will be 621 less than the Gregorian year that begins on January 1. The calendar usually produces a 5-year leap year interval after about every seven 4-year leap year intervals. The leap year cycle is, in total, 2820 years long, with 683 leap years during the cycle.

In 1976, Shah Mohammad Rezā Shāh Pahlavi (1919–1980) changed the origin of the calendar by using the birth of Cyrus as the first day of the calendar, instead of the Hegira of Mohammad. However, this change did not last.

The names of the months:

1. نیفـــرورد Færværdin (31 days)
2. بهشـــتیارد Ordibehesht (31 days)
3. خرداد Khordab (31 days)

4. ریت Tir (31 days)
5. مرداد Amordab (31 days)
6. وریشهر Shæhrivær (31 days)
7. مهر Mehr (30 days)
8. آبان Aban (30 days)
9. آذر Azær (30 days)
10. ید Dey (30 days)
11. بهمن Bæhmæn (30 days)
12. اسفند Esfænd (29/30 days)

The days of the week:

1. shambe, = Saturday
2. yekshambe, = Sunday
3. doshambe, = Monday
4. seshambe, = Tuesday
5. Chæharshambe, = Wednesday
6. panjshambe, = Thursday
7. jom'e, = Friday

The Iranian calendar is used for all purposes in Iran, except the determining of Islamic religious festivals, for which the lunar Islamic calendar is used. See also *Avestan calendar* and *Persian calendar*.

Main sources: [EUR, p. 1328] and [YARS]

172 Islamic Calendar

This is also called the **Hijri calendar**. See also (Old) *Achehnese calendar*, (Old) *Afghan Lunar calendar*, (Old) *Hausa calendar*, (Old) *Kanurian calendar*, and (Old) *Somali calendars*.

(Abbreviated as **A.H.** = Anno Hegirae)

This lunar calendar is officially used in countries around the Gulf, especially Kuwait, Saudi Arabia and Yemen. But other Muslim countries use the Gregorian calendar for civil purposes and only turn to the Islamic calendar for religious purposes. The calendar is based on the Qur'an (Sura IX, 36–37) and its proper observance is a sacred duty for Muslims.

The year begins with Mohammed's migration from Mecca to Medina, an event known as the Hegira. The first day of the year is fixed in the Quran as the first day of the month of Muharram. In A.H. 17, Caliph 'Umar I (579–644) established the beginning of the era of the Hegira, 1 Muharram A.H. 1, as July 16, 622 in the Julian calendar. Astronomers use an "astronomical Hegira epoch" that began on July 15, 622 in the Julian calendar.

The years are based on the motion of the moon and consist of 12 lunar months. Because 12 synodic months is only $12 \times 29.53 = 354.36$ days, the Islamic calendar is consistently shorter than a tropical year, and therefore it shifts with respect to the Gregorian calendar. The months drift with respect to the seasons in a 32½ years cycle.

A new month begins when the ulama first see the lunar crescent after the new moon. If poor visibility makes it impossible to see the moon, the new month is stated to begin 30 days after the last one began. As a result of this method, the dates may differ from city to city.

For profane purposes, a tabulated lunar calendar is used with an ordinary year, with 354 days and 12 months that have alternating lengths of 29 and 30 days.

The names of the months in Arabic:

1. المحرّم Muḥarram (30 days)
2. صفر Ṣafar (29 days)
3. ربيع الأوّل Rabīʿ al-Awwal (30 days)
4. ربيع الثاني Rabīʿ ath-Thānī (29 days)
5. جمادى الأولى Jumādā al-Ūlā (30 days)
6. جمادى الثانية Jumādā ath-Thāniya (29 days)
7. رجب Rajab (30 days)
8. شعبان Shaʿbān (29 days)
9. رمضان Ramaḍān (30 days)
10. شوّال Shawwāl (29 days)
11. ذو القعدة Dhū al-Qaʿda (30 days)
12. ذو الحجّة Dhū al-Ḥijja (29 days, but 30 days in years 2, 5, 7, 10, 13, 16, 18, 21, 24, 26, and 29)

The names of the months in Ottoman Turkish:

1. Muharrem
2. Safer
3. Rebiülevvel
4. Rebiülâhır

5. Cemaziyelevvel
6. Cemaziyelâhır
7. Recep
8. Şaban
9. Ramazan
10. Sevval
11. Zilkade
12. Zilhicce

In a cycle of 30 years, 11 leap years with 355 days each appear, in which the 12th month has 30 days instead of 29. There are, however, two different structures of the 30-year cycle in use, which cause differences in the date by 1 day during 348 of the 360 months. For religious purposes, the start of a new month is not determined by the tables of the fixed calendar, but through actual observation of the young moon's crescent.

The week has 7 days and begins at sunset on Saturday (Gregorian calendar). The names of the days of the week are numbers.

1. الأحد (Yaum) al-Aḥad, = Sunday
2. الاثنين (Yaum) al-Ithnayn, = Monday
3. الثلاثاء (Yaum) ath-Thalaathaa', = Tuesday
4. الأربعاء (Yaum) al-Arba'aa', = Wednesday
5. الخميس (Yaum) al-Khamīs, = Thursday
6. الجمعة (Yaum) al-Jumu'ah, = Friday
7. السبت (Yaum) as-Sabt, = Saturday

Main sources: [FREE], [GULE], [ILYA], [REIN], and [UNAT]

173 Itelmen Calendar

This lunar calendar was used among the Itelmens on the Kamchatka Peninsula.

The names of the months:

1. month when the wood-cock arrives (starting in May)
2. cuckoo month
3. summer month
4. month when people fish in the moonlight
5. month when leaves and plants begin to wither and fall away
6. month when the porus-titmouse appears
7. month when the nettles are gathered and hung up to dry
8. month when it's rather cold
9. month when you must drink water with great wooden spoons or with shells
10. month when the ladder leading to the balagans becomes very brittle owing to the cold
11. month when the snow around the vent-hole thaws and the earth again appears
12. month when the water-wagtail arrive

Main source: [NILS]

174 Jain Calendar

This lunisolar calendar was used by practitioners of Jainism in India. A normal year consists of 12 months, and a leap year has 13 months. The average number of days in a month is 30. A normal year has 353, 354, or 355 days, and a leap year has 383, 384, or 385 days.

It was begun on October 15, 527 BCE, called the Vira Nirvana Samvat era, and commemorates the nirvana of Mahavira (599–527 BC).

175 Jalāli Calendar

See also *Iranian calendar*.

This sidereal calendar was used in Persia. It was adopted on March 15, 1079, by Sultan Jalal al-Din Malik Shah I (1072–1092), based on the recommendations of a committee of astronomers. It was based on predictions and observations of solar transit between zodiacal regions. Since the Solar transit may vary, the length of the months varied between 29 and 32 days, but there was never any need for leap years or seasonal adjustments. On March 31, 1925, the calendar was modified into what is called the Iranian calendar.

Main source: [YARS]

176 Japanese Calendars

There have been several calendars in use in Japan. The first calendar in use was probably the old Chinese solar calendar. Later, the Chinese lunisolar calendars were updated and corrected by Japanese astronomers: Genka (from 604 to 680), Gihō (from 676 to 763), Taien (from 764 to 857; developed by Yi Xing), Goki (from 858 to 862; developed by Akasuga Manomaro), and Semmyō (from 862 to 1684; developed by Shibukawa Shunkai and Shikokawa Kōkyō). Later, there were some calendars compiled in Japan: Jōkyō (from 1685 to 1753; developed by Shibukawa Shunkai), Hōryaku (from 1754 to 1797; developed by Abe Yasukuni, Shibukawa Kōkyō, and Nishiyama Seikyū), Kansei (from 1797 to 1844; developed by Takahashi Yoshitoki and Hazama Shigetomi), and Tenpō (from 1844 to 1872; developed by Shibukawa Kagesuke). The last was abandoned for the Gregorian calendar in 1872.

The Chinese solar calendar, used for agricultural purposes, divided the year into 24 solar terms, defined by the sun's movement through 24 sections defined along the ecliptic. This was probably one of the first calendars in Japan.

The names of the 24 solar terms in the old solar calendar (Nijūshisekki) based on the Chinese calendar:

1. Risshun, = 4 or 5 February–18 or 19 February
2. Usui, = 19 or 20 February–4 or 5 March
3. Keichitsu, = 5 or 6 March–20 or 21 March
4. Shumbun, = 21 or 22 March–4 or 5 April
5. Seimei, = 5 or 6 April–19 or 20 April
6. Kokuu, = 20 or 21 April–4 or 5 May
7. Rikka, = 5 or 6 May–20 or 21 May
8. Shōman, = 21 or 22 May–5 or 6 June
9. Bōshu, = 6 or 7 June–20 or 21 June
10. Geshi, = 21 or 22 June–6 or 7 July
11. Shosho, = 7 or 8 July–22 or 23 July
12. Taisho, = 23 or 24 July–6 or 7 August
13. Risshū, = 7 or 8 August–22 or 23 August
14. Shosho, = 23 or 24 August–7 or 8 September
15. Hakuro, = 8 or 9 September–22 or 23 September
16. Shūbun, = 23 or 24 September–7 or 8 October
17. Kanro, = 8 or 9 October–22 or 23 October
18. Soko, = 23 or 24 October–6 or 7 November
19. Ritto, = 7 or 8 November–21 or 22 November
20. Shōsetsu, = 22 or 23 November–6 or 7 December
21. Taisetsu, = 7 or 8 December–20 or 21 December
22. Toji, = 21 or 22 December–4 or 4 January
23. Shokan, = 5 or 6 January–19 or 20 January
24. Daikan, = 20 or 21 January–3 or 4 February

The lunisolar Chinese calendar was introduced into Japan in the mid-sixth century. After that, the Chinese sexagenary cycle (六十花甲 *liùshí huājiǎ*) and the era name system (年号 *nengō*) were also brought over from China. From 1872 to the Second World War, an Imperial year dating system (皇紀 *kōki*) was in some use. In this system, the year 1 was the year when the Emperor Jimmu (r. 660–585 BCE) founded Japan (=660 BCE according to the Gregorian calendar).

The names of the months in the lunar calendar based on the Chinese calendar:

1. 睦月 *Mutsuki*
2. 如月 *Kisarag* or 衣更着 *Kinusaragi*
3. 弥生 *Yayoi*
4. 卯月 *Uzuki*
5. 皐月 *Satsuki* or 早苗月 *Sanaetsuki*
6. 水無月 *Minazuki*
7. 文月 *Fumizuki*
8. 葉月 *Hazuki*
9. 長月 *Nagatsuki*
10. 神無月 *Kannazuki*
11. 霜月 *Shimotsuki*
12. 師走 *Shiwasu*

The names of the months, based on the ordinal numbers:

1. 一月 ichi-gatsu
2. 二月 ni-gatsu

3. 三月 san-gatsu
4. 四月 shi-gatsu
5. 五月 go-gatsu
6. 六月 roku-gatsu
7. 七月 shichi-gatsu
8. 八月 hachi-gatsu
9. 九月 ku-gatsu
10. 十月 jû-gatsu
11. 十一月 jû ichi-gatsu
12. 十二月 jû-nimbre-gatsu

The names of the seasons:

1. 春 *haru*, spring, = Kisaragi–Uzuki
2. 夏 *natsu*, summer, = Satsuki–Fumizuki
3. 秋 *aki*, autumn, = Hazuki–Kannazuki
4. 冬 *fuyu*, winter, = Shimotsuki–Mutsuki

Each month is also divided into 10-day periods:

1. **上旬** *jōjun,* = 1st–10th day
2. **中旬** *chūjun,* = 11th–20th day
3. **下旬** *gejun,* = 21st–31st day

The years are also still numbered in terms of eras which begin with the accession of each emperor. Within a year or so of a new emperor's assuming the throne, the imperial court announces an official auspicious name for the reign. These era names are referred to as nengō. This practice is based on a Chinese model dating to the second century BC. The Japanese adopted it in 645 when, after a coup d'etat, the emperor Kōtoku adopted the name Taika, "Great Reform," as a nengō. Except for the years 673–686 (now referred to as Hakuhō), nengō have been officially used in Japan ever since.

In earlier periods, emperors would sometimes adopt a new nengo in the middle of a reign, to commemorate some great event. In 1872, the government adopted the practise of using only one nengō for an emperor's entire reign, and, upon an emperor's death, the nengō becomes the official posthumous name of that emperor.

The first year of an emperor's reign begins on his accession to the throne and ends on December 31. Thereafter, a new year of the reign begins each January 1. Scholars, however, have tended to label every day in such a year as year 1 of whatever nengō applied at the year's end. Years prior to the adoption of the nengō system are often dated by the official posthumous name of the emperor and the year of reign. To distinguish such dates from true nengō, the word tennō ("sovereign") is usually added to them. Unlike nengō dates, the first year of reign is the first full year of reign.

List of the first nengōs:

645 大化 Taika
650 白雉 Hakuchi
686 朱鳥 Shuchō
701 大宝 Taihō or Daihō
704 慶雲 Keiun
708 和銅 Wadō
715 霊亀 Reiki
717 養老 Yōrō
724 神亀 Jinki
729 天平 Tenpyō
749 天平感宝 Tenpyō-kanpō
749 天平勝宝 Tenpyō-shōhō
757 天平宝字 Tenpyō-hōji
765 天平神護 Tenpyō-jingo
767 神護景雲 Jingo-keiun
770 宝亀 Hōki
781 天応 Ten'ō
782 延暦 Enryaku
806 大同 Daidō
810 弘仁 Kōnin
824 天長 Tenchō
834 承和 Jōwa or Shōwa or Sōwa
848 嘉祥 Kajō
851 仁寿 Ninju
854 斉衡 Saikō
857 天安 Tennan
859 貞観 Jōgan
877 元慶 Gangyō or Gankyō or Genkei

The names of the weekdays, named after the Five Elements and the Sun and Moon:

1. 日曜日 *nichiyōbi*, Sun day, = Sunday
2. 月曜日 *getsuyōbi*, Moon day, = Monday
3. 火曜日 *kayōbi*, Fire day, = Tuesday
4. 水曜日 *suiyōbi*, Water day, = Wednesday

5. 木曜日 *mokuyōbi*, Wood day, = Thursday
6. 金曜日 *kin'yōbi*, Gold day, = Friday
7. 土曜日 *doyōbi*, Earth day, = Saturday

Main sources: [NUSS], [TORA], and [UCHI]

177 Javanese Calendar

This calendar was created by Sultan Agung of Mataram (r. 1613–1645). It replaced the earlier use of Saka years in 1633. The pasaran cycle is a cycle of days. It dates from when villages converged at a marketplace every 5 days to sell and buy wares (names given in krama and ngoko): Manis or Legi, Pait or Pahing, Petak or Pon, Cemeng or Wagé and Asih or Kliwon.

There was also a 7-day week:

1. Minggu or Ahad , = Sunday
2. Senin, = Monday
3. Selasa, = Tuesday
4. Rebo, = Wednesday
5. Kemis, = Thursday
6. Jumat, = Friday
7. Setu, = Saturday

The solar year cycle (Pranata Mangsa) is divided into 12 periods (*mangse*):

1. Mangsa Kaso, starts at June 23 (41 days)
2. Mangsa Karo, starts at August 3 (23 days)
3. Mangsa Katelu , starts at August 26 (24 days)
4. Mangsa Kapat, starts at September 19 (25 days)
5. Mangsa Kalima, starts at October 14 (27 days)
6. Mangsa Kanem , starts at November 11 (43 days)
7. Mangsa Kapitu, starts at December 23 (43 days)
8. Mangsa Kawolu, starts at February 4 or 5 (27 days)
9. Mangsa Kasanga, starts at March 2 (25 days)
10. Mangsa Kasadasa, starts at March 27 (24 days)
11. Mangsa Desta, starts at April 20 (23 days)
12. Mangsa Saddha, starts at May 13 (41 days)

The lunar year (tahun) is divided into 12 periods (*wulan*); below, the names are given in krama and ngoko:

1. Warana or Sura (30 days)
2. Wadana or Sapar (29 days)
3. Wijanga or Mulud (30 days)
4. Wiyana or Bakda Mulud (29 days)
5. Widada or Jumadil Awal (30 days)
6. Widarpa or Jumadil Akhir (29 days)
7. Wilarpa or Rejeb (30 days)
8. Wahana or Ruwah (29 days)
9. Wanana or Pasa (30 days)
10. Wurana or Sawal (29 days)
11. Wujana or Sela (30 days)
12. Wujala or Besar (29 or 30 days)

There is also a cycle of eight tahun that makes a windu (about 7 years and 9 months in the Gregorian calendar); below, the names are given in krama and ngoko:

1. Purwana or Alip (354 days)
2. Karyana or Ehé (354 days)
3. Anama or Jemawal (355 days)
4. Lalana or Jé (354 days)
5. Ngawanga or Dal (355 days)
6. Pawaka or Bé (354 days)
7. Wasana or Wawu (354 days)
8. Swasana or Jimakir (355 days)

The windus are also grouped into a cycle that is 2835 days long, or exactly 81 repetitions of the 35-day wetonan cycle: Windu Adi, Windu Kunthara, Windu Sengara, and Windu Sancaya.

Main sources: [RICK] and [SOEB]

178 Jewish Calendar

See *Hebrew calendar*.

179 Jōkyō Calendar

This was also called the **Teikyō**. See also *Japanese calendars*.

This lunisolar calendar was used in Japan from 1684 to 1753.

Main source: [NUSS]

180 Juche Calendar

This is a variation of the Gregorian calendar, issued in a decree adopted on July 8, 1997 by the North Korean government and associated organizations. It is based on April 15, 1912, the date of the birth of Kim Il-sung, being year 1 (Juche 1).

Main source: [LEE, pp. 249–250]

181 Julian Calendar

In 46 BCE, during Julius Caesar's third consulship and with the advice of the Alexandrian astronomer Sosigenes, the Roman calendar became pervasively altered in several ways. 67 days were added between November and December to the first year, a 445-day year, to bring the seasons back to their traditional dates. Ceasar also renamed the month Quintilis as Iulius, after himself.

The names of the months:

1. Ianuarius (until 46 BCE = 29 days; after 46 BCE = 31 days)
2. Februarius (until 46 BCE = 28 days; after 46 BCE = 28 days)
3. Mercedonius (until 46 BCE = 0 days, but leap years 27 days; after 46 BCE = abolished)
4. Martius (until 46 BCE = 31 days; after 46 BCE = 31 days)
5. Aprilis (until 46 BCE = 29 days; after 46 BCE = 30 days)
6. Maius (until 46 BCE = 31 days; after 46 BCE = 31 days)
7. Iunius (until 46 BCE = 29 days; after 46 BCE = 30 days)
8. Iulius (until 46 BCE = 31 days; after 46 BCE = 31 days)
9. Sextilis (until 46 BCE = 29 days; after 46 BCE = 31 days)
10. September (until 46 BCE = 29 days; after 46 BCE = 30 days)
11. October (until 46 BCE = 31 days; after 46 BCE = 31 days)
12. November (until 46 BCE = 29 days; after 46 BCE = 30 days)
13. December (until 46 BCE = 29 days; after 46 BCE = 31 days)

In 4 BC, during the reign of Augustus, the month Sextilis was renamed Augustus. To make the length of the year the same as that of the tropical year, every 4 years, an extra day was added to Februarius between its 23 and 24 days.

The names of the months in Anglo-Norman French during the twelfth century and in Middle English during the fourteenth century:

1. Janvier/Januarie
2. Februare/Februarius
3. March/Marche
4. Avril/Averil
5. Mai/Maius
6. Juin/Jun
7. Juil/Julie
8. Aust/Augustus
9. Septembre/Septembre
10. Octobre/October
11. Novembre/November
12. Decembre/December

The Julian year of 365¼ days was misaligned with the earth by only about 11 minutes and 12 seconds, and remained in almost universal use in Europe until 1582, when the Julian calendar was gradually replaced by the Gregorian calendar.

Main source: [REIN]

182 Kalapuya Calendar

This lunar calendar was used among the Kalapuya people in northwestern parts of the present-day U.S.A.

The names of the months:

1. adshampak (not bad weather), = ~ December

2. atalka (stay inside), = ~ January
3. atchiulartadsh (out of food), = ~ February
4. atcha-uyu (women dig camas), = ~ March
5. amanta kotantal (time for pounding camas), = ~ April
6. atantal (camas blooming time), = ~ May
7. anishnalya (camas ripe), = ~ June
8. ameku or waydyu ameku (mid-summer time), = ~ July
9. akupiu (end of summer), = ~ August
10. atchiutchutin (after harvest), = ~ September
11. atchalankuaik (start getting sagittair roots), = ~ October
12. alangitapi (moving inside for winter), = ~ November

Internet source: americanindian.net

183 Kannada Calendar

See also *Hindu calendar*.

This is a Hindu calendar used predominantly in Karnataka.

The names of the months:

1. ಚೈತ್ರ Chaitra, = mid-March–mid-April
2. ವೈಶಾಖ Vaiśākha, = mid-April–mid-May
3. ಜ್ಯೇಷ್ಠ Jyaiṣṭha, = mid-May–mid-June
4. ಆಷಾಢ Āṣāḍha, = mid-June–mid-July
5. ಶ್ರಾವಣ Śrāvaṇa, = mid-July–mid-August
6. ಭಾದ್ರಪದ Bhādrapada, = mid-August–mid-September
7. ಆಶ್ವೀಜ Āśvina, = mid-September–mid-October
8. ಕಾರ್ತೀಕ Kārtika, = mid-October–mid-November
9. ಮಾರ್ಗಶಿರ Agrahāyaṇa, = mid-November–mid-December
10. ಪುಷ್ಯ Pauṣa, = mid-December–mid-January
11. ಮಾಘ Māgha, = mid-January–mid-February
12. ಫಾಲ್ಗುಣ Phālguna, = mid-February–mid-March

The names of the seasons:

1. ವಸಂತ ಋತು Vasaṃta Ṛtu, = spring
2. ಗ್ರೀಷ್ಮ ಋತು Grīṣma Ṛtu, = summer
3. ವರ್ಷ ಋತು Varṣa Ṛtu, = monsoon
4. ಶರದೃತು Śaradṛtu, = autumn
5. ಹೇಮಂತ ಋತು Hēmaṃta Ṛtu, = winter
6. ಶಿಶಿರ ಋತು Śiśira Ṛtu, = prevernal

The names of the weekdays:

1. ಭಾನುವಾರ bhānuvāra, = Sunday
2. ಸೋಮವಾರ sōmavāra, = Monday
3. ಮಂಗಳವಾರ maṁgaḷavāra, = Tuesday
4. ಬುಧವಾರ budhavāra, = Wednesday
5. ಗುರುವಾರ guruvāra, = Thursday
6. ಶುಕ್ರವಾರ śukravāra, = Friday
7. ಶನಿವಾರ śanivāra, = Saturday

Main source: [KITT]

184 Kansei Calendar

See also *Japanese calendars*.

This lunisolar calendar was used in Japan from 1797 to 1844.

Main source: [NUSS]

185 (Old) Kanurian Calendar

This Islamic calendar was used by the Kanuri people in the Bornu Empire.

The names of the months and related months in the Islamic calendar:

1. mâram, المحرّم, Muharram, (30 days)
2. safer, صفر, Safar, (29 days)
3. lafeloual, ربيع الأوّل, Rabi' al-awwal, (30 days)
4. lafelayer, ربيع الثاني or ربيع الآخر, Rabī' al-Thānī, (29 days)
5. wotšimada-loual, جمادى الأولى, Jumada al-Oola, (30 days)
6. wotšimada-layer, جمادى الثانية or جمادى الآخرة, Jumada al-Thani, (29 days)
7. radšab, رجب, Rajab, (30 days)
8. šaban, شعبان, Sha'aban, (29 days)
9. armalan, رمضان, Ramadan, (30 days)
10. soual, شوّال, Shawwāl, (29 days)

11. kide, ذو القعـدة, Dhu al-Qa'dah, (30 days)
12. atši, ذو الحجّة, Dhu al-Hijjah, (29 days and 30 days in leap year)

Main source: [GINZ]

186 Karaite Calendar

This observational lunar calendar is used by the Karaite Jews. The year begins with the first new Moon after the barley in Israel reaches the stage in its ripeness called *abib*, which means that it will be ready to harvest in 2–3 weeks. The beginning of each month, the Rosh Chodesh, is confirmed by the observation in Israel of the first sightings of the new moon. If the barley crop is abib at the end of the 12th month, the following new Moon is Hodesh Ha-Aviv, but if the barley is still immature, an intercalary 13th month (*Adar Bet*) is added.

Main sources: [GOUD] and [TSOF]

187 Karay-a Calendar

See *Cebuano calendar*.

188 Kartikadi Vikram

See also *Hindu calendar*.

This Hindu calendar is predominantly used in Gujarat.

The names of the months:

1. કારતક Kartak, mid-October–mid-November
2. માગશર Magshar, mid-November–mid-December
3. પોષ Posh, mid-December–mid-January
4. મહા Maha, mid-January–mid-February
5. ફાગણ Fagun, mid-February–mid-March
6. ચૈત્ર Chaitra, mid-March–mid-April
7. વૈશાખ Vaishak, mid-April–mid-May
8. જેઠ Jeth, mid-May–mid-June
9. અષાડ Asatd, mid-June–mid-July
10. શ્રાવણ Shravun, mid-July–mid-August
11. ભાદરવો Bhadarvo, mid-August–mid-September
12. આસો Aso, mid-September–mid-October

The names of the weekdays:

1. રવિવાર Raavivaar, = Sunday
2. સોમવાર Somvaar, = Monday
3. મંગળવાર Mangalvaar, = Tuesday
4. બુધવાર Budhvaar, = Wednesday
5. ગુરૂવાર Guruvaar, = Thursday
6. શુક્રવાર Sukhravaar, = Friday
7. શનિવાર Shanivaar, = Saturday

Main source: [CHAT]

189 (Old) Kazakh Calendar

This lunisolar calendar was used in Kazakhstan.

The names of the months in Latin script and in Cyrillic script:

1. Kangtar/Қаңтар, = ~ January
2. Akpan/Ақпан, = ~ February
3. Nawrız/Наурыз, = ~ March
4. Kökek/Сәуір, = ~ April
5. Mamır/Мамыр, = ~ May
6. Mawsım/Маусым, = ~ June
7. Şilde/Шілде, = ~ July
8. Tamız/Тамыз, = ~ August
9. Kırküyek/Қыркүйек, = ~ September
10. Kazan/Қазан, = ~ October
11. Karaşa/Қараша, = ~ November
12. Zheltoksan/Желтоқсан, = ~ December

They also use a 12-year cycle, quite similar to the Chinese zodiac cycle.

1. тышқан (rat)
2. сиыр (ox)
3. барыс (leopard)
4. қоян (rabbit)
5. улу (snail)
6. жылан (snake)
7. жылқы (horse)
8. қой (goat)
9. маймыл (monkey)

10. тауық (rooster)
11. ит (dog)
12. қара кейік (pig)

The names of the weekdays:

1. дүйсенбі Düysenbi, = Monday
2. сейсенбі Seysenbi, = Tuesday
3. сәрсенбі Särsenbi, = Wednesday
4. бейсенбі Beysenbi, = Thursday
5. жұма Juma, = Friday
6. сенбі Senbi, = Saturday
7. жексенбі Zheksenbe, = Sunday

Internet source: kk.wikipedia.org

190 Keresan Calendar

This calendar was used by the Keres Pueblo people in New Mexico.

The names of the months:

1. nadzi-kisraiti, = ~ January
2. y'amuuni dawaatra, = February
3. shch'ami daawaatra, = ~ March
4. bashch'stsishe daawaatra, = ~ April
5. shawiitsishe daawaatra, = ~ May
6. sauhua daawaatra, = ~ June
7. sina kisraiti, = ~ July
8. y'aamuni daawaatra, = ~ August
9. kinati daawaatra, = ~ September
10. ?
11. ?
12. nachuweenu daawaatra, = ~ December

Internet source: americanindian.net

191 Khanty Calendar

This lunar calendar was used among the Khanty people in Tyumen Oblast.

The names of the months:

1. spawning Moon (starting in April)
2. calving Moon or pine sap-wood Moon
3. birch sap-wood Moon
4. salmon-weir Moon
5. Moon of the hay harvest
6. ducks-and-geese-go-away Moon
7. naked tree Moon
8. freezing Moon or pedestrian Moon, since men go home on foot while the ice still remains
9. Moon in which men go on horseback
10. great winter-ridge Moon
11. little winter-ridge Moon
12. wind Moon
13. Moon of crows

Main source: [NILS]

192 Khasia Calendar

This lunar calendar was used by the Khasi tribes in Meghalaya.

The time from new moon to full moon was called suklá pakshá, and the time from full moon to the next new moon was called krishna pakshá.

The names of the months:

1. U Kylla lynkot, = ~ January
2. U Rym-pang, = ~ February
3. U Lyber, = ~ March
4. U Laiong, = ~ April
5. U Jimmang, = ~ May
6. U Jilliw, = ~ June
7. U Nai-túng, = ~ July
8. U Nai-lar, = ~ August
9. U Nai-lúr, = ~ September
10. U Rysow, = ~ October
11. U Nai-wing, = ~ November
12. U Noh-prah, = ~ December

Eight-day week used by the inhabitants in the Khásí Hills during the mid-nineteenth century:

1. Lyn-kah, 2. Nong-krem, 3. Um-long, 4. Rang-hep, 5. Shillong, 6. Pom-tih, 7. Um-nih, and 8. Yeo-duh.

Eight-day week used by the inhabitants in the Jáintiá Hills during the mid-nineteenth century:

1. Kyllao, 2. Pyn-sing, 3. Máo-long, 4. Máo-siang, 5. Máo-shai, 6. Pyn-kat, 7. Thym-blein, and 8. Ka-hat.

Main sources: [HUNT6] and [PRYS]

193 (Old) Khmer Calendar

This lunisolar calendar was used by the Khmers during the Angkor era.

The names of the lunar months:

1. មិគសិរ meaksé, = ~ mid-December-early-January
2. បុស bos, = ~ January/February
3. មាគ meak, = ~ February/March
4. ផល្គុន phalkun, = ~ March/April
5. ចេត្រ chet, = ~ April/May
6. វិសាខ or ពិសាខ pisak, = ~ May/June
7. ជេស្ឋ ches, = ~ June/July
8. អាសាឍ arsad, = ~ July/August
   Every second year, this month was doubled as:
   8a. បឋមសាឍ pathom’sad, = ~ late July
   8b. ទុតិយាសាឍ tuteyasad, = ~ early August
9. ស្រាពណ៍ sraab, = ~ August/September
10. ភទ្របទ phutrabot, = ~ September/October
11. អស្សុជ asuj, = ~ October/November
12. កត្តិក kadek, = ~ November/December

There was also a solar system (Soriya Koti សុរិយាគតី).

The names of the solar months (Sao Meas សៅរ៍មាស):

1. មករា Mâkâra, = ~ January
2. កម្ភៈ (Kŏmpheăh), = ~ February
3. មិនា or មីនា (Mïnéa), = ~ March
4. មេសា Mêsa, = ~ April
5. ឧសភា Osâphea, = ~ May
6. មិថុនា (Mĭthŏna), = ~ June
7. កក្កដា Kâkkda, = ~ July
8. សីហា Seiha, = ~ August
9. កញ្ញា Kâñña, = ~ September
10. តុលា (Tŏla), = ~ October
11. វិច្ឆិកា (Vĭkchĕka), = ~ November
12. ធ្នូ (Thnŭ), = ~ December

Internet source: khmerconnection.com

194 (Old) Khotanese Calendar

This calendar was used in the Kingdom of Khotan in present-day northwest China until about 1006. The year was divided into 6 seasons and 12 months. The days were divided into 12 double hours, each governed by 1 of the 12 animals of the animal cycle.

The names of the seasons:

1. Hamāña rva, = summer season (first and second month)
2. Paśāṃjsya rva, = autumn season (third and fourth month)
3. Ysumāña rva, = winter season (fifth and sixth month)
4. ṇa’stya ysumām bisā rva, = end of winter season (seventh and eighth month)
5. pasālya rva, = spring season (ninth and tenth month)
6. ṇa’stya rva, = spring-like season (eleventh and twelfth month)

The names of the months:

1. Haṃdyaji, = January
2. Rarūya, = February
3. Ttāṃjāra, = March
4. Brakhaysdya, = April
5. Mutca’ci, = May
6. Muñaṃja, = June
7. Skarhvāra, = July
8. Rrāhaja, = August
9. Cvātaji, = September
10. Kaja, = October
11. Hamārîji, = November
12. Siṃjsîṃja, = December

The years were also named according to the central Asian animal cycle:

1. mūla (rat)
2. gūha (ox)
3. muya (tiger)
4. sahaica (hare)
5. nā (dragon)
6. śaysda (snake)
7. aśa (horse)
8. pasa (sheep)
9. makala (monkey)
10. krreṃga (cock)
11. śve (dog)
12. pā´sa (pig)

Main sources: [BAIL], [KONO], and [YARS]

195 Khowar Calendar

This lunisolar calendar is used among the Khowar-speaking people in the Khyber Pakhtunkhwa district in Pakistan.

The names of the seasons:

1. bosun, = spring
2. grishpo, = summer
3. shoro, = autumn
4. yomun, = winter

The names of the months:

1. pheting (the month of cold weather), = ~ January
2. ghor ghor (the month of very cold weather), = ~ February
3. aliyan (the month of the ducks), = ~ March
4. shadagh (the month of snow melting), = ~ April
5. boye (the month of the birds), = ~ May
6. ronzuk (the month of starvation) = ~ June
7. yugh (the month of full dining), = ~ July
8. muzhe(the month in the middle), = ~ August
9. khumpach (the month of dry weather), = ~ September
10. kishman (the month of plowing), = ~ October
11. chanchori (the month of the falling leaves), = ~ November
12. thungshal (the month of long nights), = ~ December

The names of the weekdays:

1. کی شـــمبے yak shambey, = Sunday
2. دو شـــمبے du shambey, = Monday
3. س شـــمبے sey shambey, = Tuesday
4. چار شـــمبے char shambey, = Wednesday
5. پچھمبـــــے pahhambey, = Thursday
6. نـہیآد adina, = Friday
7. شـــمبے shambey, = Saturday

Main source: [LHOM]

196 Khwarezmian Calendar

See (Old) *Choresmian calendar*.

197 Kikongo Calendar

This calendar was used among the Kikongo-speaking people in Angola, Democratic Republic of the Congo and the Republic of the Congo.

The names of the months:

1. Yanwali, = January
2. Febwali, = February
3. Malasi, = March
4. Apila, = April
5. Mai, = May
6. Yuni, = June
7. Yuli, = July
8. Angusti, = August
9. Sepetemba, = September
10. Okotoba, = October
11. Novemba, = November
12. Desemba, = December

The names of the weekday:

1. lundi, = Monday
2. mardi, = Tuesday
3. mekedi, = Wednesday
4. juedi, = Thursday
5. vendredi, = Friday
6. sabala, = Saturday
7. dimanchi or lumingu, = Sunday

Other traditional measures reported during the nineteenth and twentieth centuries:

1 kumi diamvu, = a decade
1 mvu or mwaka (in Bwende dialect), = a year
1 angonda tatu, = a quarter of a year
1 lumumgu, = a week
1 mwini ye fuku or ndo, = 1 day
1 lokula, = an hour
1 buku kiaia, = 15 minutes
1 nuta or monuta, = a minute
1 sekunda, = a second

Main source: [LAMA]

198 Kiowa Calendar

This lunar calendar was used by the Kiowa people in the northwesterm present-day U.S.A.

The names of the months:

1. kaguat p'a san (little bud Moon), = ~ early February–early March
2. kaguar p'a (bud Moon), = ~ early March–early April
3. aiden p'a (leaf Moon), = ~ early April–late April
4. pai aganti p'a (summer aganti: I'll make it hot soon), = ~ late April–late May
5. pai tegpan p'a (summer tepgan: when geese go north), = ~ late May–mid-June
6. pai ganhina p'a (summer Moon), = ~ mid-June–late July
7. tagunotal'o p'a (little Moon of deer horns dropping off), = ~ late July–mid-August
8. aidenguak'o p'a (the Moon of yellow leaves), = ~ mid-August–late September
9. (the Moon when the leaves fall off), = ~ late September
10. gakinat'o p'a (the Moon of ten colds), = ~ early October–late October
11. aganti p'a (wait until I come), = ~ late October–late November
12. tepgan p'a (geese-going Moon), = ~ late November–late December
13. ganhina p'a (real goose Moon), = ~ late December–early February

The names of the seasons:

1. saigya or säta, = winter
2. asegya, = spring
3. paigya, = summer
4. paongya, = autumn

Internet source: americanindian.net
Main source: [NILS]

199 Kő̆jő́dá Calendar

See *Yoruba calendar*.

200 Kollavarsham Calendar

See *Malayalam calendar*.

201 Korean Calendars

Early Korea used a lunar calendar, *ŭmnyŏk*, originally adopted from the Chinese calendar. It was officially in use until January 1, 1896, when the Gregorian lunisolar calendar was adopted with the era name 건양 / 建陽 (Geonyang). The years were designated by Korean era names of its rulers from 270 to 963, and then by Chinese era names until 1894, together with the character of "*nyŏk*/*ryŏk*" (calendar). In 1984–1995, the years were numbered from the foundation of the Joseon Dynasty in 1392. During the Japanese occupation, from 1910 to 1945, Japanese era names were used.

From 1945 until 1961, the supposed date of Kija Chosŏn's arrival on the Korean peninsula and the legendary foundation of the Gojoseon Kingdom in 2333 BCE were regarded as year 1 in South Korea, and since 1997, the Juche calendar has been the official calendar in North Korea. The Gregorian calendar is often, since the late twentieth century, used in international relations.

The traditional lunar calendar was based on the 60-year Kanji cycle. This cycle was formed by combining two alternative separate cyclical sequences, a series of ten 'stems' (*sipkan*) and a series of 12 'branches' (*sibiji*).

The ten stems with their representation in yin-yang, element and direction dimensions:

1. 갑 gap, yang—wood—east
2. 을 eul, yin—wood—east
3. 병 byeong, yang—fire—south
4. 정 jeong, yin—fire—south
5. 무 mu, yang—earth—middle
6. 기 gi, yin—earth—middle
7. 경 gyeong, yang—metal—west
8. 신 sin, yin—metal—west
9. 임 im, yang—water—north
10. 계 gye, yin—water—north

The 12 branches and the corresponding Chinese zodiac signs:

1. 자 ja (rat)
2. 축 chuk (ox)
3. 인 in (tiger)
4. 묘 myo (rabbit)
5. 진 jin (dragon)
6. 사 sa (snake)
7. 오 o (horse)
8. 미 mi (goat)
9. 신 sin (monkey)
10. 유 yu (rooster)
11. 술 sul (dog)
12. 해 hae (pig)

By ordering the ten stems with the 12 branches in a sequence of two-character combinations, the stems are repeated six times and the branches five times to complete a 60-year cycle.

The lunar calendar had 12 months, represented by the 12 branches, and an intercalary month (*yundal*) every few years in order to keep it synchronized with the seasons.

The lunar months:

1. 인 in (tiger)
2. 묘 myo (rabbit)
3. 진 jin (dragon)
4. 사 sa (snake)
5. 오 o (horse)
6. 미 mi (goat)
7. 신 sin (monkey)
8. 유 yu (rooster)
9. 술 sul (dog)
10. 해 hae (pig)
11. 자 ja) (rat)
12. 축 chuk (ox)

The names of the seasons:

1. 겨울 gyeoul, = winter
2. 봄 bom, = spring
3. 여름 yeoreum, = summer
4. 가을 kaeul, autumn

The names of the days:

1. 일요일 ilyoil, = Sunday
2. 월요일 weolyoil, = Monday
3. 화요일 hwayoil, = Tuesday
4. 수요일 suyoil, = Wednesday
5. 목요일 mokyoil, = Thursday
6. 금요일 keumyoil, = Friday
7. 토요일 ttoyoil, = Saturday

Main source: [SOHN]

202 Koryak Calendar

This lunar calendar was used among the Koryaks in the Anadyr River region.

The names of the months:

1. snowstorm month (starting in late December)
2. growing-of-the-reindeer's-spinal-sinew month
3. false-making-udder month
4. reindeer-does-calving month
5. water month
6. first summer month
7. second summer month
8. reddening month
9. pairing-season-of-the-reindeer-bucks month
10. autumn month
11. rutting-season-of-mountain-sheep month
12. month of the head itself

Main source: [NILS]

203 Kumeyaay Calendar

This calendar was used by the Kumeyaay people in southwestern North America.

The names of the months:

1. halakwol, = ~ September
2. halanyimcep, = ~ October
3. halatai, = ~ November
4. halapisu, = ~ December
5. halamrtinya, = ~ January
6. halanitca, = ~ February
7. halakwol, = ~ March
8. halanyimcep, = ~ April
9. halatai, = ~ May
10. halapisu, = ~ June
11. halamrtinya, = ~ July
12. halanitca, = ~ August

Main source: [HOFF2]

204 Kurdish Calendar

See also *Afghan Solar calendar* and *Iranian calendar*.

This solar calendar is related to the Iranian calendar. The Kurdish era starts from 612 BCE. The year is divided into 12 months and begins on nawroz, the vernal equinox, on or about March 21 according to the Gregorian calendar. The ancient Kurdish calendar was a lunisolar calendar related to the Babylonian calendar. The Gregorian and Iranian calendars are now also used to some degree.

The names of the traditional months varied between the dialects, e.g., Kalhori, Kolyaî, Laksi, Malekshahi, and Sanjâbi:

1. هوێلەخاک Xakelêw (also Cêjnan and Jejhnan) = 21 March–20 April (31 days)
2. انڵگـو Gullan (also Banemîr, Banemer, and Gulan) = 21 April–21 May (31 days)
3. ردانەزۆج Cozerdan (also Hêzîran and Zerdan) = 22 May–21 June (31 days)
4. ەڕپووشـــپ Pûşper (also Púshperr, Tîrmeh, and Trîmê) = 22 June–22 July (31 days)
5. ژێلاوەگ Gelawêj (also Gelavîj, Gelawéjh, and Tebax) = 23 July–22 August (31 days)
6. رمانـانەخ Xermanan (also Elûn, Îlon, Nûxuşan, and Xuweşan) = 23 August–22 September (31 days)
7. رەزبەڕە Rezber (also Beran and Kewcêr) = 23 September–22 October (30 days)
8. زانڕێاەڵگ Xezellwer (also Gelarêzan, Gelawêj, and Xezan) = 23 October–21 November (30 days)
9. زرماوەس Sermawez (also Saran and Sermaviz) = 22 November–21 December (30 days)
10. فرانبـــــارەب Berfanbar (also Befran) = 22 December–20 January (30 days)
11. نـدانەبڕێ Rêbendan (also Rébendan and Sevba) = 21 January–19 February (30 days)
12. مەشڕە Reşeme (also Avdar, Reşemang, Reşemê, and Reshemé) = 20 February–20 March (29 or 30 days)

The names of the seasons:

1. هار بـە buhâr, = spring
2. هـاوین hawín (or tawistan), = summer
3. خو ربـە سە serbechû (or payiz), = autumn
4. زیســـــتان zistan (or zimistan), = winter

The names of the weekdays:

1. ەیشەممە Yekşeme, = Sunday
2. دووشەممە Duşeme, = Monday
3. س شەممە Sêşeme, = Tuesday
4. چوارشەممە Çarşeme, = Wednesday
5. جشەممە Pêncşeme, = Thursday
6. جومعە Heyinî, = Friday
7. شەممە Şeme, = Saturday

Some Arabic names, borrowed from the ancient Semitic month names, that were adjusted to fit the Julian calendar months:

1. çileya paşîn, = January
2. sibat, = February
3. adar, = March

4. nîsan, = April
5. –
6. hezîran, = June
7. –
8. ab, = August
9. eylûl, = September
10. çiriya pêşîn, = October
11. çiriya paşîn, = November
12. çileya pêşîn, = December

The Soranî Kurdish (Central Kurdish, spoken in Iran and Iraq) and Kurmanji Kurdish (Northern Kurdish) names of the Roman months:

1. kânûn i dûham/janvîye, = January
2. shubât or sîbat/fevrîye, = February
3. âdâr/mars, = March
4. nîsân/aprîl, = April
5. äyâr or gulan/mê, = May
6. huzayrân or ḥezîrân/jûen, = June
7. tamûz or tîrmeh/jûîya, = July
8. âb or ût/tebax, = August
9. aylûl or îlon/september, = September
10. tişrîn i yekam/cotmeh/oktober, = October
11. tişrîn i dûham/míjdar/november, = November
12. kânûn i yekam/desember, = December

Main sources: [AYOB], [GUNT], [IZAD], [THAC], and [THAC2]
Internet: e-mail from Dilan Roshani

205 Kuril Calendar

This lunar calendar was used among the Ainu people of the Kuril Islands.
The names of the months:

1. month with long days
2. month when the snow melts
3. coalmouse month
4. sea-gull's eggs month
5. guillemot's eggs month
6. foddering month
7. salmon-catching month
8. month when the birds grow fat
9. month when the grass is withered
10. month of the short days
11. winter month
12. month when the snow fills up

Main source: [NILS]

206 (Ancient) Lacedaemonian Calendar

This calendar was used in ancient Laconia in the southeastern part of the Peloponnese peninsula.
The names of the months:

1. Ἡράσιος Herasios, ~ October
2. Ἀπελλαῖος Apellaios, ~ November
3. Diosthyos, ~ January
4. ?
5. Eleusinios, , ~ March
6. Γεράστιος Gerastios, ~ April
7. Ἀρτεμίσιος Artemisios, , ~ May
8. Delphinios, ~ June
9. Φλιάσιος Phliastos, ~ July
10. Ἑκατομβεύς Hecatombeus, ~ August
11. Καρνεῖος Carneios, ~ September
12. Πάναμος Panamos, ~ October

Main sources: [GINZ]

207 (Ancient) Lagashian Calendar

This lunar calendar was used in Lagash beginning in twentieth century BCE.
The names of the months:

1. Gan-maš
2. Gu_4-du-bi-sar-sar
3. Ezen-^{d}Li_9-si_4
4. Šu-numun
5. $Munu_x$-(DIM_4)-ku
6. Ezen dDumu-zi
7. Ezen-^{d}Šul-gi
8. Ezen-^{d}Ba-ba_6
9. Mu-šu-du_7
10. Amar-a-a-si

11. Še-gur$_{10}$-ku$_5$
12. Še-il-la

Main source: [SAUR]

208 Lakota Calendar

This lunar calendar was used among the Lakota people in the mid-northern parts of present-day U.S.A.

Wetu (the Moons of renewal and growth) (spring)

1. magzksicaagli wi (Moon when ducks come back), = ~ March
2. wihakata cèpapi wi (Moon of making fat), = ~ April
3. wójupi wi (Moon when leaves turn green) or canwapto wi, = ~ May

Bloketu (the warm Moons) (summer)

4. wípazuka wašte wi (Moon of the June berries) or tínpsinla itkahca wi, = ~ June
5. canpasapa wi (Moon when the Chokecherries are ripe) or wiocokanyan wi, = ~ July
6. wasuton wi (Moon of the harvest), = ~ August

Pyranyetu (The Moons of change) (autumn)

7. canwape gi wi (Moon when the leaves turn brown), = ~ September
8. canwape kasna wi (Moon when the wind shakes off leaves), = ~ October
9. waniyetu wi (Moon of the rutting deer) or takiyuha wi, = ~ November

Waniyetu (The cold and dark Moons) (winter)

10. wanicokan wi (Moon when the deer shed their horns) or tahecapšun wi, = ~ early December
11. wiotehika wi (the hard Moon) or wiocokanyan wi, = ~ late December/January
12. cannapopa wi (Moon when trees crack from the cold) or tiyoheyunka wi, = ~ February
13. ištawicayazan wi (Moon of sore eyes/snow blindness) or šiyo ištohcapi wi, = ~ March

The names of the weekdays:

1. Aŋpétu wakȟáŋ, = Sunday
2. Aŋpétu tȟokáhe, = Monday
3. Aŋpétu núŋpa, = Tuesday
4. Aŋpétu yámni, = Wednesday
5. Aŋpétu tópa, = Thursday
6. Aŋpétu záptaŋ, = Friday
7. Owáŋgyužažapi, = Saturday

Main source: [BUEC]

209 (Ancient) Lamian Calendar

This calendar was used in ancient Lamia.

The names of the months:

1. Bomios, = December
2. Thrixallios, = January
3. Geustus, = February
4. Lykeos, = March
5. Thyos, = April
6. Areos, = May
7. Chryttaios, = June
8. Hippodromios, = July
9. Panamos, = August
10. ?
11. Apellaios, = October
12. Bukatios, = November

Main source: [GINZ]

210 (Old) Lao Calendar

This lunisolar calendar was a mixture of Sino-Vietnamese and Thai-Khmer calendars. The year itself was reckoned by solar phases, while the months were divided according to lunar phases. The calendar followed a scheme in which year one was 638 BCE, but later, the Buddhist Era was adopted, in which year one is 543 BCE. Each year was also named after an animal, and weeks were structured according to the waxing and waning of the moon. See also *Dai calendar*.

The traditional names of the months by using Lao numerals:

1. ມັກກຣະຣາຄົມ Mockkarakhom/ Deuan Neung or Deuane Jieng (29 days)
2. ກຸມພາພັນ Koumphaphanh/ Deuane Song, Deuane Yee or Deuane Gnee (30 days)
3. ມີນາຄົມ Meenakhom/ Deuane Sam (29 days)
4. ເມສາຍົນ Mesayon/ Deuane Si or Deuane See (30 days)
5. ພຶດສະພາຄົມ Preuthsaphakhom/ Deuane Ha (29 days)
6. ມິຖຸນາຍົນ Mithunayon/ Deuane Hok (30 days)
7. ກ'ຣະກະດາຄົມ Korackkadakhom/ Deuane Jet (29 days)
8. ສິງຫາຄົມ Singhakhom/ Deuane Paet (30 days)
9. ກັນຍາຍົນ Kanyayon/ Deuane Kaoor Deuane Kow (29 days)
10. ຕຸລາຄົມ Tulakhom/ Deuane Sip or Deuane Seeb (30 days)
11. ພຶດສະຈິກາຍົນ Preuthsajikayon/ Deuane Sip-Eitt or Deuane Seeb-Eth (29 days)
12. ທັນວາຄົມ Thanwakhom/ Deuane Sip-Song or Deuane Seeb-Song (30 days)

The names of the weekdays:

1. ວັນອາທິດ, = Sunday
2. ວັນຈັນ, = Monday
3. ວັນອັງຄານ, = Tuesday
4. ວັນພຸດ, = Wednesday
5. ວັນພະຫັດ, = Thursday
6. ວັນສຸກ, = Friday
7. ວັນເສົາ, = Saturday

Main source: [CUMM]

211 Lascaux Calendar

This lunisolar calendar is probably the oldest known, dating to about 15300 BCE. It has been identified in the prehistoric caves at Lascaux, France.

The solar calendar can be seen as a grid of 3 by 3 "spirals". The centre of the "spiral", position (a), represents a 41-day period, position (b) represents a 41-day period, position (c), a 40-day period, and so on.

(h) 41 (1 April–11 May)	(i) 40 (12 May–20 June)	(b) 41 (1 August–10 September)
(g) 40 (20 February–31 March)	(a) 41 (21 June–31 July)	(c) 40 (11 September–20 October)
(f) 41 (10 January–19 February)	(e) 40 (1 December–9 January)	(d) 41 (21 October–30 November)

In total, the nine positions represent nine solar periods, and yield a regular 365-day period. By summing the number of days in the solar cycle, and entering the accumulated value, we get 41, 82, 122, 163, 203, 244, 284, 325 and 365 days for the first year.

In a similar way, a lunar calendar is written as a "spiral," with nine lunations represented by numbers in the counter-clockwise direction, starting at the top left corner and stopping at the line at the bottom left. This will give us 11 lunations, yielding 325 days in all.

30	27	30	29	30	29
29	30	29	30	29	30

By summing these numbers of days, we get 30, 59, 89, 118, 148, 177, 207, 236, 266, 295, 325 and 352 days for the first year. Multiples of 8 solar periods and 11 lunations yield 325-325, 649-649, 974-974, 1298-1298, 1623-1623, 1947-1947, 2272-2272, 2596-2596, 2920-2921 days, showing that the cycles go along for 7 years, at which point the lunar cycle passes the solar cycle by 1 day. Modern calculations show that 99 lunations are equal to about 2923.528… days (Lascaux calculations resulted in 2921 days) and 8 solar years are equal to 2921.937… (Lascaux calculations resulted in 2920 days). These calculations also show that a cycle of 8 years required 2 leap days.

Internet source: Franz Gnaedinger, Zurich at www.seshat.ch

212 (Old) Latvian Calendar

This lunar and agricultural calendar was used in Latvia. A former calendaric system, it is considered, based on petroglyphs found in 1987, to consist of months subdivided into three 9-day weeks.

The names of the months:

1. sulu, = April
2. lopu, = May
3. vosorys, = June
4. sīna, = July
5. labeibys, = August
6. rudina, = September
7. leita, = October
8. solnys, = November
9. zīmys, = December
10. jaunagods, = January
11. svacainis, = February
12. pavasara, = March

The names of the seasons:

1. pavasaris, = spring
2. vasara, = summer
3. rudens, = autumn
4. ziema, = winter

The name of the weekdays:

1. svētdiena, = Sunday
2. pirmdiena, = Monday
3. otrdiena, = Tuesday
4. trešdiena, = Wednesday
5. ceturtdiena, = Thursday
6. piektdiena, = Friday
7. sestdiena, = Saturday

Main source: [SOSĀ]

213 (Old) Lithuanian Calendar

This calendar was based on an ancient solar calendar. During the reign of Gediminas (Grand Duke of Lithuania from 1315 to 1316), it was stated that the year, starting in April, was divided into 12 months, varying in length from 29 to 31 days. The weeks were 9 days long. The traditional names of the months were formalized after independence in 1918.

The traditional names for the months:

1. geguže, biržėtas, gegužinis, karvelinis, sultekis, or žiedų, = ~ April
2. berželis, gegužinis, milčius, sėmenis, sėtinis, sultekis, žiedžius, or žiedų, = ~ May
3. biržis, jaunius, kirmėlių, mėšlinis, pūdymo, sėmenis, visjavis, or žienpjovys, = ~ June
4. liepinis, liepžiedis, plaukjavis, plūkis, šienpjūtis, or šienpjūvis, = ~ July
5. degėsis, paukštlėkis, or pjūties, = ~ August
6. paukštlėkis, rudenio, rudugys, rujos, sėjos, šilų, strazdinis, vėsulinis, veselinis, vesulis, or viržių, = ~ September
7. spalinis, vėlinis, or visagalis, = ~ October
8. lapkrėstys, lapkristys, vėlių, vėlius, vilkinis, or vilkų, = ~ November
9. gruodinis, or gruoduotis, = ~ December
10. didysis, puscius, ragas, ragutis, sausinis, or siekis, = ~ January
11. kovinis, pridėtinis, or ragutis, = ~ February
12. karvelinis, or morčius, = ~ March

The names of the months, ordered according to the Gregorian calendar, as formalized in 1918:

1. sausis, = January
2. vasaris, = February
3. kovas, = March
4. balandis, = April
5. gegužė, = May
6. birželis, = June
7. liepa, = July
8. rugpjūtis, = August
9. rugsėjis, = September
10. spalis, = October
11. lapkritis, = November
12. gruodis, = December

The days of the week, as formalized in 1918, are simply ordinal numbers:

1. Pirmadienis, = Monday
2. Antradienis, = Tuesday
3. Trečiadienis, = Wednesday
4. Ketvirtadienis, = Thursday

5. Penktadienis, = Friday
6. Šeštadienis, = Saturday
7. Sekmadienis, = Sunday

Main sources: [DWYE] and [ZERU]

Internet source: Straižys, Vytautas and Libertas Klimka. *Cosmology of the ancient Balts*. Institute of Theoretical Physics and Astronomy. www.lithuanian.net/mitai/cosmos/baltai.htm#35

214 Luba Calendar

This calendar is used by the Luba people in Central Africa.

The names of the months:

1. Mvul'a Mbedi (Month of the first rain), = ~ September
2. Kibitenda (Month when the white ants come out), = ~ October
3. Kaswa Bitenda (Month when the brown ants come out of mounds), = ~ November
4. Tshiswe Munene (Month of numerous brown ants), = ~ December
5. Tshiongo Wa Minanga (Month of drought), = ~ January
6. Luishi (Month for planting corn), = ~ February
7. Lumungulu (Month for planting), = ~ March
8. Luabanya Nkasu (Month of hoe distributor), = ~ April
9. Tshisanga Nkasu (Month of hoe assembling), = ~ May
10. Kashipu Nkenza (Month of first cold), = ~ June
11. Tshibungu Mulume (The cloudy month with a strong cloud), = ~ July
12. Tshibungu Mukaji (The cloudy month with a weak cloud), = ~ August

Main source: [MUKE]

215 Luxembourgish Calendar

This traditional calendar was used as base for agricultural planning before the introduction of the Julian calendar.

The names of the months:

1. Haartmount (hard month), = ~ January
2. Spiirkel, = ~ February
3. Aussenzäit or Lenzmount (Lent month), = ~ March
4. Ouschtermount (Easter month) or Fréileng, = ~ April
5. Päischtmount (whitsun month) or Bléiemount, = ~ May
6. Rousemount or Broochmount (fallow month), = ~ June
7. Heemount (hay month), = ~ July
8. Karschnatz, = ~ August
9. Hierschtmount (autumn month) or Huewermount, = ~ September
10. Wäimount (wine month), = ~ October
11. Allerhellgemount or Wantermount (winter month), = ~ November
12. Khrëschtmount (Christ month), = ~ December

The names of the seasons:

1. fréijoer, = spring
2. summer ,= summer
3. hierscht, = autumn
4. wanter, = winter

The names of the weekdays:

1. Sonndeg, = Sunday
2. Méindeg, = Monday
3. Dënschdeg, = Tuesday
4. Mëttwoch, = Wednesday
5. Donneschdeg, = Thursday
6. Freideg, = Friday
7. Samschdeg, = Saturday

Main source: [CHRI3]

Internet source: www.eis-sprooch.lu

216 (Ancient) Lycian Calendar

This lunisolar calendar was used in Lycia during the sixth century.

The names of the months:

1. Δῖος Dios, 1 January–31 January (31 days)
2. Lenaios, 1 February–1 March (29 days)
3. Αὐδυναῖος Audynaios, 2 March–31 March (30 days)
4. Περίτιος Peritios, 1 April–1 May (31 days)
5. Δύστρος Dystros, 2 May–31 May (30 days)
6. Ξανδικός Xanthikos, 1 June–1 July (31 days)
7. Ἀρτεμίσιος Artemisios, 2 July–31 July (30 days)
8. Δαίσιος Daisios, 1 August–31 August (31 days)
9. Πάνημος Panemos, 1 September–30 September (30 days)
10. Λῷος Loos, 1 October–31 October (31 days)
11. Γορπιαίος Gorpiaios, 1 November–30 November (30 days)
12. Ὑπερβερεταῖος Hyperberetaios, 1 December–31 December (31 days)

Main source: [GINZ]

217 Maasai Calendar

This lunisolar calendar was used by the Maasai people in central Africa.

The names of the months:

1. ol gissan (when the sheep and goats bring forth their young)
2. ol adallo (the heat of the sun)
3. ol golua
4. le erat (month of the green valley)
5. os somisso (the dark month)
6. ol nernerua (the fat month)
7. le logunja airodjerod (month of the tied-up bulls)
8. bolos airodjerod
9. kudjorok (the cold month)
10. kiber
11. ol dongosh (month with little food)
12. boshogge (month when the people come back to the kraal)

The names of the seasons:

1. ol dumeril (time of the scanty rain-fall)
2. en gokwa (the Pleiades)
3. ol airodjerod (the lesser after-rains)
4. ol aimeii (time of hunger)

Main source: [NILS]

218 Mabuygilgal Calendar

This seasonal calendar was used by the Mabuiag people in Torres Strait.

The names of the seasons and its subdivisions:

1. surlal (when the turtles copulate), = ~ late-October–end of November
2. raz (the time of death), = ~ December–February
   2a. duau-urma (the falling of the cashew nuts), = ~ December
   2b. malgui (when the yams begin to sprout), = ~ late December
   2c. dob (the last of growing things) or kusikuki (medusae of the north-west), = ~ January
   2d. purimugo, apagap or keme, = ~ February
3. kuki (when strong winds blow intermittenly from the north-west), = ~ March–May
   3a. kuki, = ~ March
   3b. kupa kuki, = ~ April
   3c. gugad arai, = ~ May
4. aibaud (the dry season), = ~ June–mid-October
   4a. waur, = ~ June
   4b. sasiwaur, = ~ July
   4c. piepe, = ~ August
   4d. tati waur, = ~ September
   4e. birubiru, = ~ October

Main source: [NILS]

219 (Ancient) Macedonian Calendar

This lunisolar calendar was used during the first millenium BCE in ancient Macedon. It consisted of 12 synodic lunar months. This makes a total of 354 days per year, causing the need for intercalary months to stay in step with the seasons. The calendar was refomed during the reign of Seleucus I in 312 BCE. Seven such intercalary months (*embolimoi*) were added, as shown below, to each 19-year Metonic cycle. See also *Macedonian-Solonian calendar* and *Macedonian-Arabian calendar*.

The names of the months, and corresponding dates in 312/311 BCE:

1. Δίοζ Dios, 6 October–4 November (30 days)
2. Απελλαίος Apellaios, 5 November–3 December (29 days)
3. Αυδναίος Audonaios, 4 December–2 January (30 days)
4. Περίτιος Peritios, 3 January–31 January (29 days)
5. Δύστρος Dystros, 1 February–2 March (30 days)
6. Ξανδικός Xandikos, 3 March–31 March (29 days)

Ξανδικός Ἐμβόλιμος Xandikos Embolimos = a month of 29 days that was intercalated six times over a 19-year cycle

7. Αρτεμίσιος Artemisos, 1 April–30 April (30 days)
8. Δαίσιος Daisios, 1 May–29 May (29 days)
9. Πάνημος Panemos, 30 May–28 June (30 days)
10. Λώιος Loos, 29 June–27 July (29 days)
11. Γορπιαίος Gorpiaios, 28 July–26 August (30 days)
12. Υπερβερεταίος Hyperberetaios, 27 August–24 September (29 days)

Ὑπερβερεταῖος Ἑμβόλιμος Hyperberetaios Embolimos, = a month of 29 days that was intercalated once over a 19-year cycle

Main sources: [MCLE, p. 166] and [SAMU, p. 17]

220 (Ancient) Macedonian-Arabic Calendar

This lunisolar calendar was used in the Nabataean kingdom from the second century BCE.

The names of the months and corresponding dates in 118 BCE:

1. Ξανδικός Xanthikos, 22 March–20 April
2. Ἀρτεμίσιος Artemisios, 21 April–20 May
3. Δαίσιος Daisios, 21 May–19 June
4. Πάνημος Panemos, 20 June–19 July
5. Λῷος Loos, 20 July–18 August
6. Γορπιαῖος Gorpiaios, 19 August–17 September
7. Ὑπερβερεταῖος Hyperberetaios, 18 September–17 October
8. Δῖος Dios, 18 October–16 November
9. Ἀπελλαῖος Apellaios, 17 November–16 December
10. Αὐδυναῖος Audynaios, 17 December–15 January
11. Περίτιος Peritios, 16 January–14 February
12. Δύστρος Dystros, 15 February–16 March

Five epegomenal days.

Main source: [GINZ]

221 (Ancient) Macedonian-Solonian Calendar

This lunisolar calendar was used in the Ptolemaic kingdom in Egypt beginning in the third century BCE.

The names of the months and corresponding dates in 247/248 BCE:

1. Ξανδικός Xanthikos, 8 June–7 July
2. Ἀρτεμίσιος Artemisios, 8 July–5 August
3. Δαίσιος Daisios, 6 August–3 September
4. Πάνημος Panemos, 4 September–3 October
5. Λῷος Loos, 4 October–1 November
6. Γορπιαῖος Gorpiaios, 2 November–1 December
7. Ὑπερβερεταῖος Hyperberetaios, 2 December–30 December
8. Δῖος Dios, 31 December–29 January
9. Ἀπελλαῖος Apellaios, 30 January–28 February
10. Αὐδυναῖος Audynaios, 1 March–30 March
11. Περίτιος Peritios, 31 March–28 April
12. Δύστρος Dystros, 29 April–28 May

Ten epagomenal days, 29 May–7 June

Main source: [GINZ]

222 Maithili Calendar

This is also called the Tirhuta Panchang (তিরহুতা পঞ্চাঙ্গ) or तिरहुता पंचांग).

This Hindu calendar is used by the Maithil people in India and Nepal. The year begins on the first day of the Baishakh month, which falls on April 13 or 14 of the Gregorian calendar.

The names of the months in Devanagri and Tirhuta:

1. बैसाख/বৈসাখ Baishakh, = mid-April–mid-May (30/31 days)
2. जेठ/জেঠ Jeth, = mid-May–mid-June (31/32 days)
3. आषाढ़/আষাঢ় Asharh, = mid-June–mid-July (31/32 days)
4. सावोन/সাৰোন Saon, = mid-July–mid-August (31/32 days)
5. भादो/ভাদো Bhado, = mid-August–mid-September (31/32 days)
6. आसिन/আসিন Aasin, = mid-September–mid-October (31/30 days)
7. कातिक/কাতিক Katik, = mid-October–mid-November (29/30 days)
8. अगहन/অগহন Agahan, = mid-November–mid-December (29/30 days)
9. पूस/পূস Poos, = mid-December–mid-January (29/30 days)
10. माघ/মাঘ Magh, = mid-January–mid-February (29/30 days)
11. फागुन/ফাগুন Fagun, = mid-February–mid-March (29/30 days)
12. चैति/চৈতি Chait, = mid-March–mid-April (30/31 days)

The names of the seasons:

1. गरमी Baishakh, Jeth, and Asharh, = summer
2. बरसात Saon and Bhado, = monsoon
3. शरत Asin and Katik, = autumn
4. सीत Agahan and Pous, = winter
5. बसन्त Fagun and Chait, = spring

The names of the weekdays in Devanagri and Tirhuta:

1. रविदिन/রৱিদিন Ravdin, = Sunday
2. सोमदिन/সোমদিন Somdin, = Monday
3. मंगलदिन/মঙ্গলদিন Mangaldin, = Tuesday
4. बुधदिन/বুধদিন Budhdin, = Wednesday
5. बृहस्पतीदिन/বৃহস্পতীদিন Brihaspatidin, = Thursday
6. शुक्रदिन/শুক্রদিন Shukradin, = Friday
7. शनीदिन/শনীদিন Shanidin, = Saturday

Internet source: motionnation.info/Tirhuta_Panchang

223 Malagasy Calendar

This lunar calendar was used by the people of the coast of the island of Madagascar.

The names of the months:

1. Alahamady (Millet is cut month)
2. Adaoro (Bulls seek shade of Sakoa tree month)
3. Adizaoza (Winter month)
4. Asorotany (The Guinea fowls sleep month)

5. Alahasaty (Beans flower month)
6. Asombola (Rains rot the ropes (with which the calves are tied) month)
7. Adimizana (Month in which tamarinds of the north are ripe)
8. Alakarabo (Gourds flower month)
9. Adijady (Tamarinds and beans are ripe month)
10. Adalo (Month in which the grains of Fano are ripe)
11. Alohotsy (Month in which cythere tree flowers)

Four months are part of a group, called the *reny vintana* (= "destiny mothers"), that is often described by a cardinal direction for each month:

Alahamady is in the northeast, Asorotany in the southeast, Adimizana in the southwest, and Adijady in the northwest.

The other months are part of a group, called the zana-bintana (= "destiny children"), that is also described by cardinal directions:

Adaro and Adizaoza are in the east, Alahasaty and Asombola in the south, Alakarabo and Alakaosy in the west, and Adalo and Alohtsy in the north.

Main sources: [FOX]

224 Malayalam Calendar

This is also called the Kollavarsham calendar.

This solar and sidereal Hindu calendar has been used in Kerala, India since the ninth century. The 12 months are named after the Signs of the Zodiac.

1. ചിങ്ങം Chingam = Leo, ~ August–September
2. കന്നി Kanni = Virgo, ~ September–October
3. തുലാം Tulam = Libra, ~ October–November
4. വൃശ്ചികം Vrscikam = Scorpio, ~ November–December
5. ധനു Dhanu = Sagittarius, ~ December–January
6. മകരം Makaram = Capricon, ~ January–February
7. കുംഭം Kumbham = Aquarius, ~ February–March
8. മീനം Minam = Pisces, ~ March–April
9. മേടം Medam = Aries, ~ April–May
10. ഇടവം Edavam = Taurus, ~ May–June
11. മിഥുനം Mithunam = Gemini, ~ June–July
12. കർക്കടകം Karkadakam = Cancer, ~ July–August

The names of the days of the week:

1. ഞായർ ആഴ്ച Njayar Azhca = Sunday
2. തിങ്കൾ ആഴ്ച Thinkal Azhca = Monday
3. ചൊവ്വ ആഴ്ച Chowva Azhca = Tuesday
4. ബുധൻ ആഴ്ച Budhan Azhca = Wednesday
5. വ്യാഴം ആഴ്ച Vyāzham Azhca = Thursday
6. വെള്ളി ആഴ്ച Velli Azhca = Friday
7. ശനി ആഴ്ച Shani Azhca = Saturday

Main sources: www.prokerala.com/general/calendar

225 Malvesh Samvat

See *Vikram Samvat*.

226 Mandinkan Calendar

This calendar was used by the Mandinka people.

The names of the months:

1. Musukoto, = ~ January
2. Kekoto, = ~ February
3. Annabi Sukuwo, = ~ March
4. Annola, = ~ April
5. Annola Fulan-Jango, = ~ May
6. Arajaba Konongo, = ~ June
7. Arajabo, = ~ July
8. Sankari Konongo, = ~ August

9. Sunkaro, = ~ September
10. Minkaro, = ~ October
11. Banna Konongo, = ~ November
12. Banna, = ~ December

The names of the weekdays:

1. Dimasso, = Sunday
2. Tenengo, = Monday
3. Talato, = Tuesday
4. Arabo, = Wednesday
5. Aramisso, = Thursday
6. Arijumo, = Friday
7. Sibito, = Saturday

Main source: [ASHR2]

227 (Old) Mangaian Calendar

This lunar calendar was used on the island of Mangaia, the most southerly part of the Cook Islands.

Ereu, = summer

1. akau, = mid-december-mid-January
2. otunga (sprats arrive)
3. kautua (time of floods)
4. akamakuru (hurricane month)
5. muriaa
6. uringa (dead leaves)
7. miringa (fishing up)

Paroro, = winter

8. paroro (cold south winds)
9. manu (incubation of birds),
10. pipiri (muffled up inside the house because of the cold)
11. kaunuunu (land-crab comes out of its hiding-place to feed)
12. ma'u (spring up)
13. vaeta (end of the year), = mid-november-mid-December

Main sources: [GILL2] and [WILL8]

228 Mangsa Calendar

This solar calendar was introduced on June 22, 1855, by Pakubuwono VII (1796–1858), the Susuhunan of Solo in Java.

The names of the months:

1. Kasa, 21 June–1 August
2. Karo, 2 August–24 August
3. Katloe, 25 August–17 September
4. Kapat, 18 September–12 October
5. Kalima, 13 October–8 November
6. Kanim, 9 November–21 December
7. Kapitoe, 22 December–2 February
8. Kawoloe, 3 February–28 February
9. Kasanga, 1 March–25 March
10. Kasepbeloeh, 26 March–18 April
11. Desta, 19 April–11 May
12. Saba, 12 May–20 June

Main source: [RICH2]

229 Mansi Calendar

This lunar calendar was used among the Mansi people in present-day Tyumen Oblast.

The names of the months:

1. little autumn-hunting Moon, = late september–late October
2. great autumn-hunting Moon, = late October–late November
3. winter Moon, = late November–late December
4. Moon of light, = late December–late January
5. wind Moon, = late January–late February
6. Moon of the thawing snow-crust, = late February–late March
7. Moon of thaw, = late March–late April
8. sap-in-firs Moon, = late April–late May
9. sap-in-birches Moon, = late May–late June
10. middle-of-summer Moon, = late June–late July

Epagomenal days

11. Moon of the young water fowl, = late July–late August
12. elk-running Moon, = late August–late September

Main source: [NILS]

230 Maramataka

This lunar calendar was used by the Māori people in New Zealand. The New Year began in June with the rising of the constellation of Matariki in the sky. The names of the months were given to represent activities completed in these months. Each tribe recognised proper names for the months. Some tribes listed 13 months in a year, indicating that 1 month was occasionally added to account for the extra period needed to match the solar year. The names of the months varied between tribes. In 1990, the calendar was revived by Te Taura Whiri I te Reo Māori (the Māori Language Commission). They promoted the traditional names, as cited by Tūtakangāhau of Maungapōhatu, a member of the Ngāi Tūhoe tribe. These names are listed below.

The names of the months according to Tūtakangāhau:

1. Pipiri—all things on earth are contracted because of cold, May–June
2. Hongonui—man is now extremely cold, June–July
3. Hereturi-kōkā—the scorching effect of fire is seen on the knees of man, July–August
4. Mahuru—the earth has now acquired warmth, August–September
5. Whiringa-ā-nuku—the earth has now become quite warm, September–October
6. Whiringa-ā-rangi—it has now become summer, October–November
7. Hakihea—birds are now sitting in their nests, November–December
8. Kohi-tātea—fruits are now ripe, December–January
9. Hui-tanguru—the foot of Rūhī (a summer star) now rests upon the earth, January–February
10. Poutū-te-rangi—the crops are now harvested, February–March
11. Paenga-whāwhā—all straw is now stacked at the borders of the plantations, March–April
12. Haratua—crops are now stored in pits, April–May

The names of the months according to the Ngati-Awa tribe of the Bay of Plenty:

1. Te Tahi o Pipiri
2. Te Rua o Takurua (Takurus is the star Sirius)
3. Te Toru o Hereturi-kōkā
4. Te Wha o Mahuru
5. Te Rima o Kopu (Kopu is the planet Venus)
6. Whitianaunau
7. Hakihea
8. Kai-tātea
9. Rūhī-te-rangi
10. Poutū-te-rangi
11. Paenga-whāwhā
12. Haki-haratua

The Kahungunu tribe used these names:

1. Aonui
2. Te Aho-turuturu
3. Te Ihomatua
4. Tapere-wai
5. Tatau-urutahi
6. Tatau-uruora
7. Akaaka-nui
8. Ahuahu-mataora
9. Te Ihonui
10. Putoki-nui-o-tau
11. Tikaka-muturangi
12. Uruwhenua

The names of the seasons:

1. kōanga, = spring
2. raumati, = summer
3. ngahuru, = autumn
4. takurua, = winter

The Māori months usually had 30 nights, each of which bore its own name. Even these names varied from one tribe to another. The list below was published by [FIRT].

The names of the nights of the moon used in the Waitako district:

1. Atarau or Pewa
2. Ahoroa or Tirea
3. Aurei
4. Oue or Ue
5. Akoro or Okoro
6. Ananga or Tamatea-tutahi
7. Ahotu or Tamatea-turua
8. Aio or Tamatea-to-toru
9. Kai-ariki or Tamatea-tuwha
10. Hune or Ngahuru
11. Ari
12. Maure
13. Mawharu
14. Ohua
15. Atua-mate-o-hotu
16. Oturu
17. Rakaunui (full moon)
18. Rakau-matohi
19. Takirau
20. Oike
21. Korekore
22. Korekore-ngana
23. Korekore-piri
24. Tangaroa-mua
25. Tangaroa-roto
26. Kiokio
27. Otane
28. Orongo-nui
29. Mauri
30. Omutu-mutu whenua

The Māori culture had no traditional terms for the days of the week. Te Taua Whiri (an autonomous Māori Language Commission set up under the Māori Language Act 1987) devised terms that were made from translations of the concepts that gave rise to the English names, e.g., *rāhina* for Monday, using a combination of *rā*(day) and *hina* (from *māhina*, 'moon').

The names of the weekdays (names derived from English names and the names proposed by Te Taua Whiri):

1. wiki / rātapu, = Sunday
2. mane / rāhina, = Monday
3. tūrei / rātū, = Tuesday
4. wenerei / rāapa, = Wednesday
5. tāite / rāpare, = Thursday
6. prairie / rāmere, = Friday
7. hāterei / rāhoroi, = Saturday

Main sources: [BEST2] and [FIRT]

231 (Ancient) Mari Calendar

This calendar was used in the ancient Sumerian and Amorite city from about 2800 BCE until 1800 BCE.

The names of the months (the order of the monhs has been reconstructed with certainty):

1. ITI *a-bi*
2. ITI ^{d}AMA.KI
3. ITI ^{d}*Da-gan*
4. ITI *e-bir*$_5$*-tí*
5. ITI KIN
6. ITI ^{d}KUR
7. ITI *lá-ḫi-im*
8. ITI *li-lí-a-tí*
9. ITI *ma-al-kà-né-en*
10. ITI NIG.NI.SAG
11. ITI ^{d}Nin-ki-gigir
12. ITI *taš-ni-tim* (intercalary month)

The names of the months during the reigns of Yaḫ-dun-Lim, Sumu-Yamam, Šamši-Adad I, Yasmaḫ-Adad, and Zimri-Lim:

1. Urāḫum
2. Malkānum
3. Laḫḫum
4. Abum
5. Ḫibirtum
6. ^{d}IGI.KUR[4]
7. Kinūnum

8. ^{d}Dagan
9. Līliātu
10. ^{d}Bēlet-bīri
11. Kiskissum
12. Ebūrum

Main source: [COHE3]

232 Mayan Long Count Calendar

This is a way of writing the number of days that have gone by since a particular date thousands of years ago. The system described here was used in pre-Colombian Mesoamerica, with the first five slots representing chucks of 1, 20, 360, 7200 and 144,000 days. Typically, scholars only write the rightmost five digits of the Long Count when they name a date, e.g., day 1886 is written as 0.0.5.4.6 = (5 × 360) + (4 × 20) + 6. The Mayans gave name to each slot in the Long Count. In the table below, the slots are specified by number of days.

alautun								
20	**kinchiltun**							
400	20	**calabtun**						
8000	400	20	**pictun**					
160,000	8000	400	20	**baktun**				
3,320,000	160,000	8000	400	20	**katun**			
66,400,000	3,320,000	160,000	8000	400	20	**tun**		
1,195,200,000	59,760,000	2,880,000	144,000	7200	360	18	**uinal**	
23,040,000,000	1,195,200,000	57,600,000	2,880,000	144,000	7200	360	20	**kin**

The first day in the Long Count is 0 alautun, 0 kinchiltun, 0 calabtun, 0 pictun, 0 baktun, 0 katun, 0 tun, 0 uinal, 0 kin, which according to the most widely accepted correlation to the Gregorian calendar, the Goodman-Martinez-Thompson-1 Correlation, is stated as August 11, 3113 BCE. The most widely accepted theory for the beginning of the Long Count among scholars was developed by three researchers over the period from 1887 to 1935. These so-called constants are usually called GMT1 (= August 11, 3114 BCE, stated by Joseph Goodman in 1905), GMT2 (= August 12, 3114 BCE, stated by Juan Martínez Hernández in 1926), and GMT3 (= August 13, 3114 BCE, stated by John Eric Sydney Thompson in 1927). In 1935, J. Eric Thompson picked the GMT1 correlation as the best assumption.

Some scholars believe that the baktun slot does not run from 0 to 19, but only from 0 to 12. This assumption makes 12.19.19.17.19, that falls on December 12, 2012, the largest date with just five values. The next day, December 21, 2012, would require inclusion of the piktun digit as well, and we would write it as 1.0.0.0.0.0. If the Mayans meant the baktun to run from 0 to19, like most of the others, the largest date that can be written with five values is 19.19.19.17.19, which falls on October 12, 4772. In the table below, the pictun only represents 12 baktuns.

alautun								
20	**kinchiltun**							
400	20	**calabtun**						
8000	400	20	**pictun**					
104,000	5200	260	13	**baktun**				
2,080,000	104,000	5200	260	20	**katun**			
41,600,000	2,080,000	104,000	5200	400	20	**tun**		
748,800,000	37,440,000	1,872,000	93,600	7200	360	18	**uinal**	
14,976,000,000	748,800,000	37,440,000	1,872,000	144,000	7200	360	20	**kin**

In addition to a name, each slot had its own glyph.

Main source: [REIN]

233 Melanau Calendar

This calendar is used by the Melanau people of Borneo. Each month has 30 days. The remaining 5 or 6 days, to complete an average solar year, are added at the end of the year.

The names of the months:

1. Pengejin (Month of the spirits), = ~ March
2. Pengelawah Umik (Month of cloudy water), = ~ April
3. Pengelawah Ayeng (Month of clear water), = ~ May
4. Paka Umik (Month of the lesser stars), = ~ June
5. Paka Ayeng (Month of the greater stars), = ~ July
6. Pelepa (Month of plenty), = ~ August
7. Pegalan (Month of the North Star), = ~ September
8. Suwah (Month of the waves), = ~ October
9. Pidai (Month of the discoloured sky), = ~ November
10. Penangaih (Month of revival), = ~ December
11. Pemalei (Taboo month), = ~ January
12. Pengesiseng (Month of the gills), = ~ February

Internet sources: learn-melanau.blogspot.se/2011/01/melanau-calendar.html; likomato.blogspot.se/2011/11/aku-dan-warisan-bangsa-kalendar-melanau.html

234 Merina Calendar

This seasonal calendar was used in the Merina Kingdom.

The names of the seasons:

1. lohataona (head of the year), = ~ September–October
2. fahavaratra (the thunder time), = ~ November–February
3. fararano (the last rains), = ~ March–April
4. ririnina (time of bareness), = ~ May–August

Main source: [NILS]

235 Miawpukek Calendar

This lunar calendar was used by the Míkmaq people in Canada's Maritime Provinces and the Gaspé Peninsula of Quebec. The names of each month include the word "moon" and reflect the close connection between the cycles of the Moon and the times for planting, harvesting, hunting and animal life.

The names of the months:

1. Si'ko'ku's (Spawning Moon), ~ March/April
2. Pnatmuiku's (Egg Laying Moon), ~ April/May
3. Sqoljuiku's (Frog Croaking Moon), ~ May/June
4. Nipniku's (Leaves are Budding Moon), ~ June/July
5. Peskewiku's (Fur/Feather Shedding Moon), ~ July/August

6. Kisaqewiku's (Fruit and Berry Ripening Moon), ~ August/September
7. Wikumkewiku's (Animal Calling Moon), ~ September/October
8. Wilewiku's (Animal Fattening Moon), ~ October/November
9. Keptekewiku's (River Freezing Moon), ~ November/December
10. Kesikewiku's (Great Moon or Winter Moon), ~ December/January
11. Panamujuiku's (Frost Fish Moon), ~ January/February
12. Apuknajit (Snow Blinding Moon), ~ February/March

Main source: [CARL3]

236 Míngúo Calendar

This calendar was used in mainland China from January 1, 1912 until the founding of the People's Republic of China in 1949. The way of numbering years is still in use in Kinmen, Matsu, and Taiwan.

Main source: [WILK2]

237 Mohawk Calendar

This lunar calendar was used by the Mohawk people in the Mohawk Valley, New York.

The names of the months:

1. tsothohrhko:wa (the big cold Moon), = ~ January
2. enniska (lateness Moon), = ~ February
3. ennisko:wa (much lateness Moon), = ~ March
4. onerahtokha (budding time Moon), = ~ April
5. onerahtohko:wa (time of big leaf Moon), = ~ May
6. ohiari:wa (ripening time Moon), = ~ June
7. ohiarihko:wa (time of much ripening Moon), = ~ July
8. seskehko:wa (time of freshness Moon), = ~ August
9. seskhoko:wa (time of much freshness Moon), = ~ September
10. kentenha (time of poverty Moon), = ~ October
11. kentenhko:wa (time of much poverty Moon), = ~ November
12. tsothohrha (time of cold Moon), = ~ December

Main sources: [BONV]

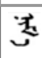
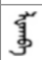
238 Mongolian Calendar

This lunisolar calendar is based on a system developed in 1747 by the monk Sümbe khambo Ishbaljir (1704–1788). The year is composed of 12 months, each beginning and ending with a new moon. A 13th month is added every 2 or 3 years, so that an average year is equal to the solar year. The months are referred to by their number.

The names of the months:

1. Нэгдүгээр сар, = ~ January
2. Хоёрдугаар сар, = ~ February
3. Гуравдугаар сар, = ~ March
4. Дөрөвдүгээр сар, = ~ April
5. Тавдугаар сар, = ~ May
6. Зургадугаар сар, = ~ June
7. Долоодугаар сар, = ~ July
8. Наймдугаар сар, = ~ August
9. Есдүгээр сар, = ~ September
10. Аравдугаар сар, = ~ October
11. Арван нэгдүгээр сар, = ~ November
12. Арван хоёрдугаар сар, = ~ December

The names of the weekdays, based on Tibetan planetary names:

	Traditional Tibetan script	Abugida Tibetan script	Cyrillic Tibetan	Cyrillic Kalmyk	Cyrillic Buryat
Sunday		ཟའ་ཉི་མ་ (gza’ nyi ma)	Ням гариг	Нарн (narn)	Няма (njama)
Monday		ཟའ་ཟླ་བ་ (gza’ zla ba)	Даваа гариг	Сарң (sarṅ)	Дабаа (dabaa)
Tuesday		ཟའ་མིག་དམར་ (gza’ mig mar)	Мягмар гариг	Мигмр (migmr)	Мягмар (mjagmar)
Wednesday		ཟའ་ལྷག་པ་ (gza’ lhag pa)	Лхагва гариг	Үлмҗ (ülmǰ)	Һагба (hagba)
Thursday		གཟའ་ཕུར་བུ་ (gza’ phur bu)	Пүрэв гариг	Пүрвә (pürvä)	Пүрбэ (pürbä)
Friday		གཟའ་པ་སངས་ (gza’ pa sangs)	Баасан гариг	Басң (basṅ)	Баасан (baasan)
Saturday		ཟའ་སྤེན་པ་ (gza’ spen pa)	Бямба гариг	Бембә (bembä)	Бямба (bjamba)

The names of the weekdays, based on Indian planetary names:

	Traditional Tibetan script	Sanskrit names in Cyrillic
Sunday		Адъяа (ad-yaa)
Monday		Сумъяа (sum-ya)
Tuesday		Ангараг (angarag)
Wednesday		Буд (bud)
Thursday		Бархасбадь (barkhasbad’)
Friday		Сугар (sugar)
Saturday		Санчир (sanchir)

There is also a 12-year cycle (Арван хоёр жил), based on the ancient Chinese zodiac signs:

1. Хулгана Hulgana (Rat)
2. Үхэр Ukher (Ox)
3. Бар Bar (Tiger)
4. Туулай Tuulai (Rabbit)
5. Луу Luu (Dragon)
6. Могой Mogoi (Snake)
7. Морь Mori (Horse)
8. Хонь Honi (Goat)
9. Бич/Мич, Бичин, Мичин, Мэчин Bichin, Michin, or Mechin (Monkey)
10. Тахиа Tahiya (Rooster)
11. Нохой Nohoi (Dog)
12. Гахай Gahai (Pig)

Main source: [ARIA]

239 (Old) Moriori Calendar

This lunistellar calendar was used by the Moriori people of the Chatham Islands.

The names of the months:

1. Kanu, = ~ June
2. Rongo, = ~ July
3. Tahei, = ~ August
4. Keitanga, = ~ September
5. Tauaropoti, = ~ October
6. Wareahe, = ~ November
7. Tchuhe a Takarore, = ~ December

8. Wairehu, = ~ January
9. Moro, = ~ February
10. Mihi-torekao, = ~ March
11. Ta Upoko o T'Etchiao, = ~ April
12. Tumatehaea, = ~ May

Main source: [BEST2]

240 (Old) Mursi Calendar

This lunar calendar was used by the Mursi people in present-day Ethiopia. They also used agricultural activities and celestial markers to determine what the current month was. The month names were not fixed.

Main source: [TURT]

241 Muscokee Calendar

This calendar was used by the Cree people in Alabama and Georgia.

The names of the months:

1. hiyo-rakko (big harvest Moon or big ripening Moon), = ~ August
2. otowoskucee (little chestnut Moon), = ~ September
3. otowoskv-rakko (big chestnut Moon), = ~ October
4. echolee (frost Moon), = ~ November
5. rvfo-rakko (big winter Moon), = ~ December
6. rv'to cusee (winter's younger brother Moon), = ~ January
7. hotvlee-hv'see (wind Moon), = ~ February
8. tasahcucee (little spring Moon), = ~ March
9. tasahcee-rakko (big spring Moon), = ~ April
10. kee-hvsee (mulberry Moon), = ~ May
11. kvco-hvsee (blackberry Moon), = ~ June
12. hiyucee (little harvest Moon or little ripening Moon), = ~ July

Internet source: americanindian.net/moons.html

242 Nabonasser Calendar

(Abbreviated as **AN**—*Anno Nabonassen*)

This calendar was used by astrologers and astronomers through the Near East and Mid-East to correct the existing Babylonian calendar, during the reign of the Chaldean king Nabonasser (747–734 BCE). The Era was started by the Greek astronomer Claudius Ptolemaeus on New Year's Day in the Egyptian calendar, equal to February 26, 747 BCE in the proleptic Julian calendar. The calendar consisted of a vague solar year of 365 days with no intercalation for leap year, which is why every fifth year started 1 day earlier. The year contained 12 months of 30 days, each with 5 days at the end.

243 Nagyszombati Kalendárium

See (Old) *Hungarian calendar*.

244 Nama Calendar

This calendar is used among the Nama-speaking people in Botswana, Namibia and South Africa. Today, it is in accordance with the Gregorian calendar.

The names of the months:

1. !Khanni, = January
2. !Khan|gâb, = February
3. |Khū‖khâb, = March
4. Hoa‖khaib, = April

5. !Khaitsab, = May
6. Gamaǀaeb, = June
7. ǂKhoesaob, = July
8. Aoǁkhumuǁkhâb, = August
9. Taraǁkhumuǁkhâb, = September
10. ǂNuǁnâiseb, = October
11. ǀHōǂgaeb, = November
12. Hôasoreb, = December

The names of the seasons:

1. ǁkhunab, = summer
2. Hai!kharib, = autumn
3. Saob, = winter
4. ǁhaoǁaeb, = spring

Internet source: www.westerncape.gov.za

245 Nanakshahi Calendar

This tropical solar calendar was adopted by the Shiromani Gurdwara Prabhandak Committee to determine the dates for important Sikh events in the Indian states of Haryana, Himachal Pradesh, and Punjab. It was designed by Pal Singh Purewal to replace the Hindu calendar, and has been in use since 1998. The epoch of this calendar is the birth of the first Sikh Guru, Nanak Dev, in 1469. The years begin on March 14, according to the Gregorian calendar.

The names of the months:

1. ਚੇਤ Chet, = 14 March–13 April (31 days)
2. ਵੈਸਾਖ Vaisakh, = 14 April–14 May (31 days)
3. ਜੇਠ Jeth, = 15 May–14 June (31 days)
4. ਹਾੜ Harh, = 15 June–15 July (31 days)
5. ਸਾਵਣ Sawan, = 16 July–15 August (31 days)
6. ਭਾਦੋਂ Bhadon, = 16 August–14 September (30 days)
7. ਅੱਸੂ Assu, = 15 September–14 October (30 days)
8. ਕੱਤਕ Katak, = 15 October–13 November (30 days)
9. ਮੱਘਰ Maghar, = 14 November–13 December (30 days)
10. ਪੋਹ Poh, = 14 December–12 January (30 days)
11. ਮਾਘ Magh, = 13 January–11 February (30 days)
12. ਫੱਗਣ Phagun, = 12 February–13 or 14 March (30 or 31 days)

Internet sources: pa.wikipedia.org/wiki/ਨਾਨਕਸ਼ਾਹੀ_ਜੰਤਰੀ

246 (Old) Natchez Calendar

This lunar calendar was used among the Natchez people

The names of the months:

1. Deer Moon, = ~ March
2. Strawberries Moon, = ~ April
3. Little-corn Moon, = ~ May
4. Watermelon Moon, = ~ June
5. Peaches Moon or fishes Moon, = ~ July
6. Mulberry Moon, = ~ August
7. Maize Moon or great-corn Moon, = ~ September
8. Turkey Moon, = ~ October
9. Bison Moon, = ~ November
10. Bear Moon, = ~ December
11. Cold-meal Moon, = ~ late December/early January
12. Chestnut Moon, = ~ late January
13. Nut Moon (when they are crushed and mixed with flour to make bread), = ~ February

Main source: [JUDS3]

247 Navajo Calendar

This calendar was used by the Navajo people in Southeastern North America.

The names of the weekdays:

1. Damóo, = Sunday
2. Damóo Biiskání, = Monday
3. Damóo dóó Naakiską́o, = Tuesday
4. Damóo dóó Táá' Yiką́o, = Wednesday
5. Damóo dóó Dį́į́' Yiką́o, = Thursday
6. Nda'iiníísh, = Friday
7. Iką́o Damóo, = Saturday

Main sources: [CORR]

248 Ndebele Calendar

This calendar is used by the South Ndebele-speaking people in Zimbabwe and South Africa.

The names of the months:

1. uTjhirhweni, = ~ January
2. uMhlolanja, = ~ February
3. uNtaka, = ~ March
4. uSihlabantangana, = ~ April
5. uMrhayili, = ~ May
6. uMgwengweni, = ~ June
7. uVelabahlinze, = ~ July
8. uRhoboyi, = ~ August
9. uKhukhulamungu, = ~ September
10. uSewula, = ~ October
11. uSinyikhaba, = ~ November
12. uNobayeni, = ~ December

Main source: [SHAB]

249 Nenet Calendars

These lunar calendars were used in northern arctic Russia among the Nenets people. The Nenets in the Yenisei River region used a calendar of only 11 months.

The names of the months among the Forest Nenets:

1. ӈарка пэвдей (the great dark month) or yary iry (knobs' (growing new antlers) month), = ~ January
2. лимбя ирий (the month of the eagle), = ~ February
3. яра ирий (the gentle month), = ~ March
4. ты ирий (the month of the reindeer) or sie nich iry (false calving month), = ~ April
5. ниць ирий (the month of the prong) or ty nich iry (real calving month), = ~ May
6. неняӈг ирий (the month of the mosquitoes) or nyavdy iry (1-year-old doe's (calving) month), = ~ June
7. пилё ирий (the month of horseflies), = ~ July
8. ям' халя ирий (the month of marine fish) or selvy iry (peeling hairy film from antler month), = ~ August
9. вэ̆ба ирий (the month of the leaves), = ~ September
10. хопа ирий (the month of Seaus) or khor iry (buck's (coupling month), = ~ October
11. нохо ирий (the month of fox snow) or malkoms iry (antlers falling month), = ~ November
12. нюдя пэвдей (the month of the little dark), = ~ December

The names of the months among the Tundra Nenets:

1. month of leaf-fall, (starting in August)
2. reindeer-rutting month
3. the dark month
4. month when the wind drives the snow along like sand
5. the calm month
6. month when the weather is favourable for trapping animals
7. eagle month
8. month of calves
9. month of inundations
10. spring month
11. month when the days are very long

Epagomenal days

Main sources: [GOLO] and [NILS]

250 Nepal Sambat

This is also called the **Nepāla Saṃvat**.

This was the national lunar calendar of Nepal during Malla and early Shah era. It was adopted during the reign of Thakuri King Raghavadeva (*c*. 879–942) in the Kingdom of Kantipur in October 20, 879. According to a legend, it was invented by a trader from Kathmandu named Sankhadhar Sakhwa. It was replaced by Bikram Samwat as the official national calendar after the conquest of Nepal by the Gorkha Kingdom in 1769.

Many people in the Kathmandu Valley and some other parts of the country continued using the calendar for ceremonial puposes. On October 25, 2011, the governement of Nepal once again recognised it as the national calendar. The year consists of 354 days, but an intercalary month is added every third year.

The names of the months:

1. कछला Kachha lā, = ~ November
2. थिंला Thin lā, = ~ December
3. पोहेला Pohe lā, = ~ January
4. सिल्ला Sil lā, = ~ February
5. चिल्ला Chil lā, = ~ March
6. चौला Chau lā, = ~ April
7. बछला Bachha lā, = ~ May
8. तछला Tachha lā, = ~ June
9. दिल्ला Dil lā, = ~ July
10. गुंला Goon lā, = ~ August
11. ञला Yen lā, = ~ September
12. कौला Kau lā, = ~ October

Ana lā, = extra month that is added every third year.

Main source: [NEPA]

251 Nepāla Saṃvat

See *Nepal Sambat*.

252 New Era Calendar

See *Invariable calendar*.

253 (Old) Niuean Calendar

This seasonal calendar was used on the island of Niue in the South Pacific Ocean.

The names of the seasons:

1. vaha tau-tuku or vaha tau-tupu, = spring
2. vaha mafana, = summer
3. vaha tau-mateafu, = autumn
4. vaha makalili, = winter

The names of various periods of the day:

1. pongipongi, = morning
2. aho, = day
3. afiafi, = evening
4. po, = night

Main source: [WILL8]

254 (Ancient) Nippurian Calendar

This lunar calendar was used in Nippur beginning in the third millenium BCE.

The names of the months:

1. Bara-zag-gar-ra
2. Ezen-gu$_4$-si-su
3. Sig$_4$-ga
4. Šu-numun
5. NE-NE-gar-ra
6. Kin-^{d}Inanna
7. Du$_6$-ku
8. Apin-du$_8$-a
9. Gan-gan-e
10. Ab-e
11. Ziz-a
12. Še-gur$_{10}$-ku$_5$

Main source: [COHE3]

255 Nisga'a Calendar

This calendar, with names referring to nature, harvesting and seasons, was used by the Nisga'a people in the Nass River valley of northwestern British Columbia in Canada.

The names of the months:

1. K'aliiyee, = ~ January
2. Buxwlaks, = ~ February
3. Xsaak, = ~ March
4. Mmaal, = ~ April
5. Yansa'alt, = ~ May
6. Miso'o, = ~ June
7. Maa'y, = ~ July
8. Wii Hoon, = ~ August
9. Genuugwwikw, = ~ September
10. Xlaaxw, = ~ October
11. Gwilatkw, = ~ November
12. Luut'aa, = ~ December

Main source: [TARP]

256 Normal Calendar

See *Invariable calendar*.

257 (Old) Norse Calendar

This lunisolar and agricultural calendar was used by inhabitants of Scandinavia until the late eleventh century.

The names of the months:

1. Torre, ~ mid-January–mid-February
2. Gjö, ~ mid-February–mid-March
3. Krikla or Kvine, ~ mid-March–mid-April
4. Voarmoanar, ~ mid-April–mid-June
5. Sumarmoanar, ~ mid-June–mid-August
6. Haustmoanar, ~ mid-August–mid-October
7. Vinterstid, ~ mid-October–mid-December
8. Jolemoane, ~ mid-December–mid-January

The names of the weekdays:

1. Drottinsdag or Synnodagr, = Sunday
2. Annandag or Mánadagr, = Monday
3. Thridiudag or Tyrsdagr, = Tuesday
4. Midvikudag or Óðinsdagr, = Wednesday
5. Fimtudag or þorsdagr, = Thursday
6. Föstudag or Frjádagr, = Friday
7. Thvottdag or Laugardagr, = Saturday

Main source: [GINZ]

258 (Old) North Frisian Calendar

This calendar was used in present day Nordfriesland and Heligoland.

The names of the months:

1. ismoune (ice month), = ~ January
2. biikenmoune (beacon month), = ~ February
3. uursmoune (spring month), = ~ March
4. gjarsmoune (grass month), = ~ April
5. krülemoune (flower month), = ~ May
6. samermoune (summer month),= ~ June
7. foodermoune (fodder month), = ~ July
8. beeridmoune (harvest month), = ~ August
9. härfstmoune (autumn month), = ~ September
10. stormmoune (storm month), = ~ October
11. mistmoune (mist month), = ~ November
12. jülmoune (yule month), = ~ December

The names of the seasons:

1. wunter, = winter
2. uurs, = spring
3. samer, = summer
4. harfst, = autumn

Main source: [JANZ]

259 Nuer Calendar

This traditional lunar calendar is used among the Nuer and Dinka people in western Nilotic. The year, called a ruon, is divided into two major seasons (tot and mai) with two minor seasons (rwil and jiom) tied to the two major seasons.

Paath Mai (dry season; winter months):

1. Tiöptharpɛat or Pay kɛl, ~ January to ~ February
2. Pɛɛt or Pay rɛw, ~ February to ~ March
3. Duɔŋ or Pay diɔk, ~ March to ~ April

Paath Rwil (time to move from camp to village; spring months):

4. Guak or Pay-Nguan, ~ April to ~ May
5. Duäd or Pay-dhic, ~ May to ~ June
6. Kuornyuoot or Paybäkɛl, ~ June to ~ July

Paath Tot (wet season; summer months):

7. Payyietni or Paybärɔw, ~ July to ~ August
8. Thhöör or Thɔrnyuëi, ~ August to ~ September
9. Tɛɛr or Paybäŋuan, ~ September to ~ October

Paath Jiom (time to move from village to camp; autumn months):

10. Laath(boor) or Paywal, ~ October to ~ November
11. Kur or Pai-walkɛl, ~ November to ~ December
12. Tiöpindiit or Paywal-rɛw, ~ December to January

Main sources: [DENG] and [EVAN]

260 (Old) Nuku Hivan Calendar

This lunistellar calendar was used on the Nuku Hiva island, the largest of the Marquesas islands.

The names of the months:

1. ouaoa, = ~ January
2. ouamehou
3. opohe
4. ouapea
5. mata-iki (also name of the Pleiades)
6. tououameataleo
7. takouna
8. oehouo
9. mai-naihea
10. avamanou
11. ouavea
12. oehoua
13. aveo

The names of various periods of the day:

1. popoui tika, = early morning
2. popo-oui, = morning
3. ouatea, = midday
4. ahi-ahi, = evening
5. po-ereere, = black night
6. tu moe nui, = the great sleeping
7. tu moe haka tea ao, = the arrival of the day

Main source: [WILL8]

261 Númenórean Calendar

This fictional calendar was constructed by Professor John Ronald Reuel Tolkien (1892–1973). It was adopted by the Men of Middle-Earth.

The names of the months in Quenya:

1. Narvinyë
2. Nénimë
3. Súlimë
4. Víressë
5. Lótessë
6. Nárië
7. Cermië
8. Urimë
9. Yavannië
10. Narquelië
11. Hísimë
12. Ringarë

Main source: [TOLK]

262 Nyakyusa Calendar

This calendar is now equal to the Gregorian calendar and is used among the Nyakyusa people in Zimbabwe.

1 ikinja, = a year
1 umwesi, = a month
1 unduungu, = a week
1 ilisiku, = a day
1 isala, = an hour
1 bubili, = a second

Names of calendar months:

Umwesi gwa kwanda, = January
Umwesi bubili, = February
Umwesi butatú, = March
Umwesi buna, = April
Umwesi buhano, = May
Umwesi gwa ntandatu, = June
Umwesi gwa tuhano na tubili, = July
Umwesi gwa lwele, = August
Umwesi gwa tuhano na tuna, = September
Umwesi gwa kalongo, = October
Umwesi gwa kalongo na gumo, = November
Umwesi gwa kalongo n bubili, = December

The names of the weekdays:

1. ikilemelo, = Monday
2. ikibili, = Tuesday
3. ikitatu, = Wednesday
4. ikina, = Thursday
5. ikihaano, = Friday
6. umbyagilo, = Saturday
7. Unduungu, = Sunday

263 Ojibwe Calendar

This solar calendar was used by the Ojibwe people in Canada.

The names of the months:

1. manitou-geezis (sun of the spirit), = ~ January
2. namaebini-geezis (sun catfish), = ~ February
3. onaubini-geezis (sun crust on the snow), = ~ March
4. baubaukunaetae-geezis (sun grows), = ~ April
5. waubegonae-geezis (sun flower), = ~ May
6. odaemine-geezis (sun strawberries), = ~ June
7. meen-geezis (sun blueberries), = ~ July
8. miskomini-geezis (sun raspberries), = ~ August
9. minomini-geezis (sun wild rice), = ~ September
10. benauquae-geezis (sun falling leaves), = ~ October
11. kushkudini-geezis (sun freezes), = ~ November
12. manitou-geezisohns (sun small mind), = ~ December

Main source: [BEID]

264 Omaha Calendar

This calendar was used by the Omaha people in the Great Plains of North America.

The names of the months:

1. Ho^{n}'ga umubthi ike (Moon when snow drifts into the tipies of Ho^{n}'ga), = ~ January
2. Mi'xa agthi ike (Moon when geese come home), = ~ February
3. Pe'nishka mieta ike (Moon of the little frog), = ~ March
4. Miu'o^{n}thi^{n}ge ke (Moon in which nothing happens), = ~ April
5. Mi waa' ike (Moon when it's time to plant), = ~ May
6. Tenu'gamigauna ike (Moon when the buffalo bulls hunt the cows), = ~ June
7. Tehu'ta^{n} ike (Moon when the buffalo bellow), = ~ July
8. U^{h}'po^{n}huta^{n} ike (Moon when the elk bellow), = ~ August

9. Ta'xte ma^{n}no^{n}xa (Moon when the deer paw the earth), = ~ September
10. Ta'xti kithixa ike (Moon when the deer rut), = ~ October
11. Ta'xte hebaxo^{n}' ike (Moon when the deer shed the antlers), = ~ November
12. Waça'be zhi^{n}ga i'da ike (Moon when the little black bears are born), = ~ December

Main source: [CUNN2]

265 (Ancient) Oromo Calendar

This has also been called the *(Ancient) Borana calendar*.

This lunistellar calendar was developed and used by the Oromo people around 300 BCE for weather forecasting and divination purposes. It was based on astronomical observations of the moon in conjunction with seven particular stars or star groups, namely Aldebaran, Bellatrix, Saiph, and Sirius, as well as the central Orion, the Pleiades, and the Triangulum constellations. These stars were called Urji Dhaha. The months were identified by báatîi (= month) + ordinal numeral. Each day of the month and each month of the year had a name. Instead of the expected 30 names for days of a month, there were only 27 names. These 27 days were permutated through the 12 months, in such a way that the beginning of each month moved forward by 2 or 3 days. The loss per month was then the difference between the 27-day month and the 30-day month.

The names of the months and corresponding stars or lunar phase:

1. bittoottessa (Iangulum), = ~ March
2. caamssaa (Pleiades), = ~ April
3. ebla or bufa (Aldebarran), = ~ May
4. waxabajjii (Belletrix), = ~ June
5. adoolessa or obora gudda (Central Orion-Saiph), = ~ July
6. hagayya or obora dikka (Sirius), = ~ August
7. birra (full moon), = ~ September
8. onkololessa or cikawa (gibbous moon), = ~ October
9. sadasaa (quarter moon), = ~ November
10. arfaasaa or abrasa (large crescent), = ~ December
11. amajji (medium crescent), = ~ January
12. Guraandhala (small crescent), = ~ February

The names of the days of the month:

1. Bita kara
2. Bita lama
3. Sorsa
4. Algajima
5. Arb
6. Walla
7. Basa dura
8. Basa ballo
9. Carra
10. Maganatti jarra
11. Maganatti britti
12. Salban dura
13. Salban balla
14. Salban dullacha
15. Gardaduma
16. Sonsa
17. Rurruma
18. Lumasa
19. Gidada
20. Ruda
21. Areri dura
22. Areri ballo
23. Adula dura
24. Adula ballo
25. Garba dura
26. Garba balla
27. Garba dullacha

In addition, the first two or three names were repeated at the end of the month. In modern time, the Gregorian calendar has been adopted with the substitution of Oromo names of the months.

The names of the weekdays:

1. Dilbata ykn Sanbata guda ykn Gidir Sanbat, = Sunday
2. Wixata ykn Hojaa dura ykn Dafino, = Monday

3. Kiibxata ykn Lamaffo ykn Facaasa ykn Ballo, = Tuesday
4. Roobi, = Wednesday
5. Kamsa, = Thursday
6. Jimaata, = Friday
7. Sanbata ykn Sanba ykn Sabata dura, = Saturday

Main sources: [BASS2], [LEGE2], [LYNC], [MEKO], [RUGG2], [SOPE], and [TABL]

266 Ossetian Calendar

This calendar is used among Ossetians in the Caucasus Mountain region.

The names of the months:

	Digor dialect (mainly in Western Ossetia)	Iron dialect
January	басилти	тъæнджы мæй
February	комахсæн	æртхъирæны мæй
March	комдарæн	комдарæн or тæргæйтты мæй
April	мартъи	хуымгæнæны мæй or цыфтæры мæй
May	Никкола or фæлвæра	зæрдæвæрæны мæй or кæрдæджы мæй
June	амистол	хурхæтæны мæй or кæхцгæнæн
July	сосæни мæйæ	сусæны мæй
August	майрæми куадзæни мæйæ	майрæмы куадзæны мæй
September	рухæн	рухæны мæй
October	кæфти мæйæ	кæфты мæй
November	горгуба	джеоргуыбайы мæй
December	цæппорсе	цыппурсы мæй

The names of the days:

1. Хуыцаубон, = Sunday
2. Къуырисæр, = Monday
3. Дыццæг, = Tuesday
4. Æртыццæг, = Wednesday
5. Цыппæрам, = Thursday
6. Майрæмбон, = Friday
7. Сабат, = Saturday

Internet source: ossetians.com

267 Ostyak Calendar

This seasonal and lunar calendar was used by the Ostyak people in Siberia, Russia.

The names of the months:

1. Spawning month
2. Naked-tree month
3. Pine-sapwood month
4. Pedestrian month (when man goes home on foot while ice still remains)
5. Birch-sapwood month
6. Month in which men go on horseback
7. Salmon-weir month
8. Great month
9. Month of hay harvest
10. Little-winter-ridge month
11. Ducks-and-geese-go-away month
12. Wind month or month of crows

Main source: [AVEN]

268 Pāḷi Calendar

This lunisolar Hindu calendar was used in Suvarṇabhumī, a land mentioned in many ancient sources, which might have included present-day Burma, Cambodia, Laos and Thailand. The year was divided into either three or six seasons. Seven intercalary lunar months were added during a 19-year cycle, to fit in with the solar cycle.

The names of the three seasons:

1. gimhāna, = summer season
2. vassāna, = rainy season
3. hemanta, = snowy season

The names of the six seasons:

1. vasanta, = spring season
2. gimha, = hot season
3. vassāna, = rainy season
4. sarada, = autumn season
5. hemanta, = snowy season
6. sisira, = cool season

The names of the months:

1. Phagguṇa, = ~ mid-February–mid-March
2. Citta, = ~ mid-March–mid-April
3. Vesākha, = ~ mid-April–mid-May
4. Jeṭṭha, = ~ mid-May–mid-June
5. Āsāḷha, = ~ mid-June–mid-July
6. Sāvaṇa, = ~ mid-July–mid-August
7. Poṭṭhapāda, = ~ mid-August–mid-September
8. Assayuja, = ~ mid-September–mid-October
9. Kattika, = ~ mid-October–mid-November
10. Māgasira, = mid-November–mid-December
11. Phussa, = ~ mid-December–mid-January
12. Māgha, = ~ mid-January–mid-February

The names of the weekdays:

1. Ravivāra, = Sunday
2. Candavāra, = Monday
3. Kujavāra, = Tuesday
4. Budhavāra, = Wednesday
5. Guruvāra, = Thursday
6. Sukkavāra, = Friday
7. Sanivāra, = Saturday

Main source: Abhidhānappadīpaka

269 (Ancient) Palmyrian Calendar

This lunisolar calendar was used in Palmyra.

The names of the months:

1. Nisan, 22 March–20 April (30 days)
2. Ijar, 21 April–20 May (30 days)
3. Siwan, 21 May–19 June (30 days)
4. Tammuz, 20 June–19 July (30 days)
5. Ab, 20 July–18 August (30 days)
6. Elul, 19 August–17 September (30 days)
7. Tišri, 18 September–17 October (30 days)
8. Kanun, 18 October–16 November (30 days)
9. Kaslul, 17 November–16 December (30 days)
10. Tebet, 17 December–15 January (30 days)
11. Šebat, 16 January–14 February (30 days)
12. Adar, 15 February–16 March (30 days)

Epagomenal days, 17 March–21 March (5 days)

Main sources: [GINZ]

270 (Ancient) Paphosian Calendar

This lunisolar calendar was used in Paphos (part of Cyprus) beginning in the third century.

The names of the months:

1. Ἀφροδίσιος Aphrodisios, 23 September–23 October (31 days)
2. Ἀπογονικός Apogonikos, 24 October–22 November (30 days)
3. Ἀἰνικός Ainicos, 23 November–23 December (31 days)
4. Ἰούλιος Iulios, 24 December–23 January (31 days)
5. Καισάριος Caesarios, 24 January–20 February (28 days)
6. Σεβαστός Sebastos, 21 February–22 March (30 days)
7. Αὐτοκρατορικός Autocratoricos, 23 March–22 April (31 days)
8. Δημαρχεξούσιος Demarchexusios, 23 April–23 May (31 days)
9. Πληθύπατος Plethypatos, 24 May–22 June (30 days)
10. Ἀρχιερεύς Archiereus, 23 June–23 July (31 days)
11. Ἕσθιος Hestios, 24 July–22 August (30 days)
12. Πωμαῖος Romaios, 23 August–22 September (31 days)

Main sources: [GINZ] and [SMIT3]

271 Parsi Calendar

See *Shahanshahi calendar*.

272 (Ancient) Parthian Calendar

This originated when the Babylonian calendar was adopted in the Seleucid Empire during the reign of Seleucus I (r. 321–281 BCE), but with Macedonian names of the months. Later, this was used in the Parthian Empire (*c*. 247 BCE–224 CE) with the substitution of Parthian names for the Macedonian ones.

The names of the months:

1. prwrtyn, = ~ March
2. 'rtywhšt
3. hrwtt
4. tyry
5. hmrtt
6. xštrywr
7. mtry
8. 'pxwny
9. 'trw
10. dtš
11. whmn
12. spndrmty, = ~ February/March

Main source: [BICK3]

273 Passamaquoddy Calendar

This calendar was used by the Passamaquoddy people in the St. Croix River region, Minnesota.

The names of the months:

1. opolahsomuwehs (whirling wind Moon), = ~ January
2. piyatokonis (when the spruce tips fall), = ~ February
3. siqon (early spring Moon), = ~ March
4. ponatom (spring Moon), = ~ April
5. siqonomeq (alewive Moon), = ~ May
6. nipon (summer Moon), = ~ June
7. accihte (ripening Moon), = ~ July
8. apsqe (feather shedding Moon), = ~ August
9. toqakiw (autumn Moon), = ~ September
10. amilkahtin (harvest Moon), = ~ October
11. kelotonuhket (freezing Moon), = ~ November
12. punam (frost fish Moon), = ~ December

Internet source: www.wwu.edu/skywise/indianmoons.html

274 Pawukon Calendar

See also *Javanese calendar*.

This calendar is used in Bali, with 6 months to a year (210 days), and 35 days to a month. Each Pawukon month is divided into ten shorter cycles (weeks), of 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 days, that run concurrently. The ten different kinds of weeks are named by prefixing the Sanskrit number from one to ten to the stem "-*wāra*," meaning "week."

Because 210 is not divisible by 4, 8, or 9, extra days must be added to the 4, 8, and 9-day weeks. For both the 4 and 8-day weeks, the penultimate day of the week is repeated twice in the week that would have otherwise ended on the 72nd day. For the 9-day week, the first day of the week is repeated three times in the first week of the year. The intercalary days are marked * in the table below. The 1-day week day is Luang if the 2-day week is Pěpět, but if the 2-day week day is Mēnga, the 1-day week day does not exist.

	Éka wāra	Dwi wāra	Tri wāra	Catur wāra	Panca wāra	Sad wāra	Sapta wāra	Asta wāra	Sanga wāra	Dasa wāra
1	Luang	Mēnga	Pasah	Sri	Umanis	Tungleh	Redite	Sri	Dangu*	Pandita
2		Pĕpĕt	Beteng or Pekenan	Laba	Paing	Aryang	Coma	Indra	Jangur	Pati
3			Kajĕng	Jaya*	Pon	Urukang	Anggara	Guru	Gigis	Suka
4				Maṇḍala	Wagé	Paniron	Buda	Yama	Nohan	Duka
5					Kliwon	Was	Wraspati	Ludra	Ogan	Sri
6						Maulu	Sukra	Brahmā	Erangan	Manuh
7							Saniscara	Kala*	Urungan	Manusa
8								Uma	Tulus	Eraja
9									Dadi	Dewa
10										Rākṣasa

The 7-day week is special in that each of its 30 weeks is named.

1. Sinta, 2. Landep, 3. Ukir, 4. Kulantir, 5. Taulu, 6. Gumbreg, 7. Wariga, 8. Warigadia, 9. Julungwangi, 10. Sungsang, 11. Dunggulan, 12. Kuningan, 13. Langkir, 14. Medangsia, 15. Pujut, 16. Pahang, 17. Krulut, 18. Merakih, 19. Julungwangi, 20. Medangkungan, 21. Matal, 22. Uye, 23. Menail, 24. Perangbakat, 25. Bala, 26. Ugu, 27. Wayang, 28. Kelawu, 29. Kukut, and 30. Watugunung.

Main sources: [ARDH], [EISE2], [KELL5], [PEND], and [REIN]

275 Pax Calendar

This reformed Gregorian calendar was proposed by James A. Colligan, a member of the Jesuit Order, in 1930. Its era started with the year 1928. Every year, beginning with 1930, having its last number or its last two numbers divisible by six got a leap week of 7 days, called *Pax*, after the month of Columbus. Every year with the number 99 and every centennial year not divisible by 400 will also have this extra week.

The names of the months:

1. January (28 days)
2. February (28 days)
3. March (28 days)
4. April (28 days)
5. May (28 days)
6. June (28 days)
7. July (28 days)
8. August (28 days)
9. September (28 days)
10. October (28 days)
11. November (28 days)
12. Columbus (28 days)
13. December (28 days)

Main source: [STEE2]
Internet source: personal.ecu.edu/mccartyr/colligan.html

276 (Ancient) Pentecontad Calendar

This was also known as the **Ḫamšâtum calendar**.

This agricultural solar calendar was probably used by the Amorites in ancient Assyrian colonies during the early second millenium BCE. It is also believed that it spread widely and continued to be in use in a fairly similar form among the fellahins of modern Palestine. The year was divided into seven periods of 50 days each, with an intercalary period (*šappatum*) of 15 or 16 days. The intercalary period was divided into two festival periods, each of 7 days' duration, one after the fourth pentecontad and the other at the end of the year. Each 50-day period was subdivided into 7 weeks of 7 days, plus an extra 50th day (*atzeret*).

Some scholars have argued that the liturgical calendar used by the Essenes at Qumran was a somewhat modified surviving version of the pentecontad calendar. See also (Ancient) *Qumran calendar*.

Main source: [LEWY3]

277 (Ancient) Perrhaebian Calendar

This calendar was used by the Perrhaebi people in northern Thessaly during ancient times.

The names of the months:

1. Panamos, = ~ August
2. Hermaios, = ~ September
3. Itonios, = ~ October
4. Apollonois, = ~ November
5. Themistios, = ~ December
6. Dios, = ~ January
7. Leschanorios, = ~ February
8. Aphrios, = ~ March
9. Agagylios, = ~ April
10. Homoloios, = ~ May
11. Hippodromios, =~ June
12. Phyllikos, = ~ July

Main source: [GINZ]

278 (Ancient) Persian Calendar

This 360-day lunisolar calendar was used in ancient Persia *c*. 550 BCE–330 BCE. The months had two or three divisions, depending on the phase of the moon. There were 12 months of 30 days each. An extra month was added every 6 years.

The names of the months:

1. Ādukanaiša, ~ March-April
2. Θūravāhara, ~ April-May
3. Θāigraciš, ~ May-June
4. Garmapada, ~ June-July
5. The fifth month had no known name in Old Persian, ~ July-August
6. The sixth month had no known name in Old Persian, ~ August-September
7. Bāgayādiš, ~ September-October
8. Vrkazana, ~ October-November
9. Āθ^r^iyādiya, ~ November-December
10. Anāmaka, ~ December-January
11. Θwayauvā, ~ January-February
12. Viyaxna, ~ February-March

Main sources: [PANA2], [POEB], [REIN], and [YARS]

279 Perugian Calendar

This calendar was used in Perugia, Arezzo and Assisi from about the twelfth century until the sixteenth century. The era began on December 25, which was set as the beginning of year 1. This made the calendar “1 year behind of the Julian calendar” from January 1 until December 25.

280 Pisan Calendar

This calendar was used in Pisa, Cortona and Pistoia from about the twelfth century until the fifteenth century. The era began on March 25 in the year of Jesus’ incarnation, thus in the year 1 according to the Julian calendar. This made the Pisan calendar “1 year ahead of the Julian calendar” from March 25 until December 31.

281 (Old) Polish Calendar

This traditional calendar was mainly based on the phases of the moon in the sky, what was happening in nature at that time and what type of work the people were engaged in during the specific period.

The names of the months in Polish:

1. Styczeń, = January
2. Luty, = February
3. Marzec, = March
4. Kwiecień, = April
5. Maj, = May
6. Czerwiec, = June
7. Lipiec, = July
8. Sierpień, = August
9. Wrzesień, = September

10. Październik, = October
11. Listopad, = November
12. Grudzień, = December

The names of the months in Kashubian-speaking areas:

1. Stëcznik, = January
2. Gromicznik, = February
3. Strëmiannik, = March
4. Łżëkwiat, = April
5. Môj, = May
6. Czerwińc, = June
7. Lëpińc, = July
8. Zélnik, = August
9. Séwnik, = September
10. Rujan, = October
11. Lëstopadnik, = November
12. Gòdnik, = December

The names of the seasons:

1. zima, = winter
2. wiosna, = spring
3. lato, = summer
4. jesień, = autumn

The names of the weekdays:

1. poniedziałek, = Monday
2. wtorek, = Tuesday
3. środa, = Wednesday
4. czwartek, = Thursday
5. piątek, = Friday
6. sobota, = Saturday
7. niedziela, = Sunday

Main sources: [GIGI] and [GINZ]

282 Pomo Calendar

This lunar calendar is used by the Pomo people in California.

The names of the months:

1. bashelamatau-la (buckeyes ripe Moon), = ~ January
2. sachau-da (cold winds Moon), = ~ February
3. kadamchido-da (growth begins Moon), = ~ March
4. chidodapuk (flowers Moon), = ~ April
5. umchachich-da (seeds ripen Moon), = ~ May
6. butich-da (bulbs mature Moon), = ~ June
7. bakaichich-da (manzanita ripens Moon), = ~ July
8. luchich-da (acorns appear Moon), = ~ August
9. shachluyiau-da (soaproot dug for fish poison Moon), = ~ September
10. kalemkayo (trees felled by fire at butt Moon), = ~ October
11. kasi-sa (cold begins Moon), = ~ November
12. stalpkel-da (leaves yellow and fall Moon), = ~ December

Internet source: www.snowwowl.com/moonnames.html

283 Ponca Calendar

This calendar was used by the Ponca people in the southern regions of the Great Plains of America.

The names of the months:

1. snow thaws Moon, = ~ January
2. ?
3. water stands in the ponds Moon, = ~ March
4. ?
5. ?
6. hot weather begins Moon, = ~ June
7. middle of summer Moon, = ~ July
8. corn is in the silk Moon, = ~ August
9. ?
10. when they store food in cases Moon, = ~ October
11. ?
12. ?

Internet source: www.snowwowl.com/moonnames.html

284 Positivist Calendar

This calendar was proposed by Auguste Comte, the founder of Positivism, in April 1849, after revising an earlier work by Marco Mastrofini. It has 13 months of 28 days each, always 4 weeks.

The first of a month was always a Monday. The spare day, called ‘Year End Day,’ followed December and was not in the weekly round. The sequence, Saturday, December 28, Year End Day, toSunday, January 1, ensured identical months. The extra month, Sol, was followed by ‘Leap Year Day’ as appropriate. He used the names of eminent men for each month, week, day and event (559 in all), consecrating Leap Year Day to ‘Eminent Women’. Each day of the year was named after lesser figures in history in various fields.

The names of the months:

1. Moses
2. Homer
3. Aristotle
4. Archimedes
5. Caesar
6. Saint Paul
7. Charlemagne
8. Dante
9. Gutenberg
10. Shakespeare
11. Descartes
12. Frederick II
13. Bichat

France tried it for a while in 1849 and it gained much support in the U.S.

Main source: [WILS2]

285 Potawatomi Calendar

This calendar was used by the Potawatomi people in the Great Lakes region.

The names of the months:

1. mkokisis (Moon of the bear), = ~ January
2. mnokesis (Moon of the rabbit conception), = ~ February
3. cicakkises (Moon of the crane), = ~ March
4. ?
5. te’minkeses (Moon of the strawberry), = ~ May
6. msheke’kesis (Moon of the turtle), = ~ June
7. we’shkitdaminkese (Moon of the young corn), = ~ July
8. e’mnomukkises (Moon of the middle), = ~ August
9. ?
10. e’sksegtukkisis (Moon of the first frost), = ~ October
11. pne’kesis (Moon of the turkey and feast), = ~ November
12. ?

Internet source: www.snowwowl.com/moonnames.html

286 Quechuan Calendar

This calendar is used by the Quechuan people in the central Andes of South America.

The names of the months:

Month	According to Qhichwa simi hamut’ana kuraq suntur (= Academia Mayor de la Lengua Quechua)	According to www.andes.org	According to www.katari.org
January	qhapaq raymi	kamay	qhapaq intiraymin
February	hatun poqoy	poqoy	puquy
March	pawqarwaray	pauqarwara	pawqarwara
April	ayriwa	ayriwa	ayriwa
May	aymuray	aymuray	aymuray
June	inti raymi	kuski	kuski
July	antasitwa	hawkaykuski	hawkaykuski
August	qhapaq sitwa	situa	sitwa
September	tarpuy	chawawarki	chakrayapuy
October	kantaray	kantarayki	kantarayki
November	ayamarka	ayamarka	ayamarka
December	paraqallariy	hatun raymi	aymarkay or hatun raymi

Month	According to Felipe Guaman Poma de Ayala (c. 1535–after 1616)	Among Kichwa speaking people	Among Kichwa speaking people in Bolivia
January	aya marq'ay	kulla or kamay	qhapaqmiy
February	chakra qunakuy	panchi or pawkartay	jatunpuquy
March	hatun puquy	pawkar or pachak	pachapuquy
April	inka raymi	ayriwa	ariwaki
May	kamay	aymuray	aymuray
June	kuski	raymi or kuski	jawkaykuski
July	pacha puquy	sitwa or antasitwa	chaqraqunakuy
August	pawqar waray	karwa or karwaki	chaqrayapuy
September	quya raymi	kuski or kuyak	tarpuy
October	qhapaq inti raymi	wayru or wayruk	pawqarwara
November	qhapaq raymi	sasi or ayamarka	ayamarq'ay
December	uma raymi	kapak or kamay	qhapaqintiraymi

The year is divided into four seasons:

1. Ch'iraw mit'a (spring)
2. Ruphay mit'a (summer)
3. Puquy mit'a (autumn)
4. Chiri mit'a (winter)

And in some regions, into two seasons:

1. Paray mit'a (the wet season)
2. Ch'aki mit'a (the dry season)

The names of the weekdays:

1. Intichu, = Sunday
2. Killachau, = Monday
3. Atipachau, = Tuesday
4. Qoyllurchau, = Wednesday
5. Illapachau, = Thursday
6. Ch'askachau, = Friday
7. K'uychichau, = Saturday

Internet sources: www.andes.org, www.katari.org, and qu.wikipedia.org/wiki/Killa_sutikuna

287 (Ancient) Qumran Calendar

This has also been called the **Essene calendar**.

This lunisolar calendar was probably used by the Essenes during the second century BCE. The year was divided into four seasons, each consisting of three 30 day months and an intercalary day at the end of each season. As this makes a total of only 364 days, the calendar would differ from the acual seasons after a few years. When the seasonal anomaly became obvious, an intercalary period was probably added to correct with respect to the season. The year was also divided into 7-day weeks.

A festival, such as the Feast of Unleavened Bread, the Feast of New Wine, the Feast of Oil, the Feast of Trumpets, the Feast of Tabernacles, and the Feast of the Great Day, was held on the last day of each 50-day period. According to some scholars, this may have been a survival of the pentecontad calendar used by the Amorites during the early second millenium BCE.

Main sources: [BEN], [FINE], and [VERM2]

288 Rapa Nui Calendar

This lunisolar calendar was used by the indigenous people of Easter Island. William Judah Thomson, a paymaster on the USS Mohican, spent 12 days on Easter Island from December 19 to 30 in 1886. He collected data on the calendar and the names of the months of the year. Intercalary days were added to some months to keep up with the solar year. The rule for when these days were added are yet unknown.

The names of the months, according to [THOM5]:

1. Anekena, = ~ August
2. Hora-iti, = ~ September
3. Hora-nui, = ~ October
4. Tangarouri, = ~ first part of November

5. Kotuti, = ~ last part of November and first part of December
6. Ruti, = ~ last part of December and first part of January
7. Koro, = ~ last part of January
8. Tuaharo, = ~ February
9. Tetuupu, = ~ March
10. Tarahao, = ~ April
11. Vaitu-nui, = ~ May
12. Vaitu-poto, = ~ June
13. Maro or Temaro, = ~ July

The names of the days of the month:

1. oata or ata
2. ohiro or oari
3. kokore tahi
4. kokore rua
5. kokore toru
6. kokore hâ
7. kokore rima
8. kokore ono
9. maharu
10. ohua or hua
11. otua or atua

ohotu or hotu (intercalary day)

1. ohotu or hotu
2. maure
3. ina-ira
4. rakau
5. omotohi
6. kokore tahi
7. kokore rua
8. kokore hâ
9. kokore rima
10. tapume
11. matua
12. orongo or rongo
13. orongo taane
14. mauri nui
15. mauri karo or mauri kero
16. omutu or mutu
17. tireo

hiro (intercalary day)

The names of the weekdays:

1. raʻā pō hitu, = Sunday
2. raʻā pō tahi, = Monday
3. raʻā pō rua, = Tuesday
4. raʻā pō toru, = Wednesday
5. raʻā pō h, = Thursday
6. raʻā pō rima, = Friday
7. raʻā pō ono, = Saturday

Main sources: [MÉTR], [THOM5], [USNM], and [WILL8]

289 Revolutionary Calendar

This calendar came into existence in October 1793 and began with the year II. It was abolished early in the year XIV in time to start 1806 on January 1. Each month was divided into three 10-day weeks known as décades. The seasonal names were proposed by the poet Fabre d'Elgantine.

The calendar contained 12 months of 30 days, each poetically named after its season:

1. vendémiaire (month of the wine harvest), = ~ September/October
2. brumaire (month of fog), = ~ October/November
3. frimaire (month of frost), = ~ November/December
4. nivôse (month of snow), = ~ December/January
5. pluviôse (month of rain), = ~ January/February
6. ventôse (month of wind), = ~ February/March
7. germinal (month of germination), = ~ March/April
8. floréal (month of flowering), = ~ April/May
9. prairial (month of meadows), = ~ May/June
10. messidor (month of the harvest), = ~ June/July
11. thermidor (month of heat), = ~ July/August
12. fructidor (month of fruits), = ~ August/September

Main sources: [REIN] and [ROMM]

290 (Ancient) Rhodian Calendar

This calendar was used on the island of Rhodes during ancient times.

The names of the months:

1. Ἀγριώνιος Agrianios, = ~ April–May
2. Ὑακίνθιος Hyacynthios, = ~ May–June
3. Πάναμο Panamos, = ~ June–July

Πάναμο ἐμβόλιμος Panamos embolimos, intercalated some years

4. Καρνείος Karneios, = ~ July–August
5. Δάλιος Dálios, = ~ August–September
6. θεσμοφόριος Thesmophorios, = ~ September–October
7. Διόσθυος Diosthyos, = ~ October–November
8. Theudasios = ~ November–December
9. Πεδαγείτνυος Pedageitnyos, = ~ December–January
10. Βαδρόμιος Badromios, = ~ January–February
11. σμίνθος Sminthios, = ~ February–March
12. Artamitios, = ~ March–April

Main source: [GINZ]

291 (Ancient) Roman Calendars

Before 713 BCE, the calendar used in Rome consisted of 10 months and 304 days, followed by an unnamed and unnumbered winter period of about 61¼ days. The year began on Martius 1, the day on which new consuls were inaugurated. The era of the Roman calendar was that of the founding of the city, ab urbe condita (AUC). The beginning of this era was originally assumed to be 750 BCE, but calculations made by the Roman historian Marcus Terentius Varro (116–27 BCE) determined 753 BCE as the founding date. An alternative system, whereby the Romans referred to the names of the annual consuls instead of the date of the year, was also in common use from that time. Hence, they could talk about the year 216 AUC as "the year of C. Terentius Varro and L. Aemilius Paulus". Fortunately for historians, the two systems were compatible, with the result that each of them could be invoked to support the other.

The names of the months before 713 BCE:

1. Martius (31 days)
2. Aprilis (30 days)
3. Maius (31 days)
4. Iunius (30 days)
5. Quintilis (31 days)
6. Sectilis (30 days)
7. September (30 days)
8. October (31 days)
9. November (30 days)
10. December (30 days)

This calendar was modified in about 713 BCE by the king Numa Pompilius (*r*. 715–672 BCE), who introduced Januarius (29 days), named after the god of gates, to the beginning of the year, and Februarius (23 days plus 5 intercalary days) at the end of the year. The months, which had 30 days in the old calendar now had 29. Like the calendar used in Greece, a year then consisted of 12 months and 355 days.

The names of the months, between 713 BCE and 452 BCE, in the religious calendar:

1. Martius (31 days)
2. Aprilis (29 days)
3. Maius (31 days)
4. Iunius (29 days)
5. Quintilis (31 days)
6. Sextilis (29 days)
7. September (29 days)
8. October (31 days)
9. November (29 days)
10. December (29 days)
11. Februarius (28 days)
12. Januarius (29 days)

In 452 BCE, Januarius was moved from before Martius to before Februarius.

The names of the months between 452 BCE and 154 BCE:

1. Martius (from the god Mars) (31 days)
2. Aprilis (from the god Aprus) (29 days)

3. Maius (from the goddess Maia, a daughter of Atlas) (31 days)
4. Iunius (from the goddess Juno) (29 days)
5. Quintilis (the fifth month) (31 days)
6. Sextilis (the sixth month) (29 days)
7. September (the seventh month) (29 days)
8. October (the eighth month) (31 days)
9. November (the ninth month) (29 days)
10. December (the tenth month) (29 days)
11. Januarius (from the god Janus) (29 days)
12. Februarius (from the goddess Februa) (28 days)

In 154 BCE, a rebellion broke out in Spain. To avoid changing consuls in the middle of a war, New Year's was shifted up 2 months, to Januarius 1, beginning Januarius 1, 153 BCE.

The names of the months after 154 BCE:

1. Januarius (29 days)
2. Februarius (28 days)
3. Martius (31 days)
4. Aprilis (29 days)
5. Maius (31 days)
6. Iunius (29 days)
7. Quintilis (31 days)
8. Sextilis (29 days)
9. September (29 days)
10. October (31 days)
11. November (29 days)
12. December (29 days)

Since the total number of days in a year of months was less than a solar year, an extra month 22 or 23 days long, *mensis intercalaris* but usually called Mercedonis, was added every 2–4 years after Februarius 23, followed by the last 5 days of Februarius. In an 8-year period, the length of the years, in theory, were then: 12 months of 355 days, 13 months of 377 days, 12 months of 355 days, 13 months of 378 days, 12 months of 355 days, 13 months of 377 days, 12 months of 355 days, and 13 months of 378 days. In practice, the addition had to be called for by the chief priest, the Pontifex Maximus, who did not show any sense of astronomical discipline. As the priesthood failed to keep track of the calendars, and as leap years were considered unlucky, the calendar eventually fell into complete disarray. By the time Julius Caesar (r. 49–44 BCE) consolidated his power by assuming control of government in the Roman Republic, the calendar was almost 3 months out of track with the seasons. See also *Julian calendar*.

The Romans' way of stating what day of the month it was depended on three specific days that occurred every month: Kalends or Kalendae (the first day of the month), Nones (8 days before the Ides, usually the fifth, but sometimes the seventh day), and Ides (the 15th day of Martius, Maius, Iulius (formerly Quintilis) and October, or the 13th day of other months). Originally, Kalends referred to the day of the new moon, and Ides to the day of the full moon.

A specific date was expressed by counting backwards from the next of the specific dates, e.g., October 2 would be "ante diem IV nonas Octobres," or by using "pride," which means "the day before," as the marker, e.g., "pridie idus Martias" for the day before the Ides of Martius. In the tables below: M = adjectival form of the name of the current month, N = adjectival form of the name of the subsequent month, and * = days that would be in the ablative plural, i.e., Ianuariis, Februariis, Martiis, Apriliis, Maiis, Iuniis, Iuliis, Augustiis, Septembriis, Octobriis, Novembriis, and Decembriis.

The names of the days of the month:

Day of the month	Ianuarias, Augustas, Decembres	Martias, Maias, Iulias, October	Apriles, Iunias, Septembres, Novembres
1	kalendis M*	kalendis M*	kalendis M*
2	ante diem IV nonas M	ante diem VI nonas M	ante diem IV nonas M
3	ante diem III nonas M	ante diem V nonas M	ante diem III nonas M
4	pridie nonas M	ante diem IV nonas M	pridie Nones
5	nonis M*	ante diem III nonas M	nonis M*
6	ante diem VIII idus M	pridie nonas M	ante diem VIII idus M
7	ante diem VII idus M	nonis M*	ante diem VII idus M
8	ante diem VI idus M	ante diem VIII idus M	ante diem VI idus M
9	ante diem V idus M	ante diem VII idus M	ante diem V idus M

(continued)

Day of the month	Ianuarias, Augustas, Decembres	Martias, Maias, Iulias, October	Apriles, Iunias, Septembres, Novembres
10	ante diem IV idus M	ante diem VI idus M	ante diem IV idus M
11	ante diem III idus M	ante diem V idus M	ante diem III idus M
12	pridie idus M	ante diem IV idus M	pridie idus M
13	idis M*	ante diem III idus M	idis M*
14	ante diem XIX kalendas N	pridie idus M	ante diem XVIII kalendas N
15	ante diem XVIII kalendas N	idis M*	ante diem XVII kalendas N
16	ante diem XVII kalendas N	ante diem XVII kalendas N	ante diem XVI kalendas N
17	ante diem XVI kalendas N	ante diem XVI kalendas N	ante diem XV kalendas N
18	ante diem XV kalendas N	ante diem XV kalendas N	ante diem XIV kalendas N
19	ante diem XIV kalendas N	ante diem XIV kalendas N	ante diem XIII kalendas N
20	ante diem XIII kalendas N	ante diem XIII kalendas N	ante diem XII kalendas N
21	ante diem XII kalendas N	ante diem XII kalendas N	ante diem XI kalendas N
22	ante diem XI kalendas N	ante diem XI kalendas N	ante diem X kalendas N
23	ante diem X kalendas N	ante diem X kalendas N	ante diem IX kalendas N
24	ante diem IX kalendas N	ante diem IX kalendas N	ante diem VIII kalendas N
25	ante diem VIII kalendas N	ante diem VIII kalendas N	ante diem VII kalendas N
26	ante diem VII kalendas N	ante diem VII kalendas N	ante diem VI kalendas N
27	ante diem VI kalendas N	ante diem VI kalendas N	ante diem V kalendas N
28	ante diem V kalendas N	ante diem V kalendas N	ante diem IV kalendas N
29	ante diem IV kalendas N	ante diem IV kalendas N	ante diem III kalendas N
30	ante diem III kalendas N	ante diem III kalendas N	pridie kalendas N
31	pridie kalendas N	pridie kalendas N	–

Day of the month	Februarias (common year)	Februarias (leap year)
1	kalendis M*	kalendis M*
2	ante diem IV nonas M	ante diem IV nonas M
3	ante diem III nonas M	ante diem III nonas M
4	pridie nonas M	pridie nonas M
5	nonis M*	nonis M*
6	ante diem VIII idus M	ante diem VIII idus M
7	ante diem VII idus M	ante diem VII idus M
8	ante diem VI idus M	ante diem VI idus M
9	ante diem V idus M	ante diem V idus M
10	ante diem IV idus M	ante diem IV idus M
11	ante diem III idus M	ante diem III idus M
12	pridie idus M	pridie idus M
13	idis M*	idis M*
14	ante diem XVI kalendas N	ante diem XVI kalendas N
15	ante diem XV kalendas N	ante diem XV kalendas N
16	ante diem XIV kalendas N	ante diem XIV kalendas N
17	ante diem XIII kalendas N	ante diem XIII kalendas N
18	ante diem XII kalendas N	ante diem XII kalendas N
19	ante diem XI kalendas N	ante diem XI kalendas N
20	ante diem X kalendas N	ante diem X kalendas N
21	ante diem IX kalendas N	ante diem IX kalendas N
22	ante diem VIII kalendas N	ante diem VIII kalendas N
23	ante diem VII kalendas N	ante diem VII kalendas N
24	ante diem VI kalendas N	ante diem VI kalendas N
25	ante diem V kalendas N	ante diem bis VI kalendas N
26	ante diem IV kalendas N	ante diem V kalendas N
27	ante diem III kalendas N	ante diem IV kalendas N
28	pridie kalendas N	ante diem III kalendas N
29	–	pridie kalendas N

The names of the weekdays:

1. Dies Solis (day of the Sun), = Sunday
2. Dies Lunae (day of the Moon), = Monday
3. Dies Martis (day of Mars), = Tuesday
4. Dies Mercurii (day of Mercury), = Wednesday
5. Dies Jovis (day of Jupiter), = Thursday
6. Dies Veneris (day of Venus), = Friday
7. Dies Saturni (day of Saturn), = Saturday

The Romans also used an 8-day week, with the market-day occurring once each *nundinum* ("ninth day"). Thus, the market days were 8 days apart, spaced evenly throughout the year.

Main sources: [DAVI8], [KIRS], and [SAMU]

292 Roman Egypt Calendar

This calendar was used in the Roman Province of Egypt before the Muslim conquest in 641.

The year began on Thoth 1, equivalent to our August 29, or August 30 in leap years. The epagomenal days lasted from August 24 until August 28.

The months match ours roughly as follows:

1. Thoth, = 29 August–27 September
2. Phaophi, = 28 September–27 October
3. Hathyr, = 28 October–26 November
4. Choiak, = 27 November–26 December
5. Tybi, = 27 December–25 January
6. Mecheir, = 26 January–24 February
7. Phamenoth, = 25 February–26 March
8. Pharmouthi, = 27 March–25 April
9. Pachon, = 26 April–25 May
10. Pauni, = 26 May–24 June
11. Epeiph, = 25 June–24 July
12. Mesore, = 25 July–23 August

Main sources: [HANN3] and [SAMU]

293 Romanian Calendar

This calendar was used in Romania and Moldavia.

The names of the months:

1. Gerar, = January
2. făurar, = February
3. mărţişor, = March
4. prier, = April
5. florar (the month of the flowers), = May
6. cireşar (the month of the cherries), = June
7. cuptor (the month of hot weather), = July
8. gustar (the month of cutting with the sickle), = August
9. răpciune (the month of harvesting) or viniceriu (the month of the wines), = September
10. brumar (the month of the mist), = October
11. frunzar (the month of the falling leaves), = November
12. ningău (the month of the snow), = December

The names of the weekdays:

1. duminică, = Sunday
2. luni, = Monday
3. marţi, = Tuesday
4. miercuri, = Wednesday
5. joi, = Thursday
6. vineri, = Friday
7. sîmbătă, = Saturday

Main source: [VULC]

294 (Old) Rotuman Calendar

This seasonal calendar was used on the Rotuma Island north of Fiji. The calendar consisted of 6 months, repeated once during the course of a year.

The names of the months:

1. oi-papa, = ~ March and ~ September
2. taftafi or noatauta, = ~ April and ~ October
3. haua, = ~ May and ~ November
4. kesepi or oipapta, = ~ June and ~ December
5. fosongau, = ~ July and ~ January
6. adapuanga, = ~ August and ~ February

Main source: [WILL8]

295 Rumi Calendar

This solar-based calendar was officially used by the Ottoman Empire from 1839, and by its successor, the Republic of Turkey, until 1926. It was based on the Julian calendar, but started with the year of Muhammad's emigration in 622.

The names of the months (Ottoman and Turkish names):

1. كـانون ى ثـان Kânûn-ı Sânî, = January (31 days)
2. شـباط Şubat, = February (28 days)
3. مارت Mart, = March (31 days)
4. سانىن Nisan, = April (30 days)
5. سىما Mayıs, = May (31 days)
6. رانىحز Haziran, = June (30 days)
7. تمـوز Temmuz, = July (31 days)
8. اغسـتوس Ağustos, = August (31 days)
9. لولىا Eylül, = September (30 days)
10. نىتشـر اول Teşrin-i Evvel, = October (31 days)
11. نىتشـر ى ثـان Teşrin-i Sânî, = November (30 days)
12. كـانون اول Kânûn-ı Evvel, = December (31 days)

The Maliye (Fiscal) calendar started with a New Year's Day of March 21 (Nau Ruz).

Main sources: [BLAK], [DENY], and [ROSE2]

296 Runic Calendar

This is a perpetual calendar based on the 19-year-long Metonic cycle of the Moon, meaning every 19 years, the full moons are on the same days. If this is the case, a year has the golden number 1, the next year, 2, etc., and there are 19 golden numbers. This calendar appeared in medieval Sweden, and the oldest found runic alamanac has been dated to the thirteenth century. The names of the weekdays and the golden numbers were written with the seven first runes of the Futhark (repeated 52 times) and the 16 runes of the Younger Futhark, plus special runes for the remaing 3 years:

ᚠ = Fe (Golden Number 1),
ᚢ = Ur (Golden Number 2),
ᚦ = Thurs (Golden Number 3),
ᚬ = As (Golden Number 4),
ᚱ = Reidh (Golden Number 5),
ᚴ = Kaun (Golden Number 6),
ᚼ = Hagall (Golden Number 7),
ᚾ = Naudhr (Golden Number 8),
ᛁ = Is (Golden Number 9),
ᛅ = Ar (Golden Number 10),
ᛋ = Sol (Golden Number 11),
ᛏ = Tyr (Golden Number 12),
ᛒ = Bjarkan (Golden Number 13),
ᛘ = Madhr (Golden Number 14),
ᛚ = Logr (Golden Number 15),
ᛦ = Yr (Golden Number 16),
ᛮ = Arlaug (Golden Number 17),
ᛯ = Tvimadur (Golden Number 18), and
ᛰ = Belgthor (Golden Number 19).

Later calendars used Pentadic numerals for the values 1–19. Christian holidays could also be marked with runes.

Main sources: [BRAT], [LIND2], [LITH], [MAGN3], and [MORL]

297 (Ancient) Sidonian calendar

This lunisolar calendar was used in Sidon (in present-day Lebanon).

The names of the months:

1. Δῖος Dios, 1 January–31 January (31 days)
2. Ἀπελλαῖος Apellaios, 1 February–28 February (28 days)
3. Αὐδυναῖος Audynaios, 1 March–31 March (31 days)
4. Περίτιος Peritios, 1 April–30 April (30 days)
5. Δύστρος Dystros, 1 May–31 May (31 days)
6. Ξανδικός Xanthikos, 1 June–30 June (30 days)

7. Ἀρτεμίσιος Artemisios, 1 July–31 July (31 days)
8. Δαίσιος Daisios, 1 August–31 August (31 days)
9. Πάνημος Panemos, 1 September–30 September (30 days)
10. Λῷος Loos, 1 October–31 October (31 days)
11. Γορπιαῖος Gorpiaios, 1 November–30 November (30 days)
12. Ὑπερβερεταῖος Hyperberetaios, 1 December–31 December (31 days)

Main source: [GINZ]

298 Saka Calendar

See *Sashi calendar*.

299 Saka Calendar

This is also called the **Indian calendar**, **Indian civil calendar**, **Indian national calendar**, **Hindu civil calendar**, or **Shalivahana calendar**.

See also *Hindu calendars*.

This lunisolar calendar was established on March 22, 1957, by the Calendar Reform Committee. The calendar is used alongside the Gregorian calendar in India, Bali, and Java. It counts its years from the vernal equinox of the year 79, and refers to itself as the Saka Era.

To determine leap years, first add 78 to the Saka year. If this sum is evenly divisible by 4, the year is a leap year, unless the sum is a multiple of 100. In the latter case, the year is not a leap year unless the sum is also a multiple of 400.

The names of the months:

1. Caitra or Chaitra, 22 March–20 April (30 or 31 days) (the latter when starting on 21 March in leap years)
2. Vaisākha, 21 April–21 May (31 days)
3. Jyaishtha, 22 May–21 June (31 days)
4. Āsādha, 22 June–22 July (31 days)
5. Shrāvana, 23 July–22 August (31 days)
6. Bhādra or Bhādrpada, 23 August–22 September (31 days)
7. Āswina, 23 September–22 October (30 days)
8. Kārtika, 23 October–21 November (30 days)
9. Agrahayana or Margashirsh, 22 November–21 December (30 days)
10. Pausha, 22 December–20 January (30 days)
11. Māgha, 21 January–19 February (30 days)
12. Phālguna, 20 February–21 March (30 days)

Main sources: [REIN] and [RICH1]

300 (Ancient) Salamisian Calendar

This lunisolar calendar was used in Salamis beginning in the third century.

The names of the months:

1. Phaophi, 4 September–3 October
2. Athyr, 4 October–2 November
3. Choiak, 3 November–2 December
4. Tybi, 3 December–1 January
5. Mechir, 2 January–31 January
6. Phamenoth, 1 February–2 March
7. Pharmuthi, 3 March–1 April
8. Pachon, 2 April–1 May
9. Payni, 2 May–31 May
10. Mesori, 1 June–30 June
11. Epiphi, 1 July–30 July
12. Thoth, 31 July–29 August

Five epagomenal days, 30 August–3 September

Main source: [GINZ]

301 Samaritan-Israelite Calendar

This lunisolar calendar is used by the Samaritans, an ethnoreligious group of the Levant. It is based on a singular system of calculation which is only known by the family of the High Priest and has been kept secret for many generations. According to the Samaritan tradition, this calculation, called *ishban qashta* (the true calculation) in Aramaic, has been passed from one generation to the next since Adam received it from God through angels. Moses fixed the month of *Abib* as the first month, and taught the system to Phinehas the High Priest. When the Israelites entered the Promised Land, Phinehas applied this reckoning to the latitude of Mt. Gerizim.

Up to this day, the High Priest issues the calendar twice a year, in August and February.- The calendar is almost equal to the Hebrew calendar, but the intercalary years are not bound to a fixed year in the lunar cycle, being decided upon according to need.

The calendar, which is based on a pure lunar year of 354 days, uses two cycles: the 19-year lunar cycle and the coincidence of the same weekdays with the same days of the month after 28 years. Seven of the 19 lunar-years are leap years, each one consisting of 13 months.

The Samaritan calendar uses two eras: the Creation Era(reckoned from the Creation of the World according to the Israelites) at 4439 BCE and the Entry Era (reckoned from the entry of the Israelites into Canaan) in the year 2800 of the Creation Era. See also *Hebrew calendar*.

Main source: [POWE6]

302 (Old) Samoan Calendar

This lunar calendar was used on the Samoan Islands.

The names of the months:

1. Fa'aafu, Taafanua or Aitu-iti, = ~ February-March
2. Lo or Fanonga, = ~ March-April
3. Aunumu or Sina, = ~ April-May
4. Oloamanu, = ~ May-June
5. Palolo-mua, = ~ June-July
6. Palolo-muli, = ~ July-August
7. Mulifa, = ~ August-September
8. Lotuanga, = ~ September-October
9. Taumafa-mua, = ~ October-November
10. Toe-taumafa, = ~ November-December
11. Utuva-mua, Aitu-tele, or Tangaloa-tele = ~ December-January
12. Utuva-muli, Toe-uta-va, or Aitu-iti = ~ January-February

The names of the seasons:

1. tau totogo, = spring
2. tau vevela, = summer
3. tau e āfu ai mea, = autumn
4. tau mālūlū, = winter

The names of the weekdays:

1. Aso Sā, = Sunday
2. Aso Gafua, = Monday
3. Aso Lua, = Tuesday
4. Aso Lulu, = Wednesday
5. Aso Tofi, = Thursday
6. Aso Faraile, = Friday
7. Aso To'ona'i, = Saturday

Main source: [BEST2]

303 (Ancient) Samosian Calendar

This calendar was used in ancient Samos in the eastern Aegean Sea.

The names of the months:

1. Apellaion, = July
2. Heraion, = August
3. Buphonion, = September
4. Apaturion, = October
5. ?
6. Poseideon, = December
7. ?
8. Anthesterion, = February
9. ?
10. Artemision, = April
11. Targelion, = May
12. Eleithyaion, = June

Main source: [GINZ]

304 (Old) Sápmi Calendars

These calendars were used in northern Scandinavia among the Sami people. Due to the close ties between the Sami culture and reindeer herding, the cycle of seasons were directly related to the annual behavioral patterns of the reindeer.

The names of the seasons in Lule Sami and Ume Sami:

1. Gidádálvve or Gijrradálvvie, spring-winter/early spring (when the herd begins the migration to the mountains), early March–late April
2. Gidá or Gijrra, spring (when the temperature increases and the snow begins to melt), late April–late May
3. Gidágiesse or Gijrragiessie, spring-summer/early summer (when the reindeer graze), late May–midsummer
4. Giesse or Giessie, summer (when there is no sunset), midsummer–late August
5. Tjaktjagiesse or Tjakttjagiessie, autumn-summer/early autumn (when the bull reindeers destined for slaughter are choosen), late August–mid-September
6. Tjaktja or Tjaktta, autumn (when the reindeer mate prior to their return to the winter-grounds), mid-September–mid-October
7. Tjaktjadálvve or Tjakttjadálvvie, autumn-winter/early winter (when the herd lead the reindeer to the lowland bogs), mid-October–late December
8. Dálvve or Dálvvie, winter (when it is winter darkness (*skábma*), 24-hour-per-day darkness, and the reindeer move to the forest), late December–early March

The names of the months:

	Northern Sami	Lule Sami	Inari Sami	Skolt Sami	Kildin Sami
January	ođđajagimánnu	ådåjakmánno	uđđâivemáánu	ođđee´jjmään	январрь
February	guovvamánnu	guovvamánno	kuovâmáánu	tä´lvvmään	февралль
March	njukčamánnu	sjnjuktjamánno	njuhčâmáánu	pâ´zzlâšttammään	маррт
April	cuoŋománnu	vuoratjismánno	cuáŋuimáánu	Njuhččmään	апрелль
May	miessemánnu	moarmesmánno	vyesimáánu	vue´ssmään	майй
June	geassemánnu	biehtsemánno	kesimáánu	ǩie´ssmään	июннь
July	suoidnemánnu	sjnjilltjamánno	syeinimáánu	suei´nnmään	июлль
August	borgemánnu	bårggemánno	porgemáánu	på´rǧǧmään	авгусст
September	čakčamánnu	ragátmánno	čohčâmáánu	čõhččmään	сентябьр
October	golggotmánnu	gålgådismánno	roovvâdmáánu	kålggmään	актябьр
November	skábmamánnu	basádismánno	skammâmáánu	skamm´mään	ноябьр
December	juovlamánnu	javllamánno	juovlâmáánu	rosttovmään	декабрръ

	Southern Sami
January	tsïengele
February	goevte
March	njoktje
April	voerhtje
May	suehpede
June	ruffie
July	snjaltje
August	mïetske
September	skïerede
October	golke
November	rahka
December	goeve

Main source: [MANK]

Internet sources: lexin.nada.kth.se/lang/trio/ss/28/sydsamiska.htm

www.sametinget.se/1673

people.uta.fi/~km56049/same/inarinsaame.html

people.uta.fi/~km56049/same/skolt/koltansaame.html

ru.wiktionary.org/wiki/Категория:Саамский_(кильдинский)_язык

305 Sashi Calendar

This is sometimes also called the **Saka Calendar**. See also *Pawukon calendar*.

This lunar calendar is used in Bali and by the mountain people of East Java. Each month begins on the day after a new moon (tilem). The middle of each month is the full moon (purnama). A lunar day is about 24 hours and 50 minutes, on the average. The months usually alternate between 29 and 30 days, and the year in total consists of 354, 355, or 356 days. An intercalary month, Saseh Nampeh, is added every 30 months.

The months, except for the last two, have names that are related to the Sanskrit sequence of numbers, from one to ten, but they also have ritual names.

The names of the months:

1. Sasih Kasa or S'rawana
2. Sasih Karo or Badra wada
3. Sasih Ketiga or Asudje
4. Sasih Kapat or Kartika
5. Sasih Kelima or Margasira
6. Sasih Kenem or Posya
7. Sasih Kepitu or Maga
8. Sasih Kaulu or Palguna
9. Sasih Kesanga or Madumasa
10. Sasih Kedasa or Wesaka
11. Sasih Desta or Dijesta
12. Sasih Sada or Asada

Main source: [EISE2] and [RICH2]

306 (Ancient) Seleucian Calendar

This lunisolar calendar was used in ancient Seleucia.

The names of the months:

1. Γορπιαῖος Gorpiaios, 1 October–31 October (31 days)
2. Πάνημος Panemos, 1 November–30 November (30 days)
3. Ξανδικός Xanthikos, 1 December–31 December (31 days)
4. Ἀὐδυναῖος Audynaios, 1 January–31 January (31 days)
5. ?, 1 February–28 February (28 days)
6. Διονυσιος Dionysios, 1 March–31 March (31 days)
7. Ἀνδιστήριος Anthisterios, 1 April–30 April (30 days)
8. Ἀρτεμίσιος Artemisios, 1 May–31 May (31 days)
9. ?, 1 June–30 June (30 days)
10. ?, 1 July–31 July (31 days)
11. Ἀδονισιος Adonisios, 1 August–31 August (31 days)
12. Ἀπελλαῖος Apellaios, 1 September–30 September (30 days)

Main source: [GINZ]

307 Selkup Calendar

This lunar calendar was used among the Selkup people in Tomsk Oblast.

The names of the months:

1. leaf-fall month (starting in August)
2. month when the earth freezes
3. month of the short days
4. month when the deer is caught or when the day is so short that women only can make the thumb of a glove
5. mid-winter month
6. month of crows
7. eagle month
8. month in which the summer animals arrive

9. month in which the fish spawn
10. month in which there is water in the little brooks
11. month in which fish is dried
12. *njelma*-month (*Stenodus nelma* is a whitefish)

Main source: [NILS]

308 Semmyō Calendar

This was also known as the **Xuanming li**. See also *Japanese calendars*.

This lunisolar calendar was used in Japan from 862 to 1684.

Main source: [NUSS]

309 Sesotho Calendar

This cosmic calendar system is used by Sotho-speaking people, primarily in South Africa and Lesotho. The reliance on certain cosmic events means that seasons can only be declared once these events take place. This means that time is not a linear series. The months are explained based on the life of plants and the weather system.

The names of the seasons:

1. hwetla, = autumn
2. maiha, = winter
3. selemo, = spring
4. hlabula, = summer

The names of the months:

1. Phato (the month that is characterised by dust), = ~ August
2. Lwetse or Loetse (the month when the first rain of the year is coming down), = ~ September
3. Mphalane (the month when the soil is tented in preparation for ploughing), = ~ October
4. Pudungwana (the month when the childen play until they are *pududu* by dirt), = ~ November
5. Tshitwe (the month when the insect tshitwe is found in abundance with its crickling sounds), = ~ December
6. Pherekgong, = ~ January
7. Hlakola (the mounth of hoeing the fields following the summer rains), = ~ February
8. Hlakubele or Tlhakubele (the month of harvest for sorghum), = ~ March
9. Mmesa (the month of harvesting maize and the time it is hard enough for brazing), = ~ April
10. Motsheanong (the month of laughing at the birds as they leave to escape the winter cold), = ~ May
11. Phupjoane (the month that marks the death of birds from intensity of the winter cold), = ~ June
12. Phupu (the month that marks the death of birds in significant numbers due to the winter cold), = ~ July

The time of the day, Letsatsi, which is solely dependent on the position of the sun:

1. Meso, = the time of the day when the first light of the day breaks
2. Hoseng, = morning
3. Motsheare, = the time of the day when the sun is high up so that shadows are directly underneath their objects
4. Thapama, = the time of the day when the sun starts to shift westward after motsheare
5. Mantsiboya, = the time of the day when the sun hovers over the mountains, just before sunset
6. Shwalane, = the time of evening when the night is still young
7. Bosiu, = the time of night when nighttime falls and people go to bed
8. Kgitla, = the time of night when people have gone to sleep, up to when nighttime falls away

Generally speaking, *matsatsi* (plural of letsatsi) make up the *kgwedi* (month), *dikgwedi* (plural of kgwedi) make up the *ngwaha* (season), and *mengwaha* (plural of ngwaha) make up the *ngwaha kgolo* (year).

The names of the weekdays:

1. Sontaha, = Sunday
2. Mantaha, = Monday
3. Labobedi, = Tuesday
4. Laboraro, = Wednesday
5. Labone, = Thursday
6. Labohlano, = Friday
7. Moqebelo, = Saturday

Main sources: [FUTH] and [NILS]

310 Shahanshahi Calendar

This is also called the **Shenshai calendar** or **Parsi calendar**.

This is a Zoroastrian calendar that was originally an approximation of the tropical solar calendar, and every month had 30 days. The months and the days of the month were dedicated to, and named after, a divinity or divine concept. During the reign of al-Mu'taḍid (*r*. 892–902), an Abbasid Caliph of Baghdad, five epagomenal days were added at the end of the month Ābān.

This religious calendar is still used by members of the Zoroastrian faith. They use the Y.Z.-suffix for its era, indicating the number of years since the coronation on June 11, 632, of Yezdegerd III ibn Saharyar (*r*. 632–651), the last king of the Sassanid dynasty. The calendar is now a 365-day cycle.

The divinities of both day and month are mentioned at every Zoroastrian act of worship.

The names of the months in Pahlavi and Modern Persian:

1. Frawardīn/Farvardīn or Farwardīn, 21 March–20 April
2. Ardwahīst/Ordībehest or Ardībihišt, 21 April–21 May
3. Xordắd/Kurdāḍ, 22 May–21 June
4. Tīr/Tīr, 22 June–22 July
5. Amurdắd/Murdād, 23 July–22 August
6. Šahrewar/Šahrīvar or Šahrīwar, 23 August–22 September
7. Mihr/Mehr or Mihr, 23 September–22 October
8. Ābān/Ābān, 23 October–21 November
9. Adur/Aḏar or Āḍar, 22 November–21 December
10. Day/Dey or Dai, 22 December–20 January
11. Wahman/Bahman, 21 January–19 February
12. Spandarmad/Esfand or Isfandārmah, 20 February–20 March

The names of the days in Pahlavi and Modern Persian:

1. Ohrmazd/Hormuz, 2. Wahman/Bahman, 3. Ardwahist/Ordibehešt, 4. Šahrewar/Šahrivar, 5.Spandarmad/Esdandārmoḏ, 6. Xurdād/Ḵordād, 7. Amurdād/Mordād, 8. Day pad Ādur/Dey be Āḏar, 9. Ādur/Āḏar, 10. Ābān/Ābān, 11. Xwar/Ḵūr, 12. Māh/Māh, 13. Tīr/Tīr, 14. Gōš/Gūš, 15. Day pad Mihr/Dey be Mehr, 16. Mihr/Mehr, 17. Srōš/Sorūš, 18. Rašn/Rašn, 19. Frawadīn/Farvardīn, 20. Wahrām/Bahrām, 21. Rām/Rām, 22. Wād/Bāḏ, 23. Day pad Dēn/Dey be Dīn, 24. Dēn/Dīn, 25. Ahrišwang/Ard, 26. Aštād/Aštāḏ, 27. Asmān/Āsmān, 28. Zamyād/Zămyaḏ, 29. Māraspand/Māraspand and 30. Anagrān/Anīrān

Each day is divided into *gahs* (watches): Hawan (sunrise to noon), Rapithwin or Second Hawan (noon to 3:00 pm), Uzerin (3:00 pm to sunset), Aiwisruthrem (sunset to midnight), and Ushahin (midnight to sunrise).

A 5-day period called the *Hamaspathmaidyen* is appended at the end of the year. These days are named:

1. Ahunawad (or Ahunavad)
2. Ushtawad (or Ushtavad)
3. Spentomad
4. Wohukhshathra (or Vohukhshathra)
5. Wahishtoisht (or Vahishtoist)

Zoroastrian Calendars date from the coronation of the last Zoroastrian Sasanian King, Yazdegird II, in 631 CE. For this reason, dates in Zoroastrian calendars are followed by the letter Y.

Main sources: [BICK2], [PUNT], and [YARS]

311 Shalivahana Calendar

See *Saka calendar*.

312 Shamsi Calendar

See (Ancient) *Afghan Lunar calendar*.

313 Shawnee Calendar

This calendar was used by the Shawnee people in Midwestern North America.

The names of the months:

1. ha'kwi kiishthwa (severe Moon), = ~ January
2. haatawi kiishtwa (crow Moon), = ~ February
3. shkipiye kwiitha (sap Moon), = ~ March
4. poosh kwiitha (half Moon), = ~ April
5. hotehimini kisssshtwa (strawberry Moon), = ~ May
6. mshkatiwi kiishthwa (raspberry Moon), = ~ June
7. miini kiishthwa (blackberry Moon), = ~ July
8. po'kawmawi kiishthwa (plum Moon), = ~ August
9. ha'shimini kiishthwa (papaw Moon), = ~ September
10. sha'teepakanootha (wilted Moon), = ~ October
11. kini kiishthwa (long Moon), = ~ November
12. washilatha kiishthwa (eccentric Moon), = ~ December

Internet source: bigbearstrading.com/BBD-S-DICTIONARY_1.php

314 Shenshai Calendar

See *Shahanshahi calendar*.

315 Shilluk Calendar

This agricultural calendar was used in the Shilluk Kingdom.

The names of the seasons:

1. yey jeria (harvest of red dura), = ~ September
2. anwoch (end of the harvest), = ~ October
3. agwero (harvest of white dura begins), = ~ November–December
4. wudo (harvest of white dura continues), = ~ December–January
5. leu (the hot season), = ~ January–February
6. dodin (no work in the fields), = ~ March
7. dokot (rain season), = ~ April
8. shwer (planting of red dura), = ~ May–July
9. doria (beginning of harvest), = ~ July–September

Main source: [NILS]

316 Shire Calendar

This fictional calendar was constructed by Professor John Ronald Reuel Tolkien (1892–1973). It was used by the Hobbits in the fictional region called the Shire and in the village named Bree, east of the Shire. The Shire era begins when the Shire was founded by the Bree Hobbits Marcho and Blanco in the year 1601 of the Third Age.

The year was set at 365 days, 5 hours, 48 minutes, and 46 seconds, and consisted of 12 months of 30 days each, plus five additional days. Every 4 years, a leap day was added as well.

The calendar during a leap year with relationship to the Gregorian calendar:

Second Yule, = 22 December

1. Afteryule (or Frery in Bree), = 23 December to 21 January
2. Solmath, = 22 January to 20 February
3. Rethe, = 21 February to 22 March
4. Astron (or Chithing in Bree), = 23 March to 21 April

5. Thrimidge = 22 April to 21 May
6. Forelithe (or Lithe in Bree), = 22 May to 20 June

First Lithe (or First Summerday in Bree), = 21 June
Mid-years's day (or Second Summerday in Bree), = 22 June
Overlithe (or Third Summerday in Bree), = leap day
Second Lithe (or Fourth Summerday in Bree), = 23 June

7. Afterlithe (or Mede in Bree), = 24 June to 23 July
8. Wedmath, = 24 July to 22 August
9. Halimath (or Harvestmath in Bree), = 23 August to 21 September
10. Winterfilth (or Wintring in Bree), = 22 September to 21 October
11. Blotmath (or Blooting in Bree), = 22 October to 20 November
12. Foreyule (or Yulemath in Bree), = 21 November to 20 December

First Yule, = 21 December

The names of the weekdays:

1. Sterday, = Saturday
2. Sunday, = Sunday
3. Monday, = Monday
4. Trewsday, = Tuesday
5. Hevensday, = Wednesday
6. Mersday, = Thursday
7. Highday, = Friday

Main sources: [DAY], [SCHA2], and [TOLK]

317 Shíxiàn Calendar

See *Chongzhen calendar*.

318 Shona Calendar

This calendar is now equal to the Gregorian calendar and is used among the Shona people in Zimbabwe.

1 gore, = a year
1 mwedzi, = a month
1 svondi, = a week
1 zuva, = a day
1 awa, = an hour
1 mineti, = a minute
1 sekondi, = a second

Names of the months:

1. Ndira, = January
2. Kukadzi, = February
3. Kukume, = March
4. Kurume, = April
5. Kubvumi, = May
6. Chivabvu, = June
7. Chikunguru, = July
8. Nyamavhuvhu, = August
9. Gunyana, = September
10. Gumiguru, = October
11. Mbudzi, = November
12. Zvita, = December

The names of the weekdays:

1. movhuro, = Monday
2. chipiri, = Tuesday
3. chitatu, = Wednesday
4. china, = Thursday
5. chishanu, = Friday
6. mugovera, = Saturday
7. svundo, = Sunday

319 Shoshone Calendar

This calendar was used by the Shoshone people in the Great Basin and Wyoming.

The names of the months:

1. goa-mea'a (freezing Moon), = ~ January
2. isha-mea'a (coyote Moon), = ~ February
3. yu'a-mea'a (warming Moon), = ~ March
4. badua'-mea'a (melting Moon), = ~ April
5. buhisea'-mea'a (budding Moon), = ~ May
6. daa'za-mea'a (summer starting Moon), = ~ June
7. daza-mea'a (summer Moon), = ~ July
8. guuteyai. mea'a (hot Moon), = ~ August
9. yeba-mea'a (autumn Moon), = ~ September
10. naa-mea'a (rutting Moon), = ~ October
11. ezhe'i-mea'a (cold Moon), = ~ November
12. dommo-mea'a (winter Moon), = ~ December

Main source: Journal of American Indian Education, Vol. 40. Center for Indian Education, 2001, p. 17. *Series*: Native American legal materials collection, No. 2270.

320 Shoshone Timbisha Calendar

This calendar was used by the Timbishan-speaking people in and around Death Valley.

The names of the months:

1. sümüm müattsi (first Moon), = ~ early January–late January
2. waham müattsi (second Moon), = ~ February
3. pahim müattsi (third Moon), = ~ March
4. wattsüwim müattsi (fourth Moon), = ~ April
5. manükim müattsi (fifth Moon), = ~ May
6. naapsim müattsi (sixth Moon), = ~ June
7. taattsüwim müattsi (seventh Moon), = ~ July
8. woosüwim müattsi (eighth Moon), = ~ August
9. wanukkim müattsi (ninth Moon), = ~ September
10. suumoonom müattsi (tenth Moon), = ~ October
11. sümüttüm ma to'engkünna müattsi (eleventh Moon), = ~ November
12. wahattüm ma to'engkünna müattsi (twelfth Moon), = ~ December
13. pahittum ma to'engkünna müattsi (thirteenth Moon), = ~ late December–early January

Main source: [DAYL]

321 (Ancient) Sicilian Calendar

This calendar was used in ancient Sicily before about 200 BCE.

The names of the months:

1. θεσμοφόριος Thesmophorios, ~ October
2. Δάλιος Dalios, ~ November
3. ,~ December
4. Ἀγριώνιος Agrianios, ~ January
5. , ~ February
6. Τηεθδασιοσ Theudasios, ~ March
7. Αρταμιτιοσ Artamitios, ~ April
8. , ~ May
9. Βαδρόμιος Badromios, ~ June
10. Ὑακίνθιος Hyakinthios, ~ July
11. Καρνειοσ Carneios, ~ August
12. Πάναμος Panamos, ~ September

Main sources: [GRES] and [STER]

322 Sìfēn Calendar

See *Chinese calendars*.

323 (Old) Sinhala Calendar

This lunar Buddhist calendar was used in Sri Lanka. An intercalary month, Æsala II, of 30 days was inserted as soon as the accumulated fraction in relation to the solar year amounted to 1 month. At irregural intervals, an extra day was added to Poson, making it 30 days.

The names of the months:

1. වෙසක් Vesak, = ~ May (30 days)
2. පොසොන් Poson, = ~ June (29 days)
3. ඇසළ Æsala, = ~ July (30 days)
4. නිකිණි Nikini, = ~ August (29 days)

5. බිනර Binara, = ~ September (30 days)
6. වප් Wap, = ~ October (29 days)
7. ඉල් Il, = ~ November (30 days)
8. උඳුවප් Unduvap, = ~ December (29 days)
9. දුරුතු Duruthu, = ~ January (30 days)
10. නවම් Navam, = ~ February (29 days)
11. මැදින් Mædhin, = ~ March (30 days)
12. බක් Bak, = ~ April (29 days)

The names of the weekdays:

1. ඉරිදා Iridaa, = Sunday
2. සඳුදා Sandudaa, = Monday
3. අඟහරුවදා Anngaharuwadaa, = Tuesday
4. බදාදා Badaadaa, = Wednesday
5. බ්‍රහස්පතින්දා Brahaspathindaa, = Thursday
6. සිකුරාදා Sikuradaa, = Friday
7. සෙනසුරාදා Senasuraadaa, = Saturday

Main source: [ELLI3]

324 Sioux Calendar

This calendar was used by the Sioux people in the Dakotas and Nebraska.

The names of the months:

1. Strong cold Moon, frost in the tepee Moon, or wolves run together Moon, = ~ January
2. Racoon Moon or dark red calves Moon, = ~ February
3. Buffalo cows drop their calves Moon, snowblind Moon, or sore eye Moon, = ~ March
4. Greening grass Moon or red grass appearing Moon, = ~ April
5. When the ponies shed Moon, = ~ May
6. Making fat Moon, when green grass is up Moon, or strawberry Moon, = ~ June
7. When the wild cherries are ripe Moon, red cherries Moon, or red blooming lilies Moon, = ~ July
8. When the geese shed their feathers Moon or cherries turn black Moon, = ~ August
9. Drying grass Moon, when calves grow hair or black calf Moon, or when the plums are scarlet Moon, = ~ September
10. Falling leaves Moon or changing season Moon, = ~ October
11. Falling leaves Moon, = ~ November
12. Popping trees Moon, when deer shed their horns Moon, or buffalo cow's fetus is getting large Moon, = ~ December

Main source: [SOUT]

325 (Ancient) Sīstānian Calendar

This lunisolar calendar was used by the Saka tribes in ancient Scythia. The year consisted of 12 months of 30 days each, plus five epagomenal days.

The names of the months:

1. kw'ḏ
2. rhw
3. ʾws'l
4. tyr ky'nw'
5. sryzw'
6. mryzw'
7. twzr
8. mr'nw'
9. ''rkb'zw'
10. kžpšt
11. kžḥn
12. s'rw'

Main source: [YARS]

326 (Old) Slovenian Calendar

This traditional calendar was mainly based on the phases of the moon in the sky, what was happening in nature at that time and what type of work people were engaged in during the specific period.

The names of the months:

1. studenty, = ~ January
2. prosinetz, = ~ February
3. sjetschen, = ~ March
4. suchy, = ~ April
5. berezozol, = ~ May

6. traven, = ~ June
7. izok, = ~ July
8. tscherven, = ~ August
9. zarjew or zarev, = ~ September
10. riujen or rujan, = ~ October
11. listopad, = ~ November
12. grunden, = ~ December

The names of the weekdays:

1. Ponedeljek, = Monday
2. Torek, = Tuesday
3. Sreda, = Wednesday
4. Četrtek, = Thursday
5. Petek, = Friday
6. Sobota, = Saturday
7. Nedelja, = Sunday

Main source: [GINZ]

327 Society Island Calendars

Several lunatic calendars were reported in use on the Society Islands during various expeditions.

The names of the over-lapping seasons according to [NILS]:

1. tetau (the harvest of bread-fruit), = ~ December–early February
2. faahu (rain season), = ~ January–early February
3. te tau poai (winter season), = ~ July–October
4. te tau miti rahi (the season of high sea), = ~ November–early January

The names of the months according to [ELLI4] and [MOER]

1. Averehu (The new moon that appears about the summer solstice), = ~ December/January
2. Faaahu (Season of plenty), = ~ January/February
3. Pipiri, = ~ February/March
4. Taaoa (Beginning of new harvest; season of scarcity), = ~ March/April

According to [HALE] this was the intercalary month inserted between Pipiri and Aununu.

5. Aununu (Great abundance), = ~ April/May
6. Apaapa (people return from the seashore), = ~ May/June
7. Paroro mua or Paroro moua, = ~ June/July
8. Paroro muri, = ~ July/August
9. Muriaha, = ~ July/August
10. Hiaia, = ~ August/September
11. Tema (Near the new harvest), = ~ September/October
12. Teere (the young breadfruit flowers and nearly ripens), = ~ November/December
13. Tetai (people return to the seashore), = ~ November/December

The name of the months according to [FORS3]:

1. Wae-ahou, = ~ January
2. Pipirree, = ~ February
3. A-oo-noonoo, = intercalary month
4. O-porore-o-mooa, = ~ March
5. O-porore-o-mooree, = ~ April
6. Mooreha, = ~ May
7. Oohee-eiya, = ~ June
8. Hooree-ama or Owhirree-ama, = ~ July
9. Taowa, = ~ August
10. Hooree-erre-erre or Owhirree-erre-erre, = ~ September
11. O-te-aree, = ~ October
12. O-te-tai, = ~ November
13. Warehoo or Owarahew, = ~ December

Main sources: [CAIL], [FORS3], [HALE], [NILS], and [MOER]

328 (Ancient) Sogdian Calendar

This lunisolar calendar was used in Sogdia, a province of the Achaemenid Empire, from about 300 BCE. The year was divided into three seasons of 4 months each. Five epagomenal days were added at the end of the year.

The names of the months:

1. nʾwsrδyc
2. xwryznych
3. nysnyc
4. bs’k
5. ʾšn’kxʾntyc
6. mzʾyx-xntych
7. βγkʾnyc
8. ʾʾpʾnc
9. βwγych
10. tγmych
11. zymtycy
12. ʾxšwmycy

The names of the weekdays:

1. Mīr, = Sunday
2. Māx, = Monday
3. Unxān, = Tuesday
4. Tīr, = Wednesday
5. Urmazt, = Thursday
6. Nāxid, = Friday
7. Kēwān, = Saturday

Main sources: [FREǏ] and [YARS]

329 Solar Hijri Calendar

See *Afghan Solar calendar*, *Iranian calendar*, and *Kurdish calendar*.

330 (Old) Somali Calendars

This is also called the **Amin-tiris** or **Taqwiim**.

These solar calendars were used among farmers and herders in present-day Somalia to determine the seasons during pre-Islamic times. The calendars were based on the week.

The names of the days of the week, as used by the members of the Rendille community north-east of Namoratunga sites:

1. Hahat
2. Orra hakhan
3. Sere
4. Kumat
5. Sere hakhan
6. Sere adhi
7. Sere gaal

The names assigned to the timing of days in the week:

1. dorraad-horteed (before before-yesterday)
2. dorraad (before yesterday)
3. shaley (yesterday)
4. manta (today)
5. berry (tomorrow)
6. saakuun (after tomorrow)
7. saandanbe (after after-tomorrow)

Besides the weekly cycle, there were four other cycles: the 50-day cycle (= 7 weeks plus 1 day), the yearly cycle (= 7 × 50-days plus 15 days), the 7-year cycle (= 7 × 365 days), and the 49-year cycle (= 7 × 7 years). Anyhow, the names of the months varied from one region to another. Below, I have compiled two examples.

The names of the months:

1. Habar-Ari = 20 August–18 September (30 days)
2. Diraac-Good = 19 September–18 October (30 days)
3. Lix-kor = 19 October–18 November (31 days)
4. Daleela-tire = 19 November–18 December (30 days)
5. Axal = 19 December–18 January (31 days)
6. Baranbeer = 19 January–17 February (30 days)
7. Toddob = 18 February–20 March (31 days)
8. Amminla’ = 21 March–19 April (30 days)
9. Fushade = 20 April–20 May (31 days)
10. Gu’soore = 21 May–19 June (30 days)
11. Samuulad = 20 June–20 July (31 days)
12. Dirir-Sagaaro = 21 July–19 August (30 days)

The names of the seasons:

1. Xagaa, = Samuulad–Dirir-Sagaaro, = summer

2. Dayrta, = Habar-Ari–Diraac-Good, = autumn
3. Jilaalka, = Lix-kor–Baranbeer, = winter
4. Guga, = Toddob–Gu'soore, = spring

The names of the months:

1. Karan = 20 July–19 August (31 days)
2. Habar-Ari = 20 August–18 September (30 days)
3. Dirac-Good = 19 September–18 October (30 days)
4. Dayrweyn = 19 October–18 November (31 days)
5. Ximir = 19 November–18 December (30 days)
6. Xays = 19 December–17 January (30 days)
7. Lix-kor = 18 January–17 February (31 days)
8. Toddob = 18 February–19 March (30 days)
9. Amminla' = 20 March–18 April (30 days)
10. Fushade = 19 April–19 May (31 days)
11. Gu'soore = 20 May–18 June (30 days)
12. Samuulad = 19 June–19 July (31 days)

The names of the seasons:

1. Xagaa, = Karan–Dayrweyn, = summer
2. Dayr, = Ximir–Xays, = autumn
3. Diraac, = Lix-kor–Amminla', = winter
4. Gu', = Fushade–Samuulad, = spring

After the Islamic conquests, the Islamic calendar was adopted, but with different names for the months. Below, one example from northern Somalia.

The names of the months in northern Somalia and related months in the Islamic calendar:

1. dâg-o, dâgâ-di, المحرّم, Muharram, (30 days)
2. bil dûra hôre, صفر, Safar, (29 days)
3. bil dûra dâmbe, ربيع الأوّل, Rabi' al-awwal, (30 days)
4. râdjal hôre, ربيع الثاني or ربيع الآخ, Rabī' al-Thānī, (29 days)
5. râdjal ḍâḥa, جمادى الأولى, Jumada al-Oola, (30 days)
6. râdjal dâmbe, جمادى الثانية or جمادى الآخرة, Jumada al-Thani, (29 days)
7. sabbûh-di, رجب, Rajab, (30 days)
8. wâ-bîris-ki, شعبان, Sha'aban, (29 days)
9. sôn-gâd-di, رمضان, Ramadan, (30 days)
10. sô-fûr-ti, شوّال, Shawwāl, (29 days)
11. sidatâl or sidatâši, ذو القعدة, Dhu al-Qa'dah, (30 days)
12. 'arafâ-di or 'arafo, ذو الحجّة, Dhu al-Hijjah, (29 days and 30 days in leap year)

Main sources: [CERU], [GINZ], and [LEWI8]

331 (Old) Sorbian Calendar

This calendar was used by Sorbs in eastern Germany.

1. wulki róžk, = ~ January
2. mały róžk, = ~ February
3. nalětnik, = ~ March
4. jutrownik or haperleja, = ~ April
5. róžownik, = ~ May
6. smažnik, = ~ June
7. pražnik, = ~ July
8. žnjenc, = ~ August
9. požnjenc, = ~ September
10. winowc, = ~ October
11. nazymnik, = ~ November
12. hodownik, = ~ December

Main source: [SERB2]

332 Soviet Calendars

Including the **Russian Revolutionary calendar** and the **Russian calendar**.

This reformed Gregorian calendar was used from the autumn of 1929 until June 26, 1940 in Russia. From 1929 until the summer of 1931, each Gregorian year was usually divided into 72 five-day weeks. This was later called the Russian Revolutionary calendar. Then, from the summer of 1931 until June 26, 1940, each month was usually divided into five 6-day-weeks. This was later called the Russian calendar. From 1940 onward, Russia returned to the official Gregorian calendar, with its 7-day week.

The names of thgeoe months:

	Russian	Kyrgyz	Tajik	Tatar	Belarusian	Ukranian
January	январь	январь	январ	гыйнвар	студзень	сі́чень
February	февраль	февраль	феврал	февраль	люты	лю́тий
March	март	март	март	март	сакавік	бе́резень
April	апрель	апрель	апрел	апрель	красавік	кві́тень
May	май	май	май	май	травень	тра́вень
June	июнь	июнь	июн	июнь	чырвень	че́рвень
July	июль	июль	июл	июль	ліпень	ли́пень
August	август	август	август	август	жнівень	се́рпень
September	сентябрь	сентябрь	сентябр	сентябрь	верасень	ве́ресень
October	октябрь	октябрь	октябр	октябрь	кастычнік	жо́втень
November	ноябрь	ноябрь	ноябр	ноябрь	лістапад	листопа́д
December	декабрь	декабрь	декабр	декабрь	сьнежань	гру́день

Main sources: [ACHE], [KETC], and [PARR2]

333 (Ancient) Sumerian Calendars

These lunisolar calendars were used in ancient Sumer until *c*. 2500 BCE. The year was divided into 12 lunar months of 29 or 30 days. An intercalary month, še-gur$_{10}$-ku$_5$, was inserted, but no fixed principle has been observed. There was also an extra month of 62 days included every 6 years. There were no weeks, and a day was divided into 12 hours.

The names of the months at the time of the Sumerian Third Dynasty of Ur:

1. bar$_2$-zag-ga (the month of the throne in the temple)
2. gu$_4$-si-sa$_3$ (the month when horned oxen is out)
3. sig$_4$-ga (the month when bricks are placed in molds)
4. šu-nummun-a (the month of sowing or the month of the feast of Dumuzi)
5. ne-izi-ğar (the month when fires are lit)
6. kin-dingir-nini (the month of the goddess Inanna)
7. du$_6$-ku$_3$ (the month of the sacred hill)
8. apin-du$_8$-a (the month when the plow is set aside)
9. gan-gan-e$_3$-(na) (the month when clouds appear)
10. ab-ba-e$_3$ (the month when our ancestors came out of the sea)
11. ziz$_2$-am$_3$ (the month spelled)
12. še-kin-tar (the month of the harvest)

še-gur$_{10}$-ku$_5$ (intercalary month to catch the solar year)

There were various city-calendars in use. Below is listed the known names for these calendars in Umma, Lagash, Duraihim, and Ur.

	Umma	Lagash	Duraihim	Ur
1.	Še.Gur. Kud.	Gan.Maš.	Maš.Du. Ku.	Še.Gur. Kud.
2.	Sig.I. Sub.Ba. Gar	Har.Ra. Ne.Mu. Mu.	Šeš.Da. Ku.	Maš.Ku. Ku.
3.	Še.Kar. Gal.La.	Ezen ^{d}Ne. Šu.	U.Ne.Ku.	Šeš.Da. Ku.
4.	?	Šu.Kul.	Ki.Sig. Nin.A.Zu.	U.Ne.Ku.
5.	?	Dim.Ku.	Ezen.Nin. A.Zu.	Ki.Sig. ^{d} Nin.A.Zu.

(continued)

	Umma	Lagash	Duraihim	Ur
6.	Šu. Numun.	Ezen ^{d} Dumu-Zi	A.Ki.Ti.	Ezen.^{d} Nin.A.Zu.
7.	Min.Ab.	Ezen ^{d}Šul. Gi.	Ezen.^{d} Šul.Gi.	A.Ki.Ti.
8.	E.Itu.Aš.	Ezen ^{d}Ba.U.	Šu.Ešh. Ša.	Ezen.^{d}Šul. Gi.
9.	^{d}Ne.Gun.	Mu.Su.Du.	Ezen. Makh.	Šu.Eš. Ša.
10.	Ezen. ^{d} Shul.Gi.	Amar.A.A. Si.	Ezen.An. Na.	Ezen.^{d} Makh.
11.	Kur.U.E.	Še.Gur. Kud.	Ezen.Me. Ki.Gal.	Ezen.An. Na.
12.	^{d}Dumu-Zi	Še.Il.La.	Še.Gur. Kud.	Ezen.Me. Ki.Gal.

Main sources: [COHE3], [LAND2], [LEWY2], [NEB74], and [TROL]

334 Suriyakhati Calendar

This is also called the **Thai solar calendar**.

This calendar was adopted by King Chulalongkorn the Great (1853–1910) in 1888 as the Siamese version of the Gregorian calendar. Today, it is the legal calendar in Thailand. The year 1 was first set at April 6, 1782, but during the reign of King Vajiravudh (Rama VI), the Buddhist Era (BE), which has an epochal year 0 beginning on March 11, 545 BCE, was adopted.

The names of the zodiacal months:

1. มกราคม makkarakhom (the month of the dragon), = January (31 days)
2. กุมภาพันธ์ koumphaaphan, = February (28 days, but solar leap years 29 days)
3. มีนาคม miinaakhom (the month of the mīna), = March (31 days)
4. เมษายน meesaayon (the month of the ram), = April (30 days)
5. พฤษภาคม phruetsaphaakhom (the month of the bull), = May (31 days)
6. มิถุนายน mithounaayon (the month of the twins), = June (30 days)
7. กรกฎาคม karakadaakhom (the month of the crab), = July (31 days)
8. สิงหาคม singhaakhom (the month of the lion), = August (31 days)
9. กันยายน kanyaayon (the month of the girl), = September (30 days)
10. ตุลาคม toulaakhom (the month of the scale), = October (31 days)
11. พฤศจิกายน phruetsachikayon (the month of the scorpion), = November (30 days)
12. ธันวาคม thanwaakhom (the month of the bow), = December (31 days)

The names of the seasons:

1. ฤดูหนาว réu-doo năao, = winter
2. วสันต์ wá-săn, = spring
3. หน้าร้อน nâa rón, = summer
4. ฤดูใบไม้ร่วง réu-doo bai máai rûang, = autumn

The names of the weekdays:

1. วันอาทิตย์ wan āthit, = Sunday
2. วันจันทร์ wan chan, = Monday
3. วันอังคาร wan angkhān, = Tuesday
4. วันพุธ wan phut, = Wednesday
5. วันพฤหัสบดี wan phruehatsabodi, = Thursday
6. วันศุกร์ wan suk, = Friday
7. วันเสาร์ wan sao, = Saturday

The traditional New Year (*Songkran*) began when the sun transitted the constellation of Aries, thus on April 11 or 13. On this day, the year assumes the name of the next animal in the 12-year animal cycle. In 1912, Rama IV moved the start of the year to April 1, and by a decree of Prime Minister Phibunsongkhram in 1940, the start of the year was set at January 1.

The names of the years in the animal cycle:

1. ขาล Khan, = tiger
2. เถาะ Tho, = rabbit
3. มะโรง Marong, = dragon
4. มะเส็ง Maseng, = snake
5. มะเมีย Mamia, = horse
6. มะแม Mamae, = goat
7. วอก Wok, = monkey
8. ระกา Raka, = rooster
9. จอ Chu, = dog

10. กุน Kun, = pig
11. ชวด Chuat, = rat
12. ฉลู Chalu, = ox

Main source: [EADE]

335 (Old) Swazi Calendar

This lunisolar calendar was used by the Swazi people in present-day Swaziland and South Africa. Since the Europeans came to the country, the Swazi calendar has been modified to conform with the European calendar.

The year was divided into three seasons:

1. lihlobo, = summer
2. ikwindla, = autumn
3. ubusika, = winter

The names of the months:

1. Kholwane (hawk that nests in the moon), = ~ July/August
2. iNgci (small wolf breeds in this month), = ~ August/September
3. iNyoni (special bird mates), = ~ September/October
4. iMphala (antelope bears its young), = ~ October/November
5. Lweti (star to see when women begin work early in the morning) or Inkosi lencane (little chief), = ~ November/December
6. iNgongoni (Buffalo month or month of the wild beast) or Mavulangamithi (to swallow pickings of teeth), = ~ December/January
7. Bhimbidvwane (to eat and be satisfied), = ~ January/February
8. iNdlovana (small elephant), = ~ February/March
9. iNdlovulenkhulu (big elephant), = ~ March/April
10. Mabasa or Nhlangula (to make fire), = ~ April/May
11. iNkhwekhweti (pick up everything you have), = ~ May/June
12. iNhlaba (Aloe blossoms), = ~ June/July

Main source: [MARW]

336 (Old) Swedish Calendar

This lunisolar and agricultural calendar was used by inhabitants of present-day Sweden until the late eighteenth century, and came to correspond with the Julian months.

The names of the months:

1. Thorrmånad, = ~ January
2. Göiemånad, = ~ February
3. Thurrmånad or Vårmånad, = ~ March
4. Vårmånad or Gräsmånad, = ~ April
5. Blomstermånad or Lövmånad, = ~ May
6. Sommarmånad, = ~ June
7. Hömånad, = ~ July
8. Skördemånador Rötmånad, = ~ August
9. Höstmånad, = ~ September
10. Slagtmånad or Blotmånad, = ~ October
11. Vintermånad, = ~ November
12. Julmånad, = ~ December

The names of the weekdays:

1. sunnodagher, = Sunday
2. manadagher, = Monday
3. tisdagher, = Tuesday
4. oþinsdagher, = Wednesday
5. þorsdagher, = Thursday
6. fredagher, = Friday
7. løghardagher, = Saturday

Main source: [GINZ]

337 Swedish Calendar

This calendar was in use between March 1, 1700 and February 30, 1712, in Sweden, which included Finland at the time. In November 1699, it was decided that Sweden would begin to adopt the New Style, or Gregorian calendar, starting in 1700 by omitting the leap days in the period 1700–1740. According to this plan, February 29 was omitted in 1700, but contrary to the plan, both 1704 and 1708 were leap years in Sweden. This brought the Swedish calendar 1 day ahead of the Julian calendar and 10 days behind the Gregorian calendar.

In January 1711, King Charles XII declared that Sweden would abandon the calendar, which wasn't in use by any other nation, nor had it achieved its objective, in favour of a return to the Old Style. An extra day was added to February in the leap year of 1712, thus giving it a unique 30-day length.

In 1753, Sweden introduced the New Style, whereby the leap of 11 days was accomplished by February 17 being followed by March 1. Despite this, Sweden observed, until 1844, Easter on the Sunday after the first astronomical full moon after the true vernal equinox.

Main source: [MEIJ]

338 Symmetry454 Calendar

This Gregorian calendar reform, proposed by Professor Irv Bromberg at the University of Toronto, conserves the traditional 7-day week, starts every month on Monday, and has symmetrical 4 + 5 + 4 weeks. No month has a partial week. Seven intercalary days are added to the end of leap years.

The names of the months:

1. January (28 days)
2. February (36 days)
3. March (28 days)
4. April (28 days)
5. May (35 days)
6. June (28 days)
7. July (28 days)
8. August (35 days)
9. September (28 days)
10. October (28 days)
11. November (35 days)
12. December (28 days or 35 days)

Internet source: individual.utoronto.ca/kalendis/symmetry.htm

339 (Old) Syro-Macedonian Calendar

This lunisolar calendar was used in Syria, and remained in use until the Christian era.

The names of the months in the Syro-Macedonian calendar:

1. Tešrīn I, 1 October–31 October (31 days)
2. Tešrīn II, 1 November–30 November (30 days)
3. Kānūn I, 1 December–31 December (31 days)
4. Kānūn II, 1 January–31 January (31 days)
5. Šobāṭ, 1 February–28 February (28 days)
6. Aḏār, 1 March–31 March (31 days)
7. Nīsān, 1 April–30 April (30 days)
8. Ayyār, 1 May–31 May (31 days)
9. Ḥazīrān, 1 June–30 June (30 days)
10. Tammūz, 1 July–31 July (31 days)
11. Āb, 1 August–31 August (31 days)
12. Aylūl, 1 September–30 September (30 days)

Main sources: [GINZ], [MCLE, p. 166] and [SAMU, p. 17]

340 Tabarian Calender

This has also been called the *Caspian calendar*.

This solar calendar is used among the Mazandarani people in Iran.

The names of the months:

1. Owna Ma, = ~ January
2. Erkea Ma or Siya Ma, = ~ February
3. Dea Ma, = ~ March
4. Vehmina Ma, = ~ April
5. Neowrez Ma, = ~ May
6. Fardina Ma, = ~ June
7. Kercha Ma, = ~ July
8. Her Ma, = ~ August
9. Tir Ma, = ~ September
10. Melarea Ma or Merdal Ma, = ~ October
11. Shervin Ma, = ~ November
12. Mir Ma, = ~ December

Main sources: [ASHR] and [KĪĀ]

341 Tahitian Calendars

These calendars were used on Tahiti. The Tahitian year began when a star called Rehoua appeared in the evening, which, according to [MOER], occurred in about October.

On the island of Huahine, the people divided the year into two seasons, the *matarii-inia*, when the Pleiades (*matarii*) appeared above the horizon at the setting of the Sun, and the remaining 6 months, the *matarii-iraro*, when the Pleiades were not seen.

Main sources: [MOER] and [TYER]

342 Taien Calendar

See also *Japanese calendars*.

This lunisolar calendar was used in Japan from 764 to 857.

Main source: [OHAS]

343 Taiwanese Calendar

This calendar is used in Taiwan. It follows the Chinese Republic system tradition of using the sovereign's era name and year of reign, in which the first year (民國元年) was 1912, the year of the founding of the Republic of China.

344 Tamil Calendar

This sidereal Hindu calendar is used in Kerala, Tamil Nadu, and Puducherry in India, and by the Tamil population in Malaysia, Mauritius, Singapore, and Sri Lanka.

The names of the months:

1. சித்திரை Cittirai, = ~ mid-April–mid-May
2. வைகாசி (Vaikāci), = ~ mid-May–mid-June
3. ஆனி (Āni), = ~ mid-June–mid-July
4. ஆடி (Āṭi), = ~ mid-July–mid-August
5. ஆவணி (Āvaṇi), = ~ mid-August–mid-September
6. புரட்டாசி (Puraṭṭāci), = ~ mid-September–mid-October
7. ஐப்பசி Aippaci, = ~ mid-October–mid-November
8. கார்த்திகை (Kārttikai), = ~ mid-November–mid-December
9. மார்கழி (Mārkazhi), = ~ mid-December–mid-January
10. தை Tai, = ~ mid-January–mid-February
11. மாசி (Māci), = ~ mid-February–mid-March
12. பங்குனி (Paṅkuni), = ~ mid-March–mid-April

Seasons, each of which lasts 2 months, and mapping to English names:

1. இளவேனில் (ila-venil = chithirai - vaigās), = spring
2. முதுவேனில் (muthu-venil = āni - ādi), = summer
3. கார் (kār = āvani - puratāci), = monsoon
4. குளிர் (kulir = aippasi - kārthiga), = autumn
5. முன்பனி (mun-pani = mārkazhi - tai), = winter
6. பின்பனி (pin-pani = māsi - panguni), = prevernal

The names of the weekdays:

1. ஞாயிற்றுக்கிழமை (ñayiṟṟu-kizhamai), = Sunday
2. திங்கட்கிழமை (tingat-kizhamai), = Monday
3. செவ்வாய்க்கிழமை (cevvāi-kizhamai), = Tuesday
4. புதன்கிழமை (putan-kizhamai), = Wednesday
5. வியாழக்கிழமை (viyāzha-kizhamai), = Thursday
6. வெள்ளிக்கிழமை (veḷḷi-kizhamai), = Friday
7. சனிக்கிழமை (shani-kizhamai), = Saturday

Main source: [KRIS]
Internet source: tamil.indiancalendars.org

345 (Old) Tatar Calendar

This lunar calendar was used among the Tatars in Krasnoyarsk Krai.

The names of the months:

1. forest month (starting in September)
2. little cold month

3. great cold month
4. the mottled month
5. severe cold month
6. when the sun moves high above the horizon
7. when the birds fly out in spring
8. when the days increase
9. the red month
10. little drought month
11. birch-bark month
12. grass month
13. harvest month

Main source: [NILS]

346 (Ancient) Taorminian Calendar

This calendar was used in ancient Taormina on the east coast of Sicily.

The names of the months:

1. Artemitios, = ~ January
2. Dionysios, = ~ February
3. ?
4. ?
5. Panamos, = ~ May
6. Apellaios, = ~ June
7. Itonios, = ~ July
8. Carneios, = ~ August
9. Lanotros, = ~ September
10. Apollonios, = ~ October
11. Duodekateus, = ~ November
12. Eukleios, = ~ December

Main source: [GINZ]

347 Telugu Calendar

See also *Hindu calendars*.

This Hindu calendar is mainly used by Telugu-speaking people in Andhra Pradesh, India. The year starts with Yugadi or Ugadi.

The names of the months:

1. చైత్రము Chaithramu, = ~ March-April
2. వైశాఖము Vaisaakhamu, = ~ April-May
3. జ్యేష్ఠము Jyeshttamu, = ~ May-June
4. ఆషాఢము Aashaadhamu,= ~ June-July
5. శ్రావణము Sraavanamu, = ~ July-August
6. భాద్రపదము Bhaadhrapadamu,= ~ August-September
7. ఆశ్వయుజము Aasveeyujamu,= ~ September-October
8. కార్తీకము Kaarthikamu,= ~ October-November
9. మార్గశిరము Maargaseershamu,= ~ November-December
10. పుష్యము Pushyamu,= ~ December-January
11. మాఘము Maakhamu,= ~ January-February
12. ఫాల్గుణము Phaalgunamu,= ~ February-March

The names of the weekdays:

1. ఆదివారము = Sunday
2. సోమవారము = Monday
3. మంగళవారము = Tuesday
4. బుధవారము = Wednesday
5. గురువారము = Thursday
6. శుక్రవారము = Friday
7. శనినారము = Saturday

Internet source: www.astroica.com

348 Temiar Calendar

This natural calendar is used by the Temiar people, a Senoic group indigenous to the Malay peninsula. The prah tree (*Elateriospermum tapos*) is the indicator for the calendar. The calendar periods could be roughly related to the Gregorian months as shown below:

1. In February, the green leaves of the prah tree fall.
2. In March, the prah tree puts out new red shoots.
3. In April, the new leaves of the prah tree turn green.
4. In May, the leaves are all green, but the young fruit has not yet appeared.
5. In June, the prah fruit is just visible.
6. In July, the prah fruit is filling out.
7. In August, the prah fruit is nearly ripe and ready to fall.
8. In September, the prah fruit falls.
9. In October, the fruit season sets in.
10. November and December are months of rain.

11. In January, it stops raining and a new year cycle is about to begin.

Main sources: [RICH2]

349 Tenpō Calendar

See also *Japanese calendars*.

This lunisolar calendar was used in Japan from 1844 to 1872. The year had 355 days, and a leap month was added seven times in a 19-year cycle. The months were either 29 or 30 days and were calculated to match the actual lunar cycle.

Main sources: [GOOD2] and [NUSS]

350 Tewan Pueblo Calendar

This calendar was used by the Tewa speaking Pueblo people in southwestern New Mexico.

The names of the months:

1. ?
2. Moon of the cedar dust wind, = ~ February
3. Moon when the leaves break forth, = ~ March
4. ?
5. ?
6. Moon when the leaves are dark green, = ~ June
7. ?
8. ?
9. Moon when the corn is taken in, = ~ September
10. ?
11. Moon when all is gathered in,= ~ November
12. ?

Internet source: www.everyculture.com

351 (Old) Thai Calendars

There were many types of calendars in use during the thirteenth to fifteenth centuries in present-day Thailand. See also *Buddhist calendars*.

352 Thai Lunar Calendar

See *Dai calendar*.

353 Thai Solar Calendar

See *Suriyakhati calendar*.

354 (Ancient) Thessalian Calendar

This lunisolar calendar was used in Thessaly during ancient times.

The names of the months:

1. Ἰτώνιος Itonios, June/July or August/September
2. Πάναμος Panamos, July/August or September/October
3. θεμίστιο Themistios, August/September or October/November
4. Αγαγυλιοσ Agagylios, September/October or November/December
5. Ἀπολλώνιος Apollonios, October/November or December/January
6. Ἑρμαίος Hermaios, November/December or January/February
7. Λεσχανόριος Leschanorios, December/January or February/March
8. Ἄφριος Aphrios, January/February or March/April
9. Θυῖος Thuios, February/March or April/May
10. Ὁμολώιος Homoloios, March/April or May/June
11. Ἱπποδρόμιος Hippodromios, April/May or June/July
12. φυλλικός Phyllikos, May/June or July/August

The names of the months according to [GINZ]:

1. Panamos, = ~ August
2. Hermaios, = ~ September
3. Itonios, = ~ October
4. Euonios, = ~ November
5. Themistios, = ~ December

6. Hyperoios, = ~ January
7. Leschanorios, = ~ February
8. Aphrios, = ~ March
9. Thyos, = ~ April
10. Homoloios, = ~ May
11. Hippodromios, = ~ June
12. Phyllikos, = ~ July

Main sources: [GINZ] and [GRAN5]

355 Tibetan Calendar

This is a lunisolar calendar used in Tibet. The year is composed of 12 months, each beginning with a new moon, but an extra 13th month is added every 2 or 3 years, making an average year equal to the solar year.

Each year is associated with an animal and an element, and each element is associated with two consecutive years, a male aspect and a female aspect. The animals have the following order in the Chinese system: rabbit, dragon, snake, horse, sheep, monkey, rooster, dog, pig, mouse, bull, and tiger. This system of animal years started in about 641, under the influence of the teachings of the Chinese princess Wencheng, who then married the Tibetan king, Songtsän Gampo (617–649). The five elements ('byung-ba lnga) that are associated with the years in the Chinese system have the following order: wood, fire, earth, iron, and water. This Chinese cycle, རྒྱ་རྩིས་སྐོར། or *zhugju gor*, started with a Male-Wood-Mouse-year (in 1024).

A second cycle, རབ་བྱུང་། or *rab-byung*, is based on the Sri Kalachakra Tantra ('Wheel of Time Tantra'), which was translated into Tibetan from Sanskrit in 1027. The animals have the following order in the Kalachakra system: hare, dragon, snake, horse, sheep, monkey, bird, dog, pig, rat, ox, and tiger. The four elements ('byung-ba bzhi) that are associated with the years in the Kalachakra system have the following order: fire, wind, earth, and water. The first year of the first cycle started with a Female-Fire-Rabbit-year (in 1027).

The *zhugju gor*-cycle:

1. Male-Wood-Rat, 2. Female-Wood-Bull, 3. Male-Fire-Tiger, 4. Female-Fire-Rabbit, 5. Male-Earth-Dragon, 6. Female-Earth-Snake, 7. Male-Iron-Horse, 8. Female-Iron-Sheep, 9. Male-Water-Monkey, 10. Female-Water-Rooster, 11. Male-Wood-Dog, 12. Female-Wood-Pig, 13. Male-Fire-Rat, 14. Female-Fire-Bull, 15. Male-Earth-Tiger, 16. Female-Earth-Rabbit, 17. Male-Iron-Dragon, 18. Female-Iron-Snake, 19. Male-Water-Horse, 20. Female-Water-Sheep, 21. Male-Wood-Monkey, 22. Female-Wood-Rooster, 23. Male-Fire-Dog, 24. Female-Fire-Pig, 25. Male-Earth-Rat, 26. Female-Earth-Bull, 27. Male-Iron-Tiger, 28. Female-Iron-Rabbit, 29. Male-Water-Dragon, 30. Female-Water-Snake, 31. Male-Wood-Horse, 32. Female-Wood-Sheep, 33. Male-Fire-Monkey, 34. Female-Fire-Rooster, 35. Male-Earth-Dog, 36. Female-Earth-Pig, 37. Male-Iron-Rat, 38. Female-Iron-Bull, 39. Male-Water-Tiger, 40. Female-Water-Rabbit, 41. Male-Wood-Dragon, 42. Female-Wood-Snake, 43. Male-Fire-Horse, 44. Female-Fire-Sheep, 45. Male-Earth-Monkey, 46. Female-Earth-Rooster, 47. Male-Iron-Dog, 48. Female-Iron-Pig, 49. Male-Water-Rat, 50. Female-Water-Bull, 51. Male-Wood-Tiger, 52. Female-Wood-Rabbit, 53. Male-Fire-Dragon, 54. Female-Fire-Snake, 55. Male-Earth-Horse, 56. Female-Earth-Sheep, 57. Male-Iron-Monkey, 58. Female-Iron-Rooster, 59. Male-Water-Dog, and 60. Female-Water-Pig.

The *rab-byung*-cycle:

1. Female-Fire-Rabbit, 2. Male-Wind-Dragon, 3. Female-Wind-Snake, 4. Male-Earth-Horse, 5. Female-Earth-Sheep, 6. Male-Water-Monkey, 7. Female-Water-Rooster, 8. Male-Fire-Dog, 9. Female-Fire-Pig, 10. Male-Wind-Mouse, 11. Female-Wind-Bull, 12. Male-Earth-Tiger, 13. Female-Earth-Rabbit, 14. Male-Water-Dragon, 15. Female-Water-Snake, 16. Male-Fire-Horse, 17. Female-Fire-Sheep, 18. Male-Wind-Monkey, 19. Female-Wind-Rooster,

20. Male-Fire-Dog, 21. Female-Fire-Pig, 22. Male-Wind-Mouse, 23. Female-Wind-Bull, 24. Male-Earth-Tiger, 25. Female-Earth-Rabbit, 26. Male-Water-Dragon, 27. Female-Water-Snake, 28. Male-Fire-Horse, 29. Female-Fire-Sheep, 30. Male-Wind-Monkey, 31. Female-Wind-Rooster, 32. Male-Earth-Dog, 33. Female-Earth-Pig, 34. Male-Iron-Mouse, 35. Female-Iron-Bull, 36. Male-Water-Tiger, 37. Female-Water-Rabbit, 38. Male-Wood-Dragon, 39. Female-Wood-Snake, 40. Male-Fire-Horse, 41. Female-Fire-Sheep, 42. Male-Earth-Monkey, 43. Female-Earth-Rooster, 44. Male-Iron-Dog, 45. Female-Iron-Pig, 46. Male-Water-Mouse, 47. Female-Water-Bull, 48. Male-Wood-Tiger, 49. Female-Wood-Rabbit, 50. Male-Fire-Dragon, 51. Female-Fire-Snake, 52. Male-Earth-Horse, 53. Female-Earth-Sheep, 54. Male-Iron-Monkey, 55. Female-Iron-Rooster, 56. Male-Water-Dog, 57. Female-Water-Pig, 58. Male-Wood-Mouse, 59. Female-Wood-Bull, and 60. Male-Fire-Tiger.

During the Yar-lung Dynasty (618–841), Tibetan months were named according to the four seasons:

1. dpyid-zla ra-ba (first spring month)
2. dpyid-zla ‘bring-po (middle spring month)
3. dpyid-zla mtha’-chung (last spring month)
4. dbyar-zla-zla ra-ba (first summer month)
5. dbyar-zla ‘bring-po (middle summer month)
6. dbyar-zla mtha’-chung (last summer month)
7. ston-zla ra-ba (first autumn month)
8. ston-zla ‘bring-po (middle autumn month)
9. ston-zla mtha’-chung (last autumn month)
10. dgun-zla ra-ba (first winter month)
11. dgun-zla ‘bring-po (middle winter month)
12. dgun-zla mtha’-chung (last winter month)

As the *rab-byung* was introduced during the late eleventh century, the months were also named according to lunar constellations:

1. mchu’i zla-ba
2. dbo’i zla-ba
3. nag-pa’i zla-ba
4. sa-ga’i zla-ba
5. snron-gyi zla-ba
6. chu-stod-kyi zla-ba
7. gro-bzhin-gyi zla-ba
8. khrums-stod-kyi zla-ba
9. tha-skar-gyi zla-ba
10. smin-drug-gi zla-ba
11. mgo’i zla-ba
12. rgyal-gyi zla-ba

1. da̲wa tha̲n̲gpo (Wylie : *zla-ba dang-po*) API : da˩.wa tʰãŋ˩.po ~ February
2. da̲wa nyīpaor dawa nyīwa (*zla-ba gnyis-pa*)—da˩.wa ɲi˥.pa ~ March
3. da̲wa sūmpa (*zla-ba gsum-pa*)—da˩.wa sum˥.pa ~ April
4. da̲wa shi̲pa (*zla-ba bzhi-pa*)—da˩.wa ʃi˩.pa ~ May
5. da̲wa ngāpa (*zla-ba lnga-pa*)—da˩.wa ŋa˥.pa ~ June
6. da̲wa thru̲kpa (*zla-ba drug-pa*)—da˩.wa tʰɽuk˩.pa ~ July
7. da̲wa dünpa (*zla-ba bdun-pa*)—da˩.wa dyn˩.pa ~ August
8. da̲wa gye̲pa (*zla-ba brgyad-pa*)—da˩.wa gyɛ˩.pa ~ September
9. da̲wa gu̲pa (*zla-ba dgu-pa*)—da˩.wa gu˩.pa ~ October
10. da̲wa cūpa (*zla-ba bcu-pa*)—da˩.wa tʃu˥.pa ~ November
11. da̲wa cūkcikpa (*zla-ba bcu-gcig-pa)*—da˩.wa tʃuk˥.tʃik.pa ~ December
12. da̲wa cūknyipa (*zla-ba bcu-gnyis-pa*)—da˩.wa tʃuk˥.ɲi.pa ~ January

Since the twelfth century, each month has been named according to the 12 animals of the Chinese zodiac:

1. ‘brug (dragon)
2. sbrul (snake)
3. rta (horse)
4. lug (goat)
5. spre’u (monkey)
6. bya (rooster)
7. khyi (dog)
8. phag (pig)

9. byi (rat)
10. glang (bull)
11. stag (tiger)
12. yos (rabbit)

A system of counting the months by ordinal numbers was introduced by the first vice-king of Tibet, Drogön Chögyal Phagpa (1235–1280), during the late thirteenth century:

1. hor-zla dang-po
2. hor-zla gnyis-pa
3. hor-zla gsum-pa
4. hor-zla bzhi-pa
5. hor-zla lnga-pa
6. hor-zla drug-pa
7. hor-zla bdun-pa
8. hor-zla brgyad-pa
9. hor-zla dgu-pa
10. hor-zla bcu-pa
11. hor-zla bcu-gcig-pa
12. hor-zla bcu-gnyis-pa

The names of the weekdays, based on the Tibetan planetary names:

1. ཟའ་ཉི་མ་ *gza' nyi ma*, planet Sun, = Sunday
2. ཟའ་ཟླ་བ་ *gza' zla ba*, planet Moon, = Monday
3. གཟའ་མིག་དམར་ *gza' mig dmar*, planet Mars, = Tuesday
4. ཟའ་ལྷག་པ་ *gza' lhag pa*, planet Mercury, = Wednesday
5. ཟའ་ཕུར་བུ། *gza' phur bu*, planet Jupiter, = Thursday
6. གཟའ་པ་སངས་ *gza' pa sangs*, planet Venus, = Friday
7. ཟའ་སྤེན་པ་ *gza' spen pa*, planet Saturn, = Saturday

Each day is divided into 12 periods:

1. nam-langs yos (dawn hare-period) 5:00–7:00
2. nyi-shar 'brug (sunrise dragon-period) 7:00–9:00
3. nyi-dros sbrul (morning snake-period) 9:00–11:00
4. nyin-phyed rta (noon horse-period) 11:00–13:00
5. phyed-yol lug (early afternoon sheep-period) 13:00–15:00
6. nyi-myur sprel or bkong-bya sprel (late afternoon monkey-period) 15:00–17:00
7. nyi-nub bya (sunset bird-period) 17:00–19:00
8. sa-sros khyi (dusk dog-period) 19:00–21:00
9. srod-'khor phag (after dusk pig-period) 21:00–23:00
10. nam-phyed byi (midnight rat-period) 23:00–1:00
11. phyed-yol glang (after midnight ox-period) 1:00–3:00
12. ho-rangs stag (false dawn tiger-period) 3:00–5:00

Traditionally, the solar day is also subdivided according to the table below

					Equal to
Solar day					1440 min
60	nāḍī, ghaṭikā, daṇḍa, or chu tshod				24 min
3600	60	pāṇīpala, pala, or chu srang			24 s
21,600	360	6	śvāsa		4 s
15,271,200	254,520	4242	707	bhāga	$5\frac{2}{3}$ ms

Main sources: [HENN3], [JANS5], [LAUF], [PELL], [SCHU2], [SCHU3], and [YAMA]

356 Tirhuta Panchang

See *Maithili calendar*.

357 Tlingit Calendar

This calendar was used by the Tlingit people on the Pacific Northwest Coast of the U.S.A.

The names of the months:

1. T aawak Dis (goose Moon), = ~ January
2. S eek Dis (black bear Moon), = ~ February
3. Héentáanáx Kayaan i Dis (underwater plants sprout Moon), = ~ March
4. X eigaa Kayaani Dis (budding Moon of plants and shrubs), = ~ April
5. At gadaxéet yinas Dis (Moon before pregnancy), = ~ May
6. At gadaxéet Dis (birth Moon), = ~ June
7. Xaat Disi (salmon Moon), = ~ July
8. Sha-ha-yi (berries ripe on mountain Moon), = ~ August
9. Dis Yádi (young animals Moon), = ~ September
10. Dis Tlein (big Moon), = ~ October
11. Kukahaa Dis (scraping Moon), = ~ November
12. Shanáx Dis (unborn seals are getting hair Moon), = ~ December

Main source: [GARZ]

358 Tofalar Calendar

This lunar calendar was used among the Tofalars in southeastern Siberia.

The names of the months:

1. month of the low grass (starting in early May)
2. birch-bark month
3. month in which the lily-bulb is red
4. month in which the lily-bulb is dug up
5. month when the cedar is tapped with the hammer in order to shake down the ripe cones with the nuts
6. reindeer-buck rutting month
7. month when the people begin to trap sables
8. month of the long rest
9. month of the frost
10. great frost month
11. month when deer and elks are hunted in snow-shoes
12. month when the snow becomes sticky
13. month in which people hunt with dogs

Later, due to the influence of the Russian 12-month calendar, this calendar became a 12-month calendar. Below are listed two examples of local calendars.

The names of the months (in the hunting/gathering calendars):

1. great white month /empty month, = ~ January
2. small white month /big log month, = ~ February
3. hunting with dogs month /tree bud month, = ~ March
4. tree bud month /good birch bark collecting month, = ~ April
5. hunting in the taiga month /digging saranki root month, = ~ May
6. (forgotten)/bad birch bark collecting month, = ~ June
7. hay cutting month /hay cutting month, = ~ July
8. (forgotten)/collecting saranki month, = ~ August
9. preparing skins month /preparing skins month, = ~ September
10. rounding up male steer month /move Autumn campsite month, = ~ October
11. sable hunting month /junting month, = ~ November
12. cold month /braiding (rope making) month, = ~ December

Main sources: [HARR4] and [NILS]

359 (Old) Tokelau Calendar

This lunar calendar was used on Tokelau in the South Pacific Sea.

The names of the months:

1. palolo muamua, = ~ June
2. palolo lua, = ~ July

3. mulifa, = ~ August
4. takaogna, = ~ September
5. selinga muamua, = ~ October
6. selinga lua, = ~ November
7. utua muamua, = ~ December
8. utua lua, = ~ January
9. vainoa, = ~ late January
10. fakaafu, = ~ February
11. ?, = ~ March
12. oaunono, = ~ April
13. oloamanu, = ~ May

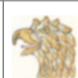
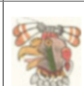
Main source: [WILL8]

360 Tonalpohualli Calendar

See also *Xiuhpohualli calendar*.

This 260-day sacred calendar was used by the Aztec cultures in pre-Columbian Mesoamerica. The calendar used two independent cycles, a 13-day count and a 20-name cycle. Both the number and day sign would be incremented, after which the cycle of numbers would restart, even though the 20-day signs had not yet been exhausted, e.g., 13 Ācatl was followed by 1 Ocēlōtl, 2 Cuāuhtli, and so on. There was no system for distinguishing one tonalpohualli calendar cycle from another. A day was called a *tonal*.

The names of the 20 day names and signs according to the *Codex Magliabechiano* from mid-sixteenth century:

	Sign (*trecena*)	Name	Protected by
1		Cipactli (Crocodile)	Tonacatecuhtli
2		Ehēcatl (Wind)	Quetzalcoatl
3		Calli' (House)	Tepeyollotl
4		Cuetzpalin (Lizard)	Huehuecoyotl
5		Cōātl (Snake)	Chalchihuitlicue
6		Miquiztli (Death)	Tecciztecatl
7		Mazātl (Deer)	Tlaloc
8		Tōchtli (Rabbit)	Mayahuel
9		Ātl (Water)	Xiuhtecuhtli
10		Itzcuintli (Dog)	Mictlantecuhtli
11		Ozomahtli (Monkey)	Xochipili
12		Malīnalli (Grass)	Patecatl
13		Ācatl (Reed)	Tezcatlipoca
14		Ocēlōtl (Jaguar)	Tlazolteotl
15		Cuāuhtli (Eagle)	Xipe Totec
16		Cōzcacuāuhtli (Vulture)	Itzpapalotl
17		Ollīn (Movement)	Xolotl
18		Tecpatl (Stone Knife)	Chalchihuihtotolin
19		Quiahuitl (Rain)	Tonatiuh
20		Xōchitl (Flower)	Xochiquetzal

Main sources: [DERS], [JIMÉ2], and [VANT]

Internet source: Signs from WikiCommon

361 (Old) Tongan Calendars

This lunatic calendar was used on Tongareva. The year consisted of 12 months, but was sometimes composed of 13 months.

The names of the seasons:

1. Faahi tau mafana = summer
2. Faahi tau momoke, = winter

The names of the months according to [CAIL]:

1. Liha Mu'a, = ~ December
2. Liha Mui, = ~ January
3. Vai Mu'a, = ~ February
4. Vai Mui, = ~ March
5. Faka'afu Mo'ui, = ~ April
6. Faka'afu Mate, = ~ May
7. Hilinga Kelekele, = ~ June
8. Hilinga Mea'a, = ~ July
9. 'Ao'ao, = ~ August
10. Fu'Ufu'Unekinanga, = ~ September
11. 'Uluenga, = ~ October
12. Tanumanga, = ~ November
13. 'O'Oamofanongo, = Intercalary month added to keep up with the solar year

Main sources: [CAIL] and [MACG2]

362 Tranquility Calendar

This solar calendar was proposed by Jeff Siggins in 1989. The year consists of 13 months of 28 days each, with one extra day added at the end of the year. This day is not part of any month or week. Approximately every 4 years, an extra leap day is added. The year 1 A.T. (After Tranquility) began on the Moon Landing Day, July 20, 1969, on Archimedes 1. The intercalary day, corresponding to February 29, is known as Aldrin Day for the moon-walker Edwin "Buzz" Aldrin, and falls between Hippocrates 27 and Hippocrates 28.

The names of the months:

1. Archimedes, = 21 July to 17 August
2. Brahe, = 18 August to 14 September
3. Copernicus, = 15 September to 12 October
4. Darwin, = 13 October to 9 November
5. Einstein, = 10 November to 7 December
6. Faraday, = 8 December to 4 January
7. Galileo, = 5 January to 1 February
8. Hippocrates, = 2 February to 1 March
9. Imhotep, = 2 March to 29 March
10. Jung, = 30 March to 26 April
11. Kepler, = 27 April to 24 May
12. Lavoisier, = 25 May to 21 June
13. Mendel, = 22 June to 19 July

Main source: [SIGG]

363 Tripuri Calendar

This traditional calendar was used by the Tripuri people in the Tripura Kingdom, which became part of the Indian Union in 1949. Its era, Tripurabda, was set at April 15, 590.

Main sources: [DEBB] and [SIRC2]

364 (Old) Trobriand Calendar

This traditional lunar and seasonal calendar is used on the Kiriwina Islands (also formerly called the Trobriand Islands). The year consists of 12 or 13 lunations and is thought of as a full-cycle of gardening. It generally lists 10 months, whose names it correlates with horticultural activities. Tribes grow different staple crops in four districts, and though they share the language and the names of the months, their harvest months are staggered, and which named month it is differs from one district to another. To keep the lunar calendar in sync with the seasons, one or two extra months are added and the months are renamed afterwards.

The Northern Kiriwina and Kudowa	Kitava	The Southern and main land of Kiriwina	Vakuta
Kuluwasasa	*Yakosi*	*Ilebisila*	Utokakana
Milamala	Kuluwasasa	*Yakosi*	*Ilebisila*
Yakosi	Milamala	Kuluwasasa	*Yakosi*
Yavatakulu	Yakosi	Milamala	Kuluwasasa
Toliyavata	Yavatakulu	Yakosi	Milamala
Yavatamwa	Toliyavata	Yavatakulu	Yakosi
Galivilai	Yavatamwa	Toliyavata	Yavatakulu
Bulumaduku	Galivilai	Yavatamwa	Toliyavata
Kuluwotu	Bulumaduku	Galivilai	Yavatamwa
Utokakana	Kuluwotu	Bulumaduku	Galivilai
Ilebisila	Utokakana	Kuluwotu	Bulumaduku
Yakosi	*Ilebisila*	Utokakana	Kuluwotu
Kuluwasasa	*Yakosi*	*Ilebisila*	Utokakana
Milamala	Kuluwasasa	*Yakosi*	*Ilebisila*
Yakosi	Milamala	Kuluwasasa	*Yakosi*
Yavatakulu	Yakosi	Milamala	Kuluwasasa
Toliyavata	Yavatakulu	Yakosi	Milamala
Yavatamwa	Toliyavata	Yavatakulu	Yakosi

Once a year, the spawning marine annelid (Leodice viridis), called the “milamala” by natives, is seen on the surface of the sea at the southern Vakuta following the full moon that falls between October 15 and November 15 (Gregorian time). Trobrianders celebrate a great festival in the honour of the sea worm, to inaugurate the planting season. If the milamala fail to appear at the full moon of the Milamala month, the month is repeated as an epgagomenal month.

This festival was held 1 month earlier in the southern and main land part of Kiriwina, 2 months earlier in Kitava and the outlaying islands to the south, and 3 months earlier in the northern Kiriwina.

Main sources: [ASCH], [BÖDE], and [MALI]

365 (Old) Tuamotuan Calendar

This seasonal calendar was used on the Tuamotus in French Polynesia. Only some words referring to seasonal periods are known.

Some seasons/periods:

1. kauunu (the season about February)
2. paroro (the time of dearth)
3. ruaroa (the summer solstice)
4. manu (the season of summer)
5. kaukume (the season of plenty)
6. kamitika (the season about September)
7. ruapoto (the winter solstice)

Main source: [WILL8]

366 (Old) Tulunadu Calendar

This solar and agricultural calendar was used in Tulu Nadu, the regions of Southwest Karnataka and Northern Kerala in India. The year was known as a *Varsa* or *Vorsa*, and the first day of the year was known as *Bisu* (= ~ 14 April).

The names of the months:

1. Paggu, = ~ mid-April–mid-May
2. Besa, = ~ mid-May–mid-June
3. Kaartel, = ~ mid-June–mid-July
4. Aati, = ~ mid-July–mid-August
5. Sona, = ~ mid-August–mid-September
6. Nirnaala, = ~ mid-September–mid-October
7. Bontyolu, = ~ mid-October–mid-November
8. Jaarde, = ~ mid-November–mid-December
9. Peraarde, = ~ mid-December–mid-January

10. Ponny or Puyinthel, = ~ mid-January–mid-February
11. Maayi, = ~ mid-February–mid-March
12. Suggi, = ~ mid-March–mid-April

Main source: [BURN2]

367 (Old) Tumxuk Calendar

This calendar was used in the western part of Xinjiang. The months were named according to numbers or name. According to [YARS], only three names are known: Ahverjane, Buzadine, and Tsvizānañye.

Main source: [YARS]

368 Tun-Uc Calendar

This calendar was used by the Maya people in pre-Columbian Mesoamerica. It used a 28-day cycle that mirrors the women's menstrual cycle, and that was further divided into four smaller cycles of approximately 7 days each. These shorter cycles are the four phases of the Moon.

Main sources: [MEN] and [ZOSI]

369 (Ancient) Tyrean Calendar

This lunisolar calendar was used in Tyre, in present-day Lebanon, after the fourth century BCE.

The names of the months:

1. Ὑπερβερεταῖος Hyperberetaios, 19 October–17 November (30 days)
2. Δίος Dios, 18 November–17 December (30 days)
3. Ἀπελλαῖος Apellaios, 18 December–16 January (30 days)
4. Αὐδυναῖος Audynaios, 17 January–15 February (30 days)
5. Περίτιος Peritios, 16 February–17 March (30 days)
6. Δύστρος Dystros, 18 March–17 April (31 days)
7. Ξανθικός Xanthikos, 18 April–18 May (31 days)
8. Ἀρτεμίσιος Artemisios, 19 May–18 June (31 days)
9. Δαίσιος Daisios, 19 June–19 July (31 days)
10. Πάνημος Panemos, 20 July–19 August (31 days)
11. Λώιος Looios, 20 August–18 September (30 days)
12. Γορπιαῖος Gorpiaios, 19 September–18 October (30 days)

Main source: [GINZ]

370 Tzek'eb

This ancient Pleiadian calendar, also known as the Great Calendar of the Sun, was used by the Maya people in pre-Columbian Mesoamerica. It consisted of a 26,000-year cycle, or 9,496,500 days, representing the revolution of our Sun around Alcyone A, the central star of the Pleiades.

Main source: [MEN]

371 Tzolk'in

This is the ancient Mayan version of the Mesoamerican 260-day calendar called a Sacred Round. It consisted of a smaller wheel of 13 glyphs rotated within a large wheel of 20 days, resulting in a 260-day year that meets the Haab calendar (see this entry) at the end of 52 solar years.

The Tzolk'in was probably the oldest, dating back to at least 600 BCE, and most important calendar. It was based on the 9-month human gestation period, but also tied several celestial events together, including the configuarion of Mars and appearances of Venus.

The Tzolk'in was made up of a set of 20 day names and 13 numerals. There was also a unique day name for each of the 260 days, and there were no weeks or months.

The names of the 20 days (glyphs in monumental style and in Mayan codex style):

1.  Imix' or Im'ix
2.  Ik' or Iq
3.  Ak'bal or Aq'ab'al
4.  K'an or K'at
5.  Chikchan, Chicchan, or Kaan
6.  Kimi, Cimi, or Kame
7.  Manik' or Kiej
8.  Lamat or Q'aniel
9.  Muluk, Muluc, or Toj
10.  Ok, Oc, or Toj
11.  Chuwen, Chuen, or B'aatz
12.  Eb' or Eey'
13.  B'en or Aaj
14.  Ix or Ix-B'alam
15.  Men or Tz'ikin
16.  Kin, Kib' or Cib
17.  Kab'an or Caban
18.  Etz'nab' or Tijax
19.  K'awak or Cauac
20.  Ahaw, Ajaw, or Ahau

The calendar combines the 20 day names with the 13 *uninales* (numbers) of the trecena cycle to produce the 260 unique *kines* (days).

Day names[a]	1	2	3	4	5	6	7	8	9	10	11	12	13
Imix'	1	8	2	9	3	10	4	11	5	12	6	13	7
Ik'	2	9	3	10	4	11	5	12	6	13	7	1	8
Ak'b'al	3	10	4	11	5	12	6	13	7	1	8	2	9
K'an	4	11	5	12	6	13	7	1	8	2	9	3	10
Chikchan	5	12	6	13	7	1	8	2	9	3	10	4	11
Kimi	6	13	7	1	8	2	9	3	10	4	11	5	12
Manik'	7	1	8	2	9	3	10	4	11	5	12	6	13
Lamat	8	2	9	3	10	4	11	5	12	6	13	7	1
Muluk	9	3	10	4	11	5	12	6	13	7	1	8	2
Ok	10	4	11	5	12	6	13	7	1	8	2	9	3
Chuwen	11	5	12	6	13	7	1	8	2	9	3	10	4
Eb'	12	6	13	7	1	8	2	9	3	10	4	11	5
B'en	13	7	1	8	2	9	3	10	4	11	5	12	6
Ix	1	8	2	9	3	10	4	11	5	12	6	13	7
Men	2	9	3	10	4	11	5	12	6	13	7	1	8
K'ib'	3	10	4	11	5	12	6	13	7	1	8	2	9
Kab'an	4	11	5	12	6	13	7	1	8	2	9	3	10
Etz'nab'	5	12	6	13	7	1	8	2	9	3	10	4	11
Kawak	6	13	7	1	8	2	9	3	10	4	11	5	12
Ajaw	7	1	8	2	9	3	10	4	11	5	12	6	13

[a]Day-names according to: Academia de las Lenguas Mayas de Guatemala. *Lenguas Mayas de Guatemala: Documento de referencia para la pronunciación de los nuevos alfabetos oficiales*. Guatemala City: Instituto Indigenista Nacional, 1988

Main sources: [KETT], [MALM], and [WEEK]

372 Vaiṣṇava Calendar

See *Gaurabda calendar*.

373 Venda Calendar

This lunisolar calendar is used by the Venda people in South Africa and Zimbabwe.

The names of the seasons:

1. tshilimo, = summer, ~ December–February
2. tshifhefho, = autumn, ~ March–May
3. vhuriha, = winter, ~ June–August
4. lutavula, = spring, ~ September–November

The names of the months:

1. Phando, = ~ January
2. Luhuhi, = ~ February
3. Thafamuhwe, = ~ March
4. Lambamai, = ~ April
5. Shundunthule, = ~ May
6. Fulwi, = ~ June
7. Fulwana, = ~ July
8. Thangule, = ~ August
9. Khubvumedzi, = ~ September
10. Tshimedzi, = ~ October
11. Lara, = ~ November
12. Nyendavhusiku, = ~ December

The names of the weekdays:

1. Swondaha, = Sunday
2. Musumbuluwo, = Monday
3. Ḽavhuvhili, = Tuesday
4. Ḽavhuraru, = Wednesday
5. Ḽavhuṇa, = Thursday
6. Ḽavhuṱanu, = Friday
7. Mugivhela, = Saturday

Main sources: [WARM] and [ZIER]

374 (Old) Vietnamese Calendars

This lunisolar calendar was formerly used in Vietnam. These calendars were used for determining the times of planting, harvesting, and festival occasions. The Chinese Shoushi calendar was introduced to the Vietnamese Trần Dynasty, by the Chinese Yuan dynasty, in 1324. In 1339, the name for the Shoushi calendar was changed to the Hiệp-kỷ calendar, but there were no changes of the calculation methods. In 1401, a new calendar, the Thuận-thiên calendar, was introduced. The Datong calendar was introduced in 1413, and in 1813, another calendar, called the Hiệp-kỷ, essentially the Shíxiàn calendar, was introduced by the Chinese Qing dynasty. This calendar was in official use until 1954, when the Gregorian calendar was introduced by the French.

The era began with the year 2637 BCE. A year consisted of 355 days and 12 months of 29 or 30 days each. The difference with the solar year was made up every 19 years by adding seven extra lunar months. Approximately every third year, an intercalary month with 30 days was included between the third and fourth months.

The lunar months were further divided into 24 solar divisions distinguished by the four seasons and times of heat and cold. The calendar was also divided into 60-year periods, called *Hoi*, and the 60-year period was divided into one 10-year cycle and one 12-year cycle. The 10-year cycle, called *Can*, was composed of 10 heavenly stems, while the 12-year cycle, called *Ky*, represented the names of the 12 zodiac signs.

Each year was named as a combination of one of the names of the ten heavenly stems and one of the names of the 12 earthly stems.

The names of the ten heavenly stems:

1. giáp—(wood—yang)
2. ất—(wood—ying)
3. bính—(fire—yang)
4. đinh—(fire—ying)
5. mậu—(earth—yang)
6. kỷ—(earth—ying)
7. canh—(metal—yang)
8. tân—(metal—ying)

9. nhâm—(water—yang)
10. quý—(water—ying)

The names of the 12 earthly stems:

1. tý (rat)
2. sửu or trâu (water buffalo)
3. dần (tiger)
4. mão or mẹo (cat)
5. thìn (dragon)
6. tỵ (snake)
7. ngọ (horse)
8. mùi (goat)
9. thân (monkey)
10. dậu (rooster)
11. tuất (dog)
12. hợi (pig)

The names of the seasons:

1. 务冬 mùa đông, = winter
2. 务春 mùa xuân, = spring
3. 务夏 mùa hạ, = summer
4. 务秋 mùa thu, = autumn

Main sources: [HUNG] and [NGUY]

375 Vikram Samvat

Until the eighth century, this was usually called the **Malvesh Samvat**. See also *Bikram Samwat* and *Hindu calendars*.

This Hindu calendar is used in Northern India. The year, equal to 354 days and 9 hours, begins with the first day after the new moon, in the month of Chaitra, which usually falls in late March or early April. The days start at Sunrise and last up to the Sunrise of the next day.

The names of the seasons:

1. vasanta (spring), contains Chaitra and Vaisakha
2. grishma (windy), contains Jyeshtha and Aashaadha
3. varsha (rainy), contains Shraawan and Bhadrapada
4. saradrutu (winter), contains Ashvin and Kartika
5. himanta (cold), contains Aghrahaayan and Paush
6. sasira (dropping of leaves), contains Magha and Phalgun

The names of the months in Devanagari:

1. चैत्र Chaitra, = 22 March–20 April, in leap year from 21 March (30 or 31 days)
2. वैशाख Vaisakha, = 21 April–21 May (31 days)
3. जेष्ठ Jyeshtha, = 22 May–21 June (31 days)
4. आषाढ़ Aashaadha, = 22 June–22 July (31 days)
5. श्रवण or सावन Shraawan, = 23 July–22 August (31 days)
6. भाद्रपद or भादो Bhadrapada, = 23 August–22 September (31 days)
7. आश्विन Ashvin, = 23 September–22 October (30 days)
8. कार्तिक or कातिक Kartika, = 23 October–21 November (30 days)
9. अग्रहण or अगहन Aghrahaayan, = 22 November–21 December (30 days)
10. पौष or पूस Paush, = 22 December–20 January (30 days)
11. माघ Magha, = 21 January–19 February (30 days)
12. फाल्गुन or फागुन Phalgun, = 20 February–21 March, in leap year it ends at 20 March (30 days)

Main source: [SHUK]

376 (Old) West Frisian Calendar

This agricultural lunisolar calendar was used along the North Sea coast of the Netherlands until at least the ninth century. See also (Old) *Frisian calendar*.

The names of the months:

1. Foarmoanne, = ~ January
2. Sellemoanne, = ~ February
3. Foarjiersmoanne, = ~ March
4. Gersmoanne, = ~ April
5. Blommemoanne, = ~ May
6. Simmermoanne, = ~ June

7. Heamoanne, = ~ July
8. Rispmoanne, = ~ August
9. Hjerstmoanne, = ~ September
10. Wynmoanne, = ~ October
11. Slachtmoanne, = ~ November
12. Wintermoanne, = ~ December

The names of the seasons:

1. winter, = winter
2. fear, = spring
3. simmer, = summer
4. hjest, = autumn

The names of the weekdays:

1. Snein, = Sunday
2. Moandei, = Monday
3. Tiisdei, = Tuesday
4. Woansdei, = Wednesday
5. Tongersdei, = Thursday
6. Freed, = Friday
7. Sneon or Saterdei, = Saturday

Main source: [HAAN]

377 Wetonan Calendar

This calendar is used by the Javanese, Madurese, and Sundanese people. It was inaugurated by Sultan Agung of Mataram (r. 1613–1645) in 1633.

The names of the days in the Arabic 7-day week:

1. Minggu, = Sunday
2. Senén, = Monday
3. Selasa, = Tuesday
4. Rebo, = Wednesday
5. Kemis, = Thursday
6. Jumaah, = Friday
7. Saptu, = Saturday

Superimposing this 7-day week onto the 5-day *pasaran* week makes the 35-day Wetonan cycle, which repeats itself *ad infinitum* every 35 days[2]:

[2] The days are numbered for convenience only. Javanese recognize no fixed starting day.

1. Senin Legi, 2. Selasa Pahing, 3. Rebo Pon, 4. Kemis Wagé, 5. Jumat Kliwon, 6. Setu Legi, 7. Minggu Pahing, 8. Senin Pon, 9. Selasa Wagé, 10. Rebo Kliwon, 11. Kemis Legi, 12. Jumat Pahing, 13. Setu Pon, 14. Minggu Wagé, 15. Senin Kliwon, 16. Selasa Legi, 17. Rebo Pahing, 18. Kemis Pon, 19. Jumat Wagé, 20. Setu Kliwon, 21. Minggu Legi, 22. Senin Pahing, 23. Selasa Pon, 24. Rebo Wagé, 25. Kemis Kliwon, 26. Jumat Legi, 27. Setu Pahing, 28. Minggu Pon, 29. Senin Wagé, 30. Selasa Kliwon, 31. Rebo Legi, 32. Kemis Pahing, 33. Jumat Pon, 34. Setu Wagé, and 35. Minggu Kliwon.

This cycle makes up the most typical Javanese "months." It has no fixed starting or ending point, and successive groups of 35 days are neither assigned names nor grouped into a Javanese "year." This cycle figures prominently in a great number of traditional divinitory systems, from predicting human character, fate, and vocational talents, to determining compatible partners in marriage, and gambling strategies. It also figures in the timing of many ritual meals (*slametan*). This 365-day cycle is divided into 12 "seasons" (*mangsa*) of uneven length, whose names simply translate as the ordinal numbers 1–12.

The names of the months:

1. Mangsa Kaso (starting 23 June) (41 days)
2. Mangsa Karo (starting 3 August) (23 days)
3. Mangsa Katelu (starting 26 August) (24 days)
4. Mangsa Kapat (starting 19 September) (25 days)
5. Mangsa Kalima (starting 14 October) (27 days)
6. Mangsa Kanem (starting 11 November) (43 days)
7. Mangsa Kapitu (starting 23 December) (43 or 44 days)
8. Mangsa Kawolu (starting 4 or 5 February) (27 days)
9. Mangsa Kasanga (starting 2 March) (25 days)
10. Mangsa Kasadasa (starting 27 March) (24 days)

11. Mangsa Desta (starting 20 April) (23 days)
12. Mangsa Saddha (starting 13 May) (41 days)

Main source: [OEY]

378 Wiccan Calendar

This calendar is used in the modern pagan religion Wicca. The religion was developed in England during the early twentieth century and introduced to the public by Gerald Gardner (1884–1964) in 1954. The monthly Esbat meetings are coordinated with the full Moon.

The names of the full Moons and related months:

1. wolf Moon, = ~ January
2. snow Moon, = ~ February
3. worm Moon or seed Moon, = ~ March
4. pink Moon or grass Moon, = ~ April
5. flower Moon, = ~ May
6. strawberry Moon, = ~ June
7. buck Moon or thunder Moon, = ~ July
8. sturgeon Moon or green corn Moon, = ~ August
9. harvest Moon, = ~ September
10. hunter's Moon, = ~ October
11. beaver Moon, = ~ November
12. cold Moon, = ~ December
13. blue Moon, = ~ late-December/early January

Main source: [AMBE]

379 Winnebago Calendar

This calendar was used by the Winnebago people in the North-central region of present-day U.S.A.

The names of the months:

1. hûdjwitconînâ (first bear Moon), = ~ December
2. hûdjwioragnîna (last bear Moon), = ~ January
3. wakekiruxewira (raccoon mating Moon), = ~ February
4. hoiroginînâwira (fish appearing Moon), = ~ March
5. mâîtawucira (earth drying Moon), = ~ April
6. mâînaûwira (earth cultivating Moon), = ~ May
7. waxaodjrawira (corn tasseling Moon), = ~ June
8. waradjoxhiwira (corn-popping Moon), = ~ July
9. hûwâjugwira (elk calling Moon), = ~ August
10. tcamâînâghowira (deer pawing Moon), = ~ September
11. caiki´ruxewira (deer mating Moon), = ~ October
12. tcahewakcûwira (deer antler Moon), = ~ November

Main source: [LONG]

380 Wishram Calendar

This calendar was used by the Wishram people around the Columbia River, in Oregon and Washington.

The names of the months:

1. her acorns Moon, = ~ September
2. travel in canoes Moon, = ~ October
3. snowy mountains in the morning Moon, = ~ November
4. her winter houses Moon, = ~ December
5. her cold Moon, = ~ January
6. shoulder to shoulder around the fire Moon,= ~ February
7. long days Moon, = ~ March
8. the eighth Moon, = ~ April
9. the ninth Moon, = ~ May
10. fish spoils easily Moon, = ~ June
11. salmon go up the rivers in a group Moon, = ~ July
12. blackberry patches Moon, = ~ August

Main source: [LONG]

381 Wolof Calendar

This calendar was used by the Wolof people in Gambia.

The names of the months:

1. Tamharit, = January
2. Digi, = February
3. Gamo, = March
4. Raki Gamo, = April
5. Rakati Gamo, = May
6. Mamam-Kor, = June
7. Ndey-Kor, = July
8. Barah-Lu, = August
9. Weer-Kor, = September
10. Hori, = October
11. Digi, = November
12. Tobaski, = December

The names of the weekdays:

1. Dimas, = Sunday
2. Altene, = Monday
3. Talaata, = Tuesday
4. Alarba, = Wednesday
5. Alxems, = Thursday
6. Arjuma, = Friday
7. Samdi, = Saturday

Main source: [GAMB]

382 The World Calendar

This calendar was created by Elisabeth Achelis of Brooklyn, New York in 1930, as a modification of the Gregorian calendar. She also founded The World Calendar Association (TWCA) the very same year with the goal of worldwide adoption of the calendar. It was also considered by the United Nations in 1954.

The year begins on Sunday, January 1. Every year, an extra day, called Year-End Day, is added at the end of the year. This day is not part of any month or week. Every 4 years, an extra Leap-Year Day is added. This day is also without date or day of the week, and is inserted at the end of the 26th week, between the last day of June and the first day of July.

The names of the months:

1. January (31 days)
2. February (30 days)
3. March (30 days)
4. April (31 days)
5. May (30 days)
6. June (30 days)
7. July (31 days)
8. August (30 days)
9. September (30 days)
10. October (31 days)
11. November (30 days)
12. December (30 days)

The names of the weekdays are the same as in the Gregorian calendar. The first day of each quarter falls on a Sunday. In leap years, an extra Leap-Year Day, without date or day of the week, is inserted at the end of the 26th week, between the last day of June and the first day of July.

Main sources: [ACHE2], [ACHE3], and [ACHE4]

383 World Season Calendar

This calendar was proposed by author Isaac Asimov (1920–1992) in 1973. In this calendar, the year is divided into four seasons of 13 weeks each. Every day is named according to its number, e.g., C-6 = the sixth day of season C.

The names of the seasons:

1. A (91 days)
2. B (91 days)
3. C (91 days)
4. D (91 days)

To complete a 365-day year, an extra day, Year Day, is added every year at the end of the year. This day is also called D-92. Every 4 years, an extra day, Leap Day, is added at the end of season B. This day is then called B-92.

Main source: [ASIM2]

384 Xiuhpohualli Calendar

This 365-day calendar was used by the Aztecs and other pre-Columbian Nahua peoples in central Mexico. The Aztec rituals and sacrifices were governed by this calendar. It was composed of eighteen 20-day months, along with five nameless days to complete the year. These days were considered unlucky days, and were called *nemontemi*. An additional 12-day New Fire Festival every 52 years, made the length of the years close to that of the solar year used by scientists today. Each year was also divided into four seasons.

The 20-day months (veintenas):

1.  ātlcāhualco (where there are dry brush and water), 1 March–20 March
2.  tlācaxīpēhualiztli, 21 March–9 April
3.  tozoztōntli (little sleep), 10 April–29 April
4.  hueyi tozōztli (big sleep), 30 April–19 May
5.  toxcatl, 20 May–8 June
6.  etzalcualiztli (feast with cooked corn with beans), 9 June–28 June
7.  tēcuilhuitōntli (little feast of Lords), 29 June–18 July
8.  hueyi tēcuilhuitl (great celebration of Lords), 19 July–7 August
9.  miccāilhuitōntli or miccailhuitzintli (little feast of the Dead), 8 August–27 August
10.  hueyi miccāilhuitl (great day of the Dead), 28 August–16 September
11.  ochpāniztli, 17 September–6 October
12.  pachtōntli or teōtlehco, 7 October–26 October
13.  huēyi pachtli or tepēilhuitl, 27 October–15 November
14.  quechōlli, 16 November–5 December
15.  panquetzaliztli, 6 December–25 December
16.  ātemoztli, 26 December–14 January
17.  tititl, 15 January–3 February
18.  izcalli, 4 February–23 February

 nemontemi, 24 February–28 February

The calendar counted days and months, but years were only designated as *Xihuitl* (Agricultural Years). The name of the Xihuitl day was taken from the *Tonalpohualli* (a 260-day calendar) day that corresponds to the last day of the last month of the Xiuhpohualli calendar. As in the Tonalpohualli calendar, a day is called a *tonal*. See also *Tonalpohualli calendar*.

Main sources: [DERS], [JIMÉ2], and [VANT]

385 Xhosa Calendar

This calendar is used among the Xhosa people in South Africa. The 12-month year begins in June. The months are poetically named according to a situation or circumstance that occurs particularly in that month, for example, by what happens in the stars during the month, what happens with the trees or the seasonal plants, or anything else that forms part of the people's daily lives.

The names of the months:

1. inyanga yeSilimela, eyeSilimela, or kweyeSilimela (month of the Pleiades), = ~ June

2. inyanga yeKhala, eyeKhala, kweyeKhala, or eyeNtlaba (month of the aloes), = ~ July
3. inyanga yeThupha, eyeThupha, or kweyeThupha (month of the buds), = ~ August
4. inyanga yoMsintsi, eyoMsintsi, or kweyoMsintsi (month of the coast coral tree), = ~ September
5. inyanga yeDwarha, eyeDwarha, or kweyeDwarha (month of the lilypad), = ~ October
6. inyaga yeNkanga, eyeNkanga, or kweyeNkanga (month of the small yellow daisies), = ~ November
7. inyanga yoMnga, eyoMnga, or kweyoMnga (month of the mimosa thorn tree and simba), = ~ December
8. inyanga yomOungu. eyomQungu, or kweyomOunga (month of the Tambuki Grass), = ~ January
9. inyanga yomDumba, eyomDumba, or kweyoMdumba (month of the swelling grain), = ~ February
10. inyanga yoKwindla, eyoKwindla, or kweyoKwindla (month of the first fruits), = ~ March
11. inyanga kaTshazimpuzi, ekaTshazimpuzi, KuTshazimpuzi, or uEpreli (month of the withering pumpkins), = ~ April
12. inyanga kaCanzibe, uCanzibe, or kuTCanzibe (month of Canopus), = ~ May

The names of the seasons:

1. UHlobo, = summer
2. UKwindla, = autumn
3. UBusika, = winter
4. iNwasahlobo, = spring

The names of the days of the week:

1. ngeCawe, = Sunday
2. ngoMvulo, = Monday
3. ngoLwesibini, = Tuesday
4. ngoLwesithathu, = Wednesday
5. ngoLwesine, = Thursday
6. ngoLwesihlanu, = Friday
7. ngoMgqibelo, = Saturday

Main source: [SURH]

386 Xuanming Li Calendar

See *Semmyō calendar*.

387 Yeniseian Calendar

This lunar calendar was used by the Ket people in the Krasnoyarsk Krai district of Russia.

The names of the months:

1. summer Moon (starting in May)
2. unknown name
3. Moon when the ducks moult
4. Moon when the garrot moults
5. Moon in which the *njelma* (*Stenodus nelma* is a whitefish) is caught with great nets
6. Moon in which the willow loses its foliage
7. winter Moon
8. Moon in which the earth freezes
9. reindeer-rutting Moon
10. little Moon
11. great Moon
12. eagle Moon
13. squirrel Moon

The name of the winter months for Ket people along the Sym River:

1. Moon in which the earth freezes (starting in December)
2. reindeer-rutting Moon
3. little Moon
4. great Moon
5. eagle Moon
6. squirrel Moon
7. spawning Moon, in which the pike spawns

Main source: [NILS]

388 Yin Calendar

See *Chinese calendars*.

389 Yoruba Calendar

This is also called the **Kǒ̃jǒ̃dá calendar**.

This calendar is used by the Yoruba people in Nigeria, Benin, and Togo. The 12-month year starts on June 3. The traditional calendar is based on a 4-day week that is dedicated to the Orisha, a deity that reflects one of the manifestations of God in the Yoruba religious system.

The names of the months:

1. Okudu, = ~ June
2. Agẹmo, = ~ July
3. Ogun, = ~ August
4. Òwéré, = ~ September
5. Ọwara, = ~ October
6. Bèlu, = ~ November
7. Òpé, = ~ December
8. Sere, = ~ January
9. Erele, = ~ February
10. Erénà, = ~ March
11. Igbe, = ~ April
12. Èbìbí, = ~ May

The names of the days of the 4-day-week:

1. ǒjǒ-Ọ̀bàtálá (Dedicated to Obatala)
2. ǒjǒ-Ọ̀rùnmílá (Dedicated to Orunmila)
3. ǒjǒ-Ògún (Dedicated to Ogun)
4. ǒjǒ-Ṣàngó (Dedicated to Sango)

To reconcile with the Gregorian calendar, there is also a 7-day week in use:

1. ǒjǒ-Àíkú, = Sunday
2. ǒjǒ-Ajé, = Monday
3. ǒjǒ-Ìṡẽgun, = Tuesday
4. ǒjǒ-RíRú, = Wednesday
5. ǒjǒ-RuBọ̀, = Thursday
6. ǒjǒ-Ėtì, = Friday
7. ǒjǒ-Àbámẽta, = Saturday

Main source: [ADEL]

390 Yoruk Calendar

This lunar calendar was used by the Yoruk people in California.

The names of the months:

1. kohtsewets, = ~ December/January
2. na'aiwets, = ~ January/February
3. nahksewets, = ~ February
4. tsona'aiwets, = ~ March
5. meroyo, = ~ April
6. kohtsawets, = ~ May
7. tserwerserk, = ~ June
8. knewoleteu, = ~ July
9. kerermerk or pia'ago, = ~ August
10. wetlowa or le'lo'o, = ~ September
11. nohso, = ~ October
12. hohkemo, = ~ November
13. ku'umo or ka'amo (the cold Moon), = ~ December

Main source: [KROE]

391 Yukaghir Calendar

This lunar and seasonal calendar was used among the Yukaghir people in the Kolyma River region of Russia.

The names of the months:

1. middle-of-the-summer month (starting in July)
2. small-mosquito month
3. fish month
4. wild-reindeer-bucks month
5. autumn month
6. before-the-ridge month
7. ridge of the spinal column month
8. little-butterfly (gadflies) month
9. ?
10. *cille* month (cille = the icy surface formed during the night on the snow, after having melted during the day)
11. leaf month
12. mosquito month

The names of the seasons:

1. puge (summer), = 13 June–8 September
2. nade (autumn), = 9 September–8 November
3. cieje (winter), = 9 November–2 February

4. pore (first spring), = 3 February–23 April
5. cille (second spring), = 24 April–9 March
6. conjile (third spring), = 10 March–12 June

Main source: [NILS]

392 Yupik Calendar

This lunar calendar was used among the Yupik people in the Yukon Region of Canada.

The names of the months:

1. month for top-spinning and running around the *kashim,* = ~ late December
2. month of offal-eating, = ~ January
3. month of opening the upper passage-way into the houses, = ~ February
4. month when the birds come, = ~ March
5. month when the geese come, = ~ April
6. month of eggs, = ~ May
7. salmon month, = ~ June
8. red salmon month, = ~ July
9. month when young geese fly, = ~ August
10. month when it is time for shedding velvet from reindeer horns, = ~ September
11. month when mush-ice forms, = ~ October
12. month of musk-rats, = ~ November
13. month of the feast, = ~ early December

Main source: [NILS]

393 Zuni Calendar

This lunisolar calendar was used by the Zuni people in western New Mexico. Like most of the pueblo Native American tribes, rituals were used to mark months and years. One yearlong ritual, Sayatasha's Night Chant, began with the sighting of the first full moon after the winter solstice ceremony. An actor, portraying the masked god Sayatasha, plants prayer sticks every full moon for ten lunar months. Then, he begins counting the days before the end of the year dance, Shalako, by untying one knot for each day on a string of 49 knots. At the end of the 48th day, he begins the long talk and, along with a set of other masked gods, a ritual dance until dawn. During the 49th night, the Sayatasha actor recites a precise "Night Chant," which describes the motions of the Sun and the Moon.

The names of the months:

1. dayamcho yachunne (when limbs of trees are broken by snow Moon), = ~ January
2. onon u'lla'ukwamme (no snow in trails Moon), = ~ February
3. li'dekwakk ya ts'ana (little sand storm Moon), = ~ March
4. li'dekwakkya lana (great sand storm Moon), = ~ April
5. yachun kwa'shi'amme (?), = ~ May
6. ik'ohbu yachunne (turning Moon), = ~ June
7. dayamcho yachunne (when limbs of trees are broken by fruit Moon), = ~ July
8. onan u'la'ukwamme (?),= ~ August
9. il'dekwakkya ts'ana (corn is harvested Moon), = ~ September
10. il'dekwakkya lana (big wind Moon), = ~ October
11. yachun kwa'shi'amme (?), = ~ November
12. ik'ohbu yachunne (sun has traveled home to rest Moon), = ~ December

Main sources: [GREG2] and [WILL7]
Internet source: sfnfsitestewards.org

General Terms, Abbreviations and Various Units of Time

A
An abbreviation for Alpha Time Zone.

a
A French abbreviation for *année* = year.

$\mathbf{a_{anom}}$
An abbreviation for anomalistic year.

$\mathbf{a_{astr}}$
An abbreviation for astronomical year.

$\mathbf{a_{gauss}}$
An abbreviation for Gaussian year.

$\mathbf{a_{sid}}$
An abbreviation for sidereal year.

Ab Urbe Condita
(for specifying a year written as Anno Urbis Conditae)

(Abbreviated as AUC, A.U.C., a.u.c. or a.u.) [< L: = "from the founding of the City"] This is an era used very infrequently in the Roman calendar and the early Julian calendar. The ancient Roman historians counted years from the legendary founding of Rome by Romulus and Remus, an event placed in 753 BCE in our present calendar. Dionysius Exiguus (*c*.470–*c*.544) implied, but did not explicitly state, that 1 CE was 754 AUC. The Christian Church continued to count years AUC for centuries after the fall of Rome. The year 2015 is the same as the year 2768 AUC (2015 + 753).[3]

AC
An abbreviation for ***A****nte* ***C****hristum* = Before Christ.

academic year
A unit of time in U.S. schools, generally = 9 months.

ACDT
An abbreviation for Australian Central Daylight Time.

ACST
An abbreviation for **A**ustralian **C**entral **S**tandard **T**ime.

AD or **A.D.**
An abbreviation for Anno Domini.

ADT
An abbreviation for **A**tlantic **D**aylight **T**ime.

AEDT
An abbreviation for **A**ustralian **E**astern **D**aylight **T**ime.

aeon
A unit of time = 10^9 years. Proposed in 1957 by the American physical chemist, geophysicist and cosmochemist Harold Clayton Urey (1893–1981), for use in geology. The aeon is not approved by the SI and has not found much favor. See also *eon*.

AEST
An abbreviation for **A**ustralian **E**astern **S**tandard **T**ime.

age
A very variable unit of time, used in anthropology, usually tied to some cultural development, e.g., the Bronze Age.

[3] [DARV] and [PERE2].

age
A smaller, informal unit in the context of the geo-chronologic scale, usually representing less than an epoch, but also used to span epochs.

AH or **A.H.**
An abbreviation for Anno Hegirae.

ainsworth
A jocular unit of time, said to equal the "length of time it takes to get served in a camera shop."[4]

AKDT
An abbreviation for Alaska Daylight Time.

AKST
An abbreviation for Alaska Standard Time.

Alpha Time Zone (A)
A military time zone, 1 hour ahead of Coordinated Universal Time (UTC).

a.m. or **A.M.**
An abbreviation for the Latin *ante meridiem*, "before noon," used after a time to indicate that the time is before 12:00 (noon).

AM or **A.M.**
An abbreviation for Anno Martyrum.

AM or **A.M.**
An abbreviation for Anno Mundi.

AM
An abbreviation for Ante Meridiem.

Anno Diocletiani
See *Anno Martyrum.*

Anno Domini
(Abbreviated as **AD** or **A.D.**) [< L: = "year of the Lord"] This is a traditional designation for years of the common or Christian era. It is more completely written as *Anno Domini Nostri Iesu Christi* ("In the Year of Our Lord Jesus Christ"). AD is used in the Gregorian calendar.[5] Anno Salutis, meaning *in the year of salvation*, is also sometimes used to indicate this era. AD is often replaced by CE

[4] [ADAM, p. 10].

[5] AD was used in the medieval Julian calendar as well, but the calendars are not identical. To distinguish between them, O.S. (Old Style) and N.S. (New Style) were often added to the date, especially during the seventeenth and eighteenth centuries, when both calendars were in common use. Old Style was used for the Julian calendar, and New Style was used for the Gregorian calendar.

(common era), especially in countries where Christianity is not a dominant religion, e.g., 600 AD is replaced by 600 CE.[6]

Years before, the epoch was denoted *a.C.n.* (for *Ante Christum Natum*, Latin for "before the birth of Christ"), although BC (Before Christ) is now usually used in English.

Anno Graecorum [< L: = "in the year of the Greeks"] or **Seleucid Era**

(Sometimes abbreviated as **AG**)

This was a system of numbering years in the Seleucid Empire and among other ancient Hellenistic civilizations. The era dates from the return of Seleucus I Nicator to Babylon in 311 BCE. This corresponded roughly to April 311 BCE in the Babylonian calendar, which was used by the natives of the Seleucid Empire. This dating was later called the *Era of Contracts* by the Jews.

Anno Hegirae

(Abbreviated as **AH** or **A.H.**) [< L: = "in the year of Hijra"]

This is the name for an era traditionally used in the West to designate years of the Islamic calendar. The era is also used in the Iranian calendar, but written there as A.H.S. (or AHS) to indicate the solar years since the Hijra. Years are counted from the day of the Hijra (Hegira in Latin), the flight of Mohammed from Mecca to Medina, which is fixed at July 16, 622 CE in the Julian calendar. The Islamic year 1427 AH began at sunset on January 31, 2006 in the current Gregorian calendar.[7]

Anno Lucis

(Abbreviated as AL or A.L.) [< L: = "in the year of the light"]

This is the name for an era of Freemasonry, which claims to date from the creation of the world. It is given by adding 4000 years to the AD date, e.g., 2015 CE in the current Gregorian calendar is equal to AL 6015.[8]

Anno Martyrum

(Abbreviated as AM or A.M.) [< L: = "in the year of the martyrs"]

This is the name for an era used in the Coptic calendar, and equivalent to the old Anno Diocletiani, that counts years from the reign of Emperor Diocletian. Its epoch is August 29, 284 in the Julian calendar.[9]

Anno Mundi

(Abbreviated as AM or A.M.) [< L: = "in the year of the world"]

This is the name for an era used in the Hebrew calendar that counts years from the creation of the world, which is thought to have taken place in the year 3761 BCE.[10]

Anno Persarum or Anno Persico

(Abbreviated as A.P.) [< L: = "in the year of the Persia"]

This is the name for an era used in the Islamic solar calendar.

annus fictus

See *astronomical years*.

anomalistic month

A unit defined as the mean time of revolution of the moon from perigee to perigee, and equal to 27 d, 13 h, 18 m, 33.1 s = about 0.918485 common days = about 27.55455 common days = about 2,380,713.1 s.

Anomalistic year

This is a seldom used unit of time. It is the period it takes for the earth to pass from the perihelion back to the same point again. The anomalistic year is longer than the sidereal year and the tropical year, because of the eastward motion of the line of apsides, which is caused by the slow rotation of the earth's orbit as a whole.[11]

antebellum [< L: *ante* ("before") + *bellum* ("war")]

A term used when referring to a period prior to a war. See also *interbellum* and *postbellum*.

antediluvium [< L: *ante* ("before") + *diluvium* ("flood")]

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6 [DECL].

7 [KOUT].

8 [WHAL].

9 [GABR].

10 [DICK].

11 [STEE2].

A term, in reference to the episode of Noah's Ark in the Bible (Gen. 6–9), sometimes used to refer to a prehistoric time.

ante meridiem (AM, A.M., or a.m.) ["before midday"]

A term indicative of a time before the Sun nominally reaches the meridian. Used to indicate the period of time between midnight (00.00) and noon (12.00).

apparent solar day

This is the time between successive "noons," which is equal to the period of time between two successive passages of the sun across a meridian of a stationary, earth-bound observer.

apparent time

This is a local time, determined by the angle of the sun.

Apr

An abbreviation for April.

AST

An abbreviation for **A**tlantic **S**tandard **T**ime.

astronomical day

A traditional unit = the mean solar day beginning at 12:00 noon within the civil day of the same date.

astronomical year numbering

Year numbering with a year 0. The years before year 0 are designated with a minus sign '−'. The era designations CE are dropped. So, the year 1 BCE is numbered 0, the year 2 BCE is numbered −1, and, in general, the year *n* BCE is numbered (1−*n*). The numbers of CE years are not changed, but CE is not used, being replaced by either no sign or a positive sign. For normal calculation, a number zero is often needed, here most notably when calculating the number of years in a period that spans the epoch; the end years need only be subtracted from each other.[12]

astronomical years[13]

This is a unit of time, defined as being the period of time required for the Earth to make one revolution around the Sun. Its approximate value of 365–366 days was known by ancient cultures. There are a number of year units depending upon how and where the motion is measured. The most well-known are the tropical year, the sidereal year, the anomalistic year, the astronomical year, the ecliptic year and the Gaussian year.

The **tropical year** ($\mathbf{a_{trop}}$) [< Gr: *tropos* = "turn"; the tropics of Cancer and Capricorn mark the extreme northern and southern latitudes where the Sun appears to "turn" in its annual seasonal motion. Because of this connection between the tropics and the seasonal cycle, the word "tropical" also lent its name to the "tropical year"] or **solar year** is defined as the mean interval between vernal equinoxes, or the time required for the longitude of the sun to increase 360 degrees. Our calendar year is linked to the tropical year as measured between two March equinoxes, as originally established by Caesar and Sosigenes. The length of the tropical year is often expressed, based on the orbital elements of Lasker (1986), as:

$365.2421896698 - 0.00000615359\ T - 7.29E-10\ T^2 + 2.64E-10\ T^3$[days],

in which T = (JD − 24,51,545.0)/36,525 and JD is the Julian day number. The interval from a particular vernal equinox to the next may vary from this mean by several minutes. The **mean tropical year** (averaged over all ecliptic points) is 365.24218967 days (365 d 5 h 48 min 45 s) (at the epoch 2000 January 1 12:00:00 TT).[14]

The **sidereal year** ($\mathbf{a_{sid}}$) is the average period of revolution of Earth with respect to a fixed direction in space. Its duration is on average 365.256363051 days (365 d 6 h 9 min 9.7676 s) (at the epoch 2000 January 1 12:00:00 TT).

The **anomalistic year** ($\mathbf{a_{anom}}$) is the interval between successive passages of the Earth through the perihelion (the point in its orbit

[12] [MOBI].

[13] [DOGG], [MEEU], and [MILL5].

[14] Around 1900, its length was about 365.242 196 days, and around 2100, it will be about 365.242 184 days.

nearest the Sun). Its average duration is 365.259635864 days (365 d 6 h 13 min 52 s) (at the epoch 2000 January 1 12:00:00 TT).

The **astronomical year** (**a_{astr}**), **annus fictus**, or **Bessel's year** is the period of time during which the right ascension of the mean sun increases by 360 degrees.

The **eclipse year, ecliptic year, draconic year,** or **draconitic year** is the time it takes for the Sun, as seen from the Earth, to complete one revolution with respect to the same lunar node. The average duration of the eclipse year is 346.620075883 days (346 d 14 h 52 min 54 s) (at the epoch 2000 January 1 12:00:00 TT).

The **Gaussian year** (**a_{gauss}**) is a theoretical time for the Earth to go around the Sun. The value is derived from Kepler's third law as (2π)/k, in which k = the Gaussian gravitational constant.[15] This give us a Gaussian year = 365.2568983 days. It was adopted by the German scientist Carl Friedrich Gauss (1777–1855) as the length of the sidereal year in his studies of the solar system.

The **heliacal year** is the interval between the heliacal risings of a star.

The **lunar year** comprises 12 full lunar cycles, as seen from the Earth.

The **sothic year** is the interval between heliacal risings of the star Sirius.

atom [< Gr: *atomos* = "uncuttable", "indivisible"]

A medieval unit of time. In medieval times, the Latin form *atomus* was also used to mean "a twinkling of the eye," the smallest amount of time imaginable. This was sometimes defined in a precise way equivalent to exactly 1/376 minute = about 160 ms.

AUC or **A.U.C.**

An abbreviation for Ab Urbe Condita.

Aug

An abbreviation for August.

Australian Central Daylight Time (ACDT)

A daylight saving time/summer time zone, used in South Australia. ACDT is 10 hours and 30 minutes ahead of Coordinated Universal Time.

Australian Central Standard Time (ACST)

A time zone, used in South Australia. ACST is 9 hours and 30 minutes ahead of Coordinated Universal Time.

autumn or **fall** [< Old French: *autompne*; In North American English]

A unit of time = 7,747,200 s and the temperate season that marks the transition from summer into winter.

autumn

Equinox name of the first day of autumn in the northern hemisphere. It usually falls on September 21 in the northern hemisphere. There are about 12 hours of light and 12 hours of darkness every place on the Earth during an equinox.

Av. J.C.

A French abbreviation for *Avant Jésus Christ* = Before Christ.

AWST

An abbreviation for **A**ustralian **W**estern **S**tandard **T**ime.

B

An abbreviation for Bravo Time Zone.

BC (or **Av. J.C.**) or **B.C.**

An abbreviation for "before Christ," used with the Gregorian calendar as a standard designation for years before the beginning of the Christian era. See also *CE*.

BCE or **B.C.E.**

An abbreviations for "before common era," used as a standard designation[16] for years before the beginning of the Common Era. Oddly, there is no year designated 0 in the common system for numbering years; the year 1 CE (or 1 AD) was preceded by 1 BCE (or 1 BC). The lack of a year 0 means that the number of years elapsing

[15] Its value was measured, to great precision, as = 0.017 202 098 95, by Canadian-American astronomer Simon Newcomb. See [NEWC].

[16] Used, instead of AD, to avoid the unwanted religious connotations.

between the year *n* BCE and the year *m* CE (or *n* BC and *m* AD) is $n + m - 1$.[17]

BE or **B.E.**

An abbreviation for Bahá'í Era.

B.E.

An abbreviation for Buddhist Era.

beat

A unit of time = 0.001 day = 86.4 s. "Metric time," meaning decimalized time, is an idea dating back to at least the French Revolution of the 1790s. In most metric time proposals, the day is divided into 10 metric hours, each metric hour into 100 metric minutes (or beats), and each metric minute into 100 metric seconds (sometimes called blinks). In 1998, the Swatch Corporation repackaged metric time in a very attractive way as Internet time. In their proposal, time is counted in beats from midnight Central European Standard (winter) time (2300 Universal Time of the previous day, or 6:00 pm U.S. Eastern Standard Time of the previous day). The time at *n* beats is recorded as @*n*.beat; thus, midnight U.S. Eastern Standard Time is @250.beat. See also *Swatch Internet Time*.

Before Present

(Abbreviated **BP** or **bp**)

This is a time scale mainly used in geology and some other scientific disciplines that use radiocarbon dating to specify events in the past. January 1, 1950 is usually used as the origin of the age scale.

bell [*pl.* bells]

A traditional unit of time. On ships at sea, a practical measure of time is the watch, a period of 4 hours. The watch is divided into 8 bells, so one bell equals ½ h = 30 minutes.[18] Every 30 minutes, the ship's bell sounds the number of bells elapsed since the start of the watch.

Bessel's year

See *astronomical years*.

Besselian epoch or **Besselian equinox**

An epoch based on a Besselian year, defined as a tropical year measured at the point where the Sun's longitude is exactly 280° = 365.242198781 days. Between 1930 and 1984, the Besselian epoch was the standard epoch, used by astronomers to specify the right ascension and declination of stars. Historically used Besselian epochs are B1875.0, B1900.0 and B1950.0. The current standard epoch is J2000.0. The Besselian epoch B = 1900.0 + (Julian date − 2,415,020.31352)/365.242198781.[19] The epoch is named for the German mathematician and astronomer Friedrich Wilhelm Bessel (1784–1846).[20] See also *Julian epoch*.

Besselian year

See *Besselian epoch*.

bhāga

In Tibet, a unit of time equal to 1/15,271,200 solar day = 5 2/3 milliseconds.

biennium

A period of 2 years.

billennium [*pl.* billennia]

A unit of time = one billion (10^9) years. See also *eon*.

bimester

A rarely-seen unit of time = 2 months.

bimillennium

A unit of time = 2000 years.

blink or **metric second**

A unit of time = 10^{-5} day = exactly 0.864 s; 1 s = 1.157 blink. In most metric time proposals, the day is divided into 10 hours, each hour into 100 minutes (called beats in

[17] [GIBA].

[18] "The maximum of 8 bells occurs on the multiples of 4, 8 and 12 o'clock both a.m. and p.m." [FENN, p. 44].

[19] [AOKI].

[20] See [LAVR].

"Internet time": see "beat"), and each minute into 100 seconds or blinks.[21]

boggle

A fancy unit of time, defined as the time a writer sits staring blankly at his typewriter trying to think up some way of explaining terms. Its said to be = the time it takes a writer to drink 1.5 ounces of Irish whiskey.[22]

BP or **B.P.**

An abbreviation for "before present," used in anthropology, geology, and paleontology. See *Before Present*.

BST

An abbreviation for British Standard Time.

BST

An abbreviation for British Summer Time.

C

An abbreviation for Charlie Time Zone.

calendar [< *calendae* = the first day in the Roman republican calendar]

This is the usual term for a system used for dividing time over an extended period, and arranging these divisions in a definite order. It may be used for civil life, as well as religious observances and scientific puposes.

calendar

British slang for a year in jail.

Calendar year

A civil unit of time = the time interval between January 1 and December 31, inclusive, in the Gregorian calendar. See *year*.

Callipic cycle or **Callipic period**

A unit of time = 76 years or 4 Metonic cycles, formerly used in astronomy for predicting the phases of the Moon. After the passage of one Callipic cycle, the phases of the Moon repeat, essentially on the same calendar dates as in the preceding cycle. The cycle is named for the Greek astronomer Callippus of Cyzicus (*c.* 370–310 BCE), who, in 330 BCE, improved upon the Metonic cycle. It was more accurate than the original Metonic cycle and made use of the fact that 365.25 days is a more precise value for the tropical year than 365 days. The Callippic period consisted of 4 × 235, or 940 lunar months, but its distribution of hollow and full months was different from Meton's. Instead of having totals of 440 hollow and 500 full months, Callippus adopted 441 hollow and 499 full, thus reducing the length of four Metonic cycles by 1 day. The total days involved therefore became (44129) + (49930), or 27,759 and 27,759 (194), giving 365.25 days exactly. Thus, the Callippic cycle fit 940 lunar months precisely to 76 tropical years of 365.25 days.[23]

canonical day

A term sometimes used for a day and a night. It starts at dawn and ends at sunset. See also *nychthemeron*.

CDT

An abbreviation for Central Daylight Time.

CE or **C.E.**

An abbreviation for common era.[24] This abbreviation[25] is a non-religious designation used in place of the traditional AD for years of the common or Christian era. The practice of dating years based on either the birth of Jesus of Nazareth or the Annunciation, when Archangel Gabriel foretold Jesus' birth to his mother, Mary, was devised in the year 525 by the Scythian monk Dionysius Exiguus (*c.* 470–c. 544), who named it "*anno Domini*" ("in the year of the Lord"). Two centuries later, the Anglo-Saxon historian Bede used another Latin term ("*ante incarnationis dominicae tempus*"—"the time before the Lord's incarnation"), equivalent to the English "before Christ," to identify years before the first year of this era. The Biblical account of Jesus's birth implies that he was born several years before the death of Herod the Great, who died, according to what we now know, in 4 BCE. Thus, the calculation of the Common Era is off by 6 or 7 years at least. In the conventional use of the Common Era system, there is no year 0 and the year prior to 1 CE is designated 1 BCE. In astronomy,

[21] An actual eye blink takes less than half as much time as this unit.

[22] [KLEI].

[23] www.groups.dcs.st-and.ac.uk

[24] Written after the number, e.g., 2007CE or 2007 CE.

[25] This use is similar to that of the Vulgar Era in the past.

however, it simplifies calculations to define the year 0 CE = 1 BCE and to apply negative numbers to earlier years. Thus, Herod died in −3 CE, and, in general, $-n$ CE is the year more commonly called $n + 1$ BCE.

cé
In France, during the eighteenth century (used between 1792 and 1804), a unit of time = 1/100 day = 14.4 min.

cé
A unit of time proposed in 1900 by Congrès International de Chronomètre. One cé was proposed to equal 10 decicé = 1000 millicé = 14 min 24 s (= 24 h/100).[26]

ceasura
Musical term defined as a pause or breathing at a point of rhythmic division in a melody.

centigrade
See *degré*.

centioctave
A name for the interval between two musical sounds having a basic frequency ration = $2^{1/2}$. The number of centioctaves between f_1 and $f_2 = 100\log 2(f_1/f_2)$ = about 0.301 savart = 12 cent.

century [< L: *centum* = one hundred]
A traditional unit of time = 100 years. In naming centuries, historians recall that there was no year 0 in the conventional year numbering system. Thus, the First Century included the years 1–100 and the Twentieth Century includes the years 1901–2000. (As an example in the other direction, the Fifth Century BCE includes the years 500–401 BCE.) However, there is strong popular sentiment for considering the Twentieth Century to be the years 1900–1999, making 2000 the first year of the Twenty-first Century.

CEST
An abbreviation for Central European Summer Time.

CET
An abbreviation for Central European Time.

chiliad
Another name for a millennium (1,000 years).

chronology
This is the name of a scientific branch that studies various methods used to order time and to place events in the sequence in which they occurred.

chronon or **tempon**
A unit of time = 10^{-21} s = 1 zeptosecond. In a data model, a one-dimensional chronon is a non-decomposable time interval of some fixed, minimal duration. An n-dimensional chronon is a non-decomposable region in n-dimensional time. Important special types of chronons include valid-time, transaction-time, and bitemporal chronons. Consecutive chronons may be grouped into larger segments, termed granules.

chu tshod
See *nāḍī*.

chu srang
See *pāṇīpala*.

civil day
See *mean solar day*.

civil time
See *mean time*.

civil twilight
The period between astronomical sunrise or sunset and the time when the sun's unrefracted center is at elevation $h_0 = -6°$.[27]

civil year
A year as measured by the Gregorian calendar = 365 days in most years, but 366 days in a leap year. See *year*.

climatic year
A continuous 12-month period during which a complete annual cycle occurs, arbitrarily selected for the presentation of data relative to hydrologic or meteorologic phenomena. The climatic year is usually designated by

[26] 1902: Chronometry. *Nature* **66**, 411.

[27] Local topography above the astronomical horizon will make local sunset occur before astronomical sunset. During a clear evening's civil twilight, horizontal illuminance decreases from about 585–410 lux to about 3.5–2 lux. As is true of nautical and astronomical twilight, civil twilight's length varies greatly with latitude and time of year.

the calendar year during which most of the 12 months occur.

cron [Gr: = "time"]

A unit of time, proposed in 1957[28] by the British zoologist J. S. Huxley (1887–1975), = a million years.

crotchet

A unit of relative time in music = ¼ whole note (semibreve) = 1/8 breve. The word, pronounced crotch-it, comes from the old Norse word krok for a hook; in this context, it refers to the traditional hooked symbol for a quarter note.

CST

An abbreviation for Central Standard Time.

CXT

An abbreviation for Christmas Island Time.

CY

An abbreviation for calendar year.

D or **d**

An abbreviation for day.

D

An abbreviation for Delta Time Zone.

daṇḍa

See *nāḍī*.

date

Dates of the year are described in many ways in different languages. To avoid confusion in international communications, the International Organization for Standardization (ISO), established, in 1986, the International Standard 8601 for representation of dates and times. The ISO 8601 format for dates is YYYY-MM-DD, in which YYYY is the year number, MM is the month (01 through 12), and DD the day number. Hyphens, not slashes, must be used as the separators in the representation.

day (d or **da)**

A traditional unit of time marked by the average time of a single rotation of a planet with respect to the sun as the central star. With astronomers, this is usually called a mean solar day. According to the UTC time standard, a day has a length of 86,399 or 86,401 seconds, including a negative or positive leap second.

Dec

An abbreviation for December.

decade

A traditional unit of time equal to any span of 10 years. Sometimes used for the span, for instance, from 1991 to 2000. The period 1990–1999, is labelled as the 1990s.

decade

A unit of time equal to 10 days or 1/3 month. The revolutionary governments in France (1792) and the Soviet Union (1920s) tried to decimalize and secularize the calendar by eliminating the week (with its traditional day of religious observance) and substituting the decade. Both efforts failed. The days in the French Republican calendar were called, according to the order of numbers: Primidi, Duodi, Tridi, Quartidi, Quintidi, Sextidi, Septidi, Octidi, Nonidi, and Décadi. Décadi replaced the Sunday of the year vulgar. This use lasted until January 1, 1806, the date of the repeal of the Republican calendar. However, the decade survived as a unit of civil time in Russia and as a 10-day unit in some scientific contexts (for example, a 10-day cycle in meteorology is called a decade). Where the decade equals 1/3 month, the three decades of a month are the 1st–10th, 11th–20th, and 21st through the last day of the month.

decaméride

A unit of interval in music equal to 1/3010 part of an octave. The unit was defined by the French mathematician Joseph Sauveur (1653–1716) in 1696 as one tenth of an eptaméride.

decigrade

See *degré*.

decimilligrade

See *degré*.

degré

A unit of time discussed at an international conference on time measurement in 1900[29] = 10 decigrade = 100 centigrade = 1000

[28] [HUXL].

[29] 1902: *Nature* **66**, 411.

milligrade = 10,000 decimilligrade = 1/100 day. The unit has rarely been used at all. See also *cé*.

demisemiquaver

A unit of relative time in music, denoting an eighth of a crotchet, = 1/32 whole note = ½ semiquaver = 1/32 semibreve = 1/64 breve. It is written as a filled black note-head with a stem and three flags (tails).

DIS

A unit of time, used in the Klingon Culture in the TV Series Star Trek, = a year. The artifical Klingon language was developed by Mark Okrand (b. 1948) in the early 1980s.[30] See also *Hogh*, *jar*, *lup*, *rep*, and *tup*.

dog watch

An informal unit of time = 2 hours, one half the usual length of a watch.

dog year

An informal unit of time = 1/7 of a normal, or "human," year. According to folklore, dogs age 7 times faster than humans.

draconic month

The time required for the Moon to move from an orbital node back to the same node = about 27.212221 days.[31]

draconitic year

See *astronomical years*.

dynamical time

See *Ephemeris Time*.

E

An abbreviation for Echo Time Zone.

eclipse year

See *astronomical years*.

EDT

An abbreviation for Eastern Daylight Time.

EEST

An abbreviation for Eastern European Summer Time.

EET

An abbreviation for Eastern European Time.

[30] [OKRA].

[31] United States National Aeronautics and Space Administration. *NASA Conference Publication*. National Aeronautics and Space Administration, Scientific and Technical Information Office, 1999, p. 182.

EFTF

An abbreviation for European Frequency and Time Forum.

emsworth

A jocular measure of time defined as "the moment between the doors of a lift closing and it beginning to move."[32]

endurance

The longest time an aircraft can keep flying before running out of fuel. Endurance is sometimes erroneously equated with range.

enneadecaëteris

The name for a 19-year cycle = ¼ Callipic cycle.[33] If, for instance, a full moon falls on the 10th of March in any year, it is most likely to fall on the same day in 19 years, and certainly on the 9th or 11th, if not on the 10th.

eon

A unit of the geochronologic time scale = 1000 million years. The unit was suggested in 1968 by George Gamow.[34] The next smaller unit is the era. See also *aeon*.

epact

An era defined as the number of days (normally 11 days, but 12 days in a leap year) by which a full solar year exceeds a year of 12 full lunar months, or the number that gives the age of the cyclic moon on March 22 (old style epact of the Julian calendar) or January 1 (new style epact of the Gregorian calendar).[35]

epagomental

Describing a period of a day or days inserted into the calendar.[36]

[32] [ADAM, p. 47].

[33] Named by Meton of Athen in BCE 432, according to: [MART4, p. 350]. See also: [HERO2, p. 163].

[34] Gamow, George. *Nature*, 1968: **219**, 765.

[35] [WILK3, p. 125] and [HEIL, p. 43].

[36] The last 5 days of the Cairo Calendar (2 July–6 July) are known as the Epagomenal days and represent the birthdays of the gods Osiris, Horus, Seth, Isis and Nephthys, respectively. In the Gregorian calendar, February 29 is an epagomental day every leap year.

Ephemeris Time (ET), **dynamical time**, **gravitational time**, or **newtonian time**[37]

A scheme for measuring time with a standardized day length,[38] based on an idealized motion for Earth and the Moon, to get away from the variations in the earth's rotation. The International Astronomical Union introduced ET in 1952. In 1954, the 10th CGPM proposed that the **ephemeris second** be "the fraction 1/31,556,925.975 of the length of the tropical year for 1900.0." This was considered insufficiently precise, and in 1956, the CIPM defined the ephemeris second as "the fraction 1/31,556,925.9747 of the tropical year for 1900 January 0d 12h ephemeris time."[39] In 1958, the IAU General Assembly resolved: "Ephemeris Time (ET), or Temps des Ephémérides (TE), is reckoned from the instant, near the beginning of the calendar year AD 1900, when the geometric mean longitude of the sun was 279° 41' 48".04, at which instant the measure of Ephemeris Time was 1900 January 0^{d} 12^{h} precisely."[40] In 1960, the 11th CGPM abandoned the definition of the second as a fraction of the mean solar day in favor of the ephemeris second. In 1979, astronomers defined two new time scales that used the atomic second and that took into account relativity (velocity affects time).[41]

epoch [< Gr: *epoche* = "stopping point"]

1. A unit of time = 19 years, used in predictions of the tides. In this use, an epoch is another name for a Metonic cycle. All possible alignments of the sun and moon occur in this 1-year cycle, so tidal heights and other tidal phenomena are averaged over this period.
2. The name for a period characterized by the dominance of a particular physical process, such as the formation of the light elements from protons and neutrons.
3. The name for a reference date for, defining moment in the beginning of, or characteristic of a distinctive historical period or era.
4. The name for a starting time point of a calendar or clock system.

era

A fixed point in time when we start counting the years, e.g., the introduction of the Gregorian Calendar: October 15, 1582.

EST

An abbreviation for Eastern Standard Time.

E.T.

An abbreviation for Ephemeris Time.

eternity

An infinite amount of time, seen as having no beginning when applied in the past, no end in the future; sometimes specifically the endless time that begins at death.

fortnight

In Britain, a traditional unit of time = 2 weeks = 14 days. The word is a contraction of "fourteen nights." Sometimes, the fortnight is used more loosely, to include a third complete weekend.

frolesworth

A jocular measure of time = the "minimum time it is necessary to spend frowning in deep concentration at each picture in an art gallery in order that everyone else doesn't think you're a complete moron."[42]

galactic year or **cosmic year**

A unit of time in which the Solar System, or, more correctly, the average star in its neighborhood, makes one revolution around the Milky Way galaxy. The galactic year is

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37 [DUFF] and [MONT].

38 A conference on Fundamental Constants in Astronomy (in Paris, 1950) recommended that the time standard be based on the revolution of the Earth around the sun, instead of its rotation on its axis. The second would be defined as a fraction of 1 particular year, rather than a fraction of the mean solar day. The length of the year was based on [NEWC].

39 [COMI, p. 77].

40 [SADL].

41 From January 1, 1984, the ephemeris time scales were superseded by the Barycentric Dynamical Time scale and replaced in national ephemerides like the *Nautical Almanac*. The ET-scale was used in the *Astronomical Almanac* from 1960 to 1983.

42 [ADAM, p. 55].

estimated to be about 225 million ordinary years; some sources say almost 250 million ordinary years.[43] The age of the Solar System is about 20 galactic years.

Gaussian year

See *astronomical years*.

generation (gen)

An informal unit of time. Roughly speaking, a generation is the average length of time between the birth of a parent and the birth of the child. This leaves a question, however: should only the father, or only the mother, or both parents be included in the calculation? Various answers to this question, plus a lack of consistent data, have led to a range of estimates for the length of a generation, from about 25 to 35 years. Genealogists tend to use the higher figures, anthropologists the lower ones. There is some research suggesting that the approximate length of the generation in the world today is about 28 years.

ghaţikā

In traditional Hindu practice, a unit of time = 1/60 true terrestrial day or natural day. The length of this day is variable, as it depends on the Sun's daily motion and on the time in rising.[44]

ghaṭikā

See *nāḍī*.

glass

A unit of time measured by an hourglass or sandglass. At sea, time was traditionally measured with half-hourglasses, making the glass a nautical unit of time = ½ hour. In this use, the glass is another name for the bell.

GMT or **G.M.T.**

An abbreviation for Greenwich Mean Time, the standard time of longitude 0°. This meridian of longitude, called the *prime meridian*, was fixed as the longitude of the Royal Greenwich Observatory in London by the International Meridian Conference of 1884. GMT is 5 hours later than U.S. Eastern Standard Time. The abbreviation UT (Universal Time) has largely replaced GMT.

gravitational time

See *Ephemeris Time*.

great year

See *Platonic year*.

great year

Name for various real and imagined cycles with astronomical or astrological significance.[45] The Sanskrit scholar Swami Sri Yukteswar Giri (1855–1936) puts the length of a Great Year at 24,000 years, composed of one ascending age of 12,000 years and one descending age of 12,000 years.[46] Many astrologers use a Great Year period of 25,920 years, the period required for the equinox to move through all 12 of the zodiacal signs.[47]

Gregorian year

A unit of time equal to exactly 365.2425 days, the average length of a year in the Gregorian calendar currently used throughout the world. See *year*.

h

An abbreviation for hour.

haircut

English slang for a few days in jail.

helek (hl) [Heb: *pl*. halakim]

A traditional Hebrew unit of time = 1/18 minute = 10/3 s. Halakim are used in formulas establishing the molad, the instant of new moon, which marks the start of the month in the Jewish calendar.

hemidemisemiquaver or **semidemisemiquaver** ()

Name of the shortest unit of relative time in music = ½ demisemiquaver = 1/8 quaver = 1/64 semibreve (whole note) = 1/128 breve.

[43] Leong, Stacy. 2002: Period of the Sun's Orbit around the Galaxy (Cosmic Year). *The Physics Factbook*. hypertextbook.com

[44] Sūryasiddhānta, Bhāskara Āchārya. *Translation of the Súrya siddhánta by B.D. Sástri, and of the Siddhánta ś irornani*. 1861, p. 128.

[45] According to [DESA], there over 200 myths or folk stories from over thirty ancient cultures that refer to a Great Year tied to the movement of the equinox or the motion of the heavens.

[46] [POOR, p. 104].

[47] [OKEN, p. 514].

Hindu units of time

In Hindu religious scriptures, described units of time.

Smaller units of time

नक्षत्र अहोरात्रम्	मुहूर्त	दण्ड, घटि, or नाडी	विनाडी or पल	विपल	लीक्षक	लव	रेणु	त्रुटि	
nakṣatra ahorātram									~24 h
30	**muhūrta**								~48 min
60	2	**danda**, **ghaṭi**, or **nādī**							~24 min
3600	120	60	**vinādī** or **pala**						~24 s
216,000	7200	3600	60	**vipala**					~0.4 s
12,960,000	432,000	216,000	3600	60	**leekshaka**				~6.67 ms
777,600,000	25,920,000	12,960,000	216,000	3600	60	**lava**			~0.11 ms
46,656,000,000	1,555,200,000	777,600,000	12,960,000	216,000	3600	60	**renu**		~1.85 μs
2,799,360,000,000	93,312,000,000	46,656,000,000	777,600,000	12,960,000	216,000	3600	60	**truti**	~0.031 μs

The Puranas describes a number of time cycles within cycles. The length of each cycle is given in ordinary human years.

Time measurements according to Viṣṇu Purāṇa Book I Chapter III

					Human years
Mahā Yuga					4,320,000
2½	**Satya Yuga** or **Krita Yuga**				1,728,000
3⅓	1⅓	**Tretā Yuga**			1,296,000
5	2	1½	**Dvāpara Yuga**		864,000
10	4	3	2	**Kali Yuga**	432,000

Brahma Life

					Human years
Brahma life					311,040,000,000,000
2	**parardh**				155,520,000,000,000
100	50	**Brahma year**			3,110,400,000,000
72,000	36,000	720	**kalpa**		4,320,000,000
72,000,000	36,000,000	720,000	1000	**Mahā Yuga**	4,320,000

In Hindu, Brahma, who is the creator of everything, created a specific Manu, the progenitor of humanity. Manu created the world, and all its species. Upon the death of a Manu, Brahma creates a another Manu. The lifetime of a Manu is called a *Manvantara*.

The Manvatara cycle

						Human years
Brahma varsha						1,545,868,800,000
360	**kalpa**					4,293,080,000
5040	14	**Manvantara**				306,720,000
357,840	994	71	**Chaturyuga**			4,320,000
4,294,080,000	11,928,000	852,000	12,000	**Deva vatsara**		360
1,545,868,800,000	4,293,080,000	306,720,000	4,320,000	360	**Deva ahoratra**	1

Hipparchic cycle

This lunar cycle was introduced by the Greek astronomer and mathematician Hipparchus (*c*. 190 BCE–*c*. 120 BCE). It was a correction to the Calippic cycle (of 76 years), which was proposed as a correction to the Metonic cycle (of 19 years). Hipparchus found that the tropical year is about 1/300 of a day shorter than the 365 + ¼ days that Calippus used, and thus proposed making a 1-day correction after 4 Callipic cycles. It is = [(4 × 27,759) − 1 days]/(29.530587 days/month) = 37599998 months.[48]

Hogh

A unit of time, used in the Klingon Culture in the TV Series Star Trek, = a week. The artifical Klingon language was developed by Mark Okrand (b. 1948) in the early 1980s.[49] See also *jar*, *lup*, *rep*, *tup*, and *DIS*.

hour (h or **hr)** [< Gr: *hora* = "religious season"]

A traditional unit of time = 60 minutes = 3600 s = 1/24 day. The custom of dividing the daylight into 12 hours goes back at least as far as the Babylonians, who liked to divide units by 12 because groups of 12 are easily divided into halves, thirds, or fourths. Later, when people wanted to express times at night, it was natural to divide the night into 12 hours as well, making 24 hours in the day.

Incarnation Era

An era used by Ethiopia. It dates the Incarnation of Jesus to March 25, 9 (in the Julian calendar).[50] Its first civil year began 7 months earlier on August 29, 8 (in the Julian calendar).[51]

indiction

A term used to date medieval documents throughout Europe, for any of the years in a 15-year cycle.

instant

A proposed unit of time representing a time point on an underlying time axis. The instants in a discrete model of time are isomorphic to the natural numbers, i.e., there is the notion that every instant has a unique successor. Instants in the dense model of time are isomorphic to (either) the real or rational numbers: between any two instants, there is always another. Continuous models of time are isomorphic to the real numbers, i.e., both dense and also, unlike the rational numbers, with no "gaps." See *degré*.

interbellum [< L: *inter* ("between") + *bellum* ("war")]

A term used when referring to a period between two wars, e.g., the time between World War I and World War II. See also *antebellum* and *postbellum*.

intercalation

A promulgated insertion of a leap day, week or month into certain calendar years to make the calendar follow the seasons or moon phases.[52]

international atomic time (TAI (= temps atomique international)**)**

A time scale established by the Bureau International de l'Heure (BIH), given by atomic clocks in several locations through the world. The abbreviation TAI is employed in all languages.

Internet time

A global time system proposed by the Swatch Corporation in 1998. See S*watch Internet Time* and *beat*.

Jan

An abbreviation for January.

jar

A unit of time, used in the Klingon Culture in the TV Series Star Trek, = a month. The artifical Klingon language was developed by Mark Okrand (b. 1948) in the early

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48 [SAMU].

49 [OKRA, p. 160].

50 The date was chosen by Annianus of Alexandria at the beginning of the fifth century.

51 [ALEX-W, p. 191].

52 According to www.merriam-webster.com: Leap second = an intercalary second added to Coordinated Universal Time to compensate for the slowing of the earth's rotation and keep Coordinated Universal Time in synchrony with solar time.

1980s.[53] See also *Hogh*, *lup*, *rep*, *tup*, and *DIS*.

JD or **J.D.**
An abbreviation for Julian date.

JDN
An abbreviation for Julian Day Number.

jiffy
A unit of time used in computer engineering. A jiffy is the length of one cycle, or tick, of the computer's system clock. In the past, this was often = one period of the alternating current powering the computer: 1/60 s in the U.S. and Canada, usually 1/50 s elsewhere. More recently, the jiffy has become standardized, more or less, as 0.01 s. The word jiffy, with its ordinary meaning of an instant or very brief time, appeared in English during the eighteenth century, but its origin is unknown.

jiffy
A unit of time used in chemistry and physics = a "light centimetre," that is, the time required for light to travel a distance of 1 cm. This is a very brief interval indeed, about 33.3564 picoseconds. This definition of the jiffy was proposed by the American physical chemist Gilbert N. Lewis (1875–1946), who was one of the first to apply principles of quantum physics in chemistry.

Jubilee [Heb.: יובל = *yovel*]
A term, used by Jews, for the year at the end of seven cycles of *shmita* (Sabbatical years). This is the 49th or 50th year, depending on whether it is the last year of seven sabbatical cycles or the following year.

Julian day (JD)
This is a continuous count of days, beginning with January 1, 4713 BCE (–4712 CE). Julian days are named for the French scholar Joseph Justus Scaliger (1540–1609), who introduced the idea in 1582 (the same year the Gregorian calendar was proclaimed). They are often used by astronomers and sometimes by historians to provide a precise date for an event, independent of all calendar systems.

Julian day system
A system in which all days are numbered consecutively from Julian Day zero, which began at noon on January 1, 4713 BCE. Joseph Justus Scaliger (1540–1609), a French classical scholar, determined this as the date on which three important cycles coincided; the 28-year solar cycle, the 19-year lunar cycle, and the 15-year cycle of tax assessment called the "Roman Indiction."[54] By combining those three cycles as (28 × 19 × 15) years, Scaliger got a period he called the Julian period (after his father) = 7980 years, in which no 2 years would have identical numbers for all three cycles.

Julian epoch (J)
A measure of time used in astronomy. The word *epoch* comes from Greek, and means a fixed or standard instant of time. Other times are stated with reference to this fixed time using years and fractions of years. In 1984, astronomers agreed to fix the standard epoch at 12 hours Universal Time of 2000 January 1 (JD 2,451,545.0). This instant is designated J2000.0. Other times are specified with reference to this time using a year of length 365.25 days, the average length of the year in the Julian calendar. This means that J2001.0, for example, is 18 hours Universal Time of 2001 January 1 (exactly 365.25 days after J2000.0).

kiloannum
See *millennium*.

leap second
The name for a second of time added to the duration of a day, as measured by the atomic clock, to maintain consistency with the astronomically-measured diurnal pattern.

lifetime
An informal unit of time. For the human being, life expectancy was 24 years in

[53] [OKRA].

[54] A practice of taking tax censuses every 15 years, established by the Roman Emperor Diocletian (AD 245–AD 313).

1796. A hundred years later, it doubled to 48. Right now, it is 76 in the U.S. According to Dr. Ronald Klatz of the American Academy of Anti-Aging, over half of the babys today are going to see their 100th birthday and beyond.

light microsecond

A jocular unit of length, used by the American computer scientist and U.S. Navy officer Grace Hopper (1906–1992) as the distance a photon could travel in one millionth of a second = about 299.792 m, but usually said to equal 300 m. He also proposed light nanosecond (=29.9792 cm) and light picosecond (=about 0.299792 mm).

light nanosecond

See *light microsecond*.

light picosecond

See *light microsecond*.

long weekend

See weekend.

Lords of the Night

The name of a set of nine gods that cyclically ruled over a particular night, so that the same god recurred every nine nights. In the Aztec calendar, the Lords of the night are Xiuhtecuhtli, Itztli, Piltzintecuhtli, Cinteotl, Mictlantecuhtli, Chalchiuhtlicue, Tlazolteotl, Tepeyollotl, and Tlaloc. In the Mayan calendar, their specific names are unknown.[55]

LST

An abbreviation for Local Solar Time and Local Standard Time.

lunar day

Another name for the tidal day, a unit of time = 24 hours 50 minutes used in tidal predictions.

lunar month, **lunation month**, or **synodic month**

Names for the interval between two successive new moons, a unit of time = 29.53059 days (29 days 12 hours 44.5 minutes).[56] See also *month*.

lup

A unit of time, used in the Klingon Culture in the TV Series Star Trek, = a second. The artifical Klingon language was developed by Mark Okrand (b. 1948) in the early 1980s.[57] See also *DIS*, *Hogh*, *jar*, *rep*, and *tup*.

luster, **lustre**, or **lustrum** [*pl*. lustra]

A traditional unit of time = 5 years. In ancient Rome, the Lustrum was a ceremony of expiation and purification for the whole population of the city, carried out every 5 years after the completion of the census.[58] The use of luster or lustrum as a unit of time in English was fairly common in well-educated circles, as long as "well-educated" meant classically educated; the unit has pretty much disappeared today.

manvantara [Sanskrit: "between two manus"; or: "manu-within or -between."]

A manu is the group of entities that collectively appear first at the beginning of manifestation; the spiritual tree of life of any planetary chain of manifested being. The second verbal element of "manvantara," or *antara*, is a prepositional suffix signifying "within" or "between"; hence, the compound paraphrased means "within a manu," or "between manus." A manvantara is the period of activity between any two manus, on any plane, since in any such period, there is a root-manu at the beginning of evolution, and a seed-manu at its close, preceding a *pralaya*. There are many kinds of manvantaras: *prakritika* manvantara—universal manvantara; *saurya* manvantara—the manvantara of the solar system; *bhaumika* manvantara—the terrestrial manvantara, or manvantara of earth; *paurusha* manvantara—the manvantara, or period of activity, of man.

A round-manvantara is the time required for one round: that is, the cycle from globe A to the last globe of the seven, and starting from the root-manu or collective "humanity" of

55 en.wikipedia.org

56 [STEP, p. 436].

57 [OKRA].

58 [SMIT3, p. 35, p. 604].

globe A and ending with the seed-manu or collective "humanity" of Globe G.

A planetary manvantara, also called a maha-manvantara or a kalpa, is the period of the lifetime of a planet during its seven rounds. It is also called a Day of Brahma, and its length is 4,320,000,000 years.

Mar

An abbreviation for Mar̲ch.

Martian days

Mars time is measured in SOLs. 1 SOL is a Martian day, and is 24 hours, 38 minutes, and 22 seconds long (in Earth time). A Martian day has 24 Martian hours, a Martian hour has 60 Martian minutes, and a Martian minute has 60 Martian seconds. The SOL count is the number of Martian days measured from the Mars local midnight just before the Pathfinder landed on July 4, 1997. Mars local time is based on the position of the Sun in the sky over the Pathfinder site at 19.22° N latitude, 326.59° E longitude.

mean solar time

A time scale related to solar time. It corresponds to the universal time scale deduced from mean solar time by corrections of its secular inequalities and periodicity and which has its reference at 12 o'clock.

megaannum

A term used for an interval of one million years.

Metonic cycle

A unit of time, used in astronomy for predicting the phases of the Moon, = the period over which the incompatibility between visible lunar and solar periods is virtually eliminated = 19.0001 mean tropical years = 6939.602 days = 234.9987 synodic months. The difference between 235 synodic months and 19 mean tropical years is just 125 minutes. As a result, the phases of the Moon repeat almost exactly after 19 years. Since 19 years can contain either 3 or 4 leap days, the recurrence isn't always exact as to the day of the month. Lunar calendars, such as the Chinese and Jewish calendars, all share this 19-year cycle. The cycle is named for the ancient Greek astronomer Meton (*c*. 450–*c*. 400 BCE), who used it for predictions in 432/422 BCE.

microsecond (μs or μsec)

A unit of time = a millionth of a second.

millenium [pl. millennia; < L: *mille* = 1000 + *annus* = year] Sometimes also called a **kiloannum**.

A term used to indicate an interval of 1000 years. There are two main viewpoints about naming millennia. The original method of counting years was ordinal, whether *first year AD* or regnal *tenth year of King Henry VIII*. This ordinal numbering is still present in the names of the millennia and centuries, for example, *first Millennium* or the *twentieth century*, and sometimes in the names of decades, e.g., *first decade of the twenty-first century*. In recent years, most people have moved to counting individual years as cardinal numbers, for example, *1945* or *1998*. The usage *1999th year AD* is no longer found. This follows scientific usage, for example, astronomical year numbering. As a result, some other calendar names have also moved to cardinals, e.g., *1990s* is an acceptable name for a particular decade. However, *1800s* could be understood as either a decade or a century.

milligrade

See *degré*.

millisecond (ms or msec)

A common unit of time = 0.001 s.

minim

A unit of relative time in music = ½ whole note (a half note) = ½ semibreve = ¼ breve.

MJD or **M.J.D.**

An abbreviation for modified Julian date.

Mn

An abbreviation for m̲in̲ute.

mo

A sometimes used informal abbreviation for m̲o̲nth.

modified Julian day (MJD)

A count of days used by astronomers, space agencies, and others. Astronomers have long used the Julian day, a count of days beginning at noon Universal Time, January 1, 4713 BCE, as a means of specifying a date independent of all calendars. The only problem with this is that the numbers are large, more than 2.4 million, for current dates. Also, the old astronomical custom of beginning a day at noon is awkward for converting Julian dates to the ordinary calendar. To ease these problems, space engineers introduced the modified Julian date, = the Julian date minus 2,400,000.5. The result is a count of days beginning at 0 hours (midnight) Universal Time on November 17, 1858. Thus, for example, 0 hours 1 January 2005 is MJD 53371.0.

moment

A medieval unit of time in Britain = 1/40 h = 1.5 minutes. This meaning has come down to us only as "a brief interval of time." The moment was divided into 12 ounces of 7.5 s each.

Mon

An abbreviation for Monday.

mon

An abbreviation for month.

month[59]

(Abbreviated as **mo** or **mon**)

A unit of time marked by the revolution of the Moon around the Earth. In many traditional societies, the appearance of the first tiny crescent moon after the New Moon signaled the start of the month.

The **lunar month**, **lunation month**, or **synodic month** = the average interval between two successive moments of New Moon, and equals about 29.5305898 days = 29 days 12 h 44 min 3 s. Based on the lunar theory of Chapront-Touzé and Chapront (1988), it can be expressed as:

$29.5305888531 + 0.00000021621\ T - 3.64 \times 10^{-10}\ T^2$ days,

in which T = (JD – 24,51,545.0)/36,525 and JD is the Julian day number. Any particular phase cycle may vary from the mean by up to 7 hours.

The **sidereal month** = the time for one Moon orbit relative to the stars, and equals 27.321660 days = about 27 days 7 h 43 min 11 s.

The **tropical month** = the time for the mean position to increase 360º (effectively one lap around Tellus), and equals 27.3215879 days = 27 days 7 h 43 min 4 s.

The **draconic** or **nodical month** = the period between northward crossings of the ecliptic and which is shortened by the marked regressive gyration of the lunar orbital plane, and equals 27.212221 days (in 1990–2000) = 27 days 5 h 5 min 36 s.

The **anomalistic month** = the period between successive perigee passages, and equals 27.55455 days (in 1990–2000) = 27 days 13 h 18 min 33 s.

muhurta

A unit of time in India, as used in the traditional Hindu practice, measuring time of day from sunrise, = 1/30 day = 48 minutes.

nāḍī, chu tshod, **daṇḍa**, or **ghaṭikā**

In Tibet, a unit of time equal to 1/60 solar day = 1440 minutes.

nanocentury

A jocular unit of time = 3.156 s. The Canadian computer programmer Tom Duff (b. 1952), at Bell Labs Computing Science Research Center, is said to have pointed out that "…who could forget that, to within half a percent, π seconds is a nanocentury".[60]

nanosecond (ns)

A unit of time = 10^{-9} s.

natural year

See *astronomical year*.

new style (NS)

Notation used after dates to indicate that the date is stated in the Gregorian calendar rather than in the Julian calendar. The notation is used primarily for Gregorian dates between October 15, 1582, when the Gregorian calendar was adopted in Catholic

[59] [BERG2] and [CHAP2].

[60] bioreference.net/encyclopedia

Europe, and September 14, 1752, when it was adopted in Britain. See also *old style*.

newtonian time

See *Ephemeris Time*.

Nían Hào

[Traditional Chinese: 年號, simplified Chinese: 年号, pinyin: nían hào]

Name for eras used sporadically from 156 BCE and continuously from 140 BCE.[61] Until 1367, several were used during each emperor's reign. From 1368 until 1912, only one era name was used by each emperor, who was posthumously known by his era name. The era name originated as a motto or slogan chosen by an emperor.

note or **whole note**

A unit of relative time in music = ½ breve.

Nov

An abbreviation for November.

ns

An abbreviation for nanosecond.

nychthemeron [< Gr. νύξ "night" + ἡμέρα "day"]

A chronological term for a day and a night. Traditionally, it was said to start at sunset ("when the day ends") and end at dawn. This period of time is usually labelled as a date in a calendar. In a scientific meaning, it is defined as a period of 24 consecutive hours. See also *canonical day*.

o' clock

A contraction of the phrase "of the clock," used in English after a statement of time. This phrase is a relatively recent invention; it has been traced to the early 1700s. Earlier, time was usually stated in hours and minutes, and this is still the case in most languages. Thus "10 o' clock" is "10 hours" in most of the world.

[61] Emperor Wu of Han China (Han Wudi) was conventionally regarded as the first emperor to declare an era name; however, he was only the first to use an era name in every year of his reign. His grandfather and father also employed era names, though not continuously. Han Wudi changed period titles every 5 years or so, going through a total of 11 reigning slogans during his reign from 140 BCE to 87 BCE.

Oct

An abbreviation for October.

octennial or **octennium**

A unit of time = 8 years = about 252,455,407.803648 s; once every 8 years.

old style (OS)

Notation used after a date to indicate that the date is stated in the Julian calendar. The Julian calendar was replaced by the Gregorian calendar in 1582 in predominantly Catholic countries of Europe. It remained in use in Britain, a Protestant country, until 1752, and in Russia, an Orthodox country, until 1918. In addition, the first day of the New Year in Britain, until 1752, was March 25 instead of January1. Thus, George Washington, the first U.S. president, was born on February 11, 1731 OS, or February 22, 1732 in the Gregorian calendar.

olympiad

A unit of time = 4 years. In ancient Greece, the olympiad referred to the 4-year interval between successive Olympic Games. The first Greek olympiad was the period 776–773 BCE. The olympiad was revived in 1896 when the modern Olympics began.

ostent

Medieval name for the time unit now called the minute. In medieval times, a minute was = 1/10 hour = 6 modern minutes. The ostent was = 8 ounces.

pala

In India, a unit of time used in the traditional Hindu practice for measuring time of day from sunrise = 1/60 ghatika = 1/3,600 day = 24 s.

pala

See *pāṇīpala*.

pāṇīpala, **pala**, or **chu srang**

In Tibet, a unit of time equal to 1/3,600 solar day = 24 minutes.

paramanu[परमाणु]

Name in the Hindu metric system for the normal interval of blinking in humans = about 4 s.

Paschal period, **Victorian period,**[62] **Dionysian period,**[63] or **Great Pascal period**
A period of 532 years, the interval between two "identical" years. In concept, in any year, the days of the month will fall on the same weekdays, and the phases of the moon on the same dates, as they did in the year 532 years ago. The period is based on two calendrical cycles:
(i) The solar cycle. The days of every month in a year fall on the same day of the week, as the days did in the year one solar cycle ago. In the Julian calendar, used from 46 BCE to 1582, the solar cycle is 28 years. If the 4th of July was a Tuesday in 1400, in (1400 + 28) 1428, the 4th of July will also be a Tuesday.
(ii) The lunar cycle. In any year, the phases of the moon fall on the same days of the month as they did in the year one lunar cycle ago. The lunar cycle used in the Middle Ages was the Metonic cycle of 19 years. Actually, 19 years is only a close approximation, but generally speaking, if there was a full moon on August 6, 1300, there will be a full moon on August 6, 1319.

532 years have to pass (19 × 28 = 532) before both cycles complete at the same year.

PC
An abbreviation for *Post Christum*.

pentad
A unit of time = 5 days. This unit is common in meteorology, in which forecasts are frequently made for periods of 5 days at a time.

per
An abbreviation for <u>per</u>iod.

picosecond (ps)
A unit of time = 10^{-12} s.

[62] Named after Victorius of Aquitaine, a fifth century advisor to Pope Hilarius.

[63] Named after Dionysius Exiguus, the sixth century monk who established the Christian era by specifying the year of Christ's birth.

Platonic year, **equinoctial cycle**, or **great year**
A unit of time used in the history of astronomy. The earth's axis of rotation is not fixed in space. The attraction of the moon causes it to slowly trace out a circle in the sky. This motion, called precession, changes the orientation of the sky as seen from the earth's surface. The Platonic year is the length of time required for one complete precessional rotation, presently about 25,765 years. The unit is named for the ancient Greek philosopher Plato (*c*. 428–348 BCE).

PM or **pm**
An abbreviation for the Latin *post meridiem*, "after noon," used after a time to indicate that the time occurs after 12:00 noon. Thus, 4:30 pm is the same as 16:30. The notations "AM" and "PM" are used extensively in the United States, where time is usually not stated on a 24-hour basis.

postbellum [< L: *post bellum* ("after the war")]
A term used when referring to a period following a war. See also *interbellum* and *antebellum*.

quadrennium
A traditional unit of time = 4 years.

quarter (qtr or **Q)**
An informal unit of time = ¼ hour = 15 minutes. This unit occurs in informal expressions of time, such as "quarter after 10" for 10:15.

quarter (qtr or Q)
A unit of relative time used in sports = ¼ the total playing time of a competition. A quarter is 15 minutes in American football and 12 minutes in professional basketball.

quarter (qtr or **Q)**
A civil unit of time = 3 months = ¼ year. The quarter is widely used as a time unit in business and economics. Given the layout of the Gregorian calendar in civil use throughout the world, the quarter varies in length from 90 to 92 days, depending on its starting date.

quarter (qtr or **Q)**
A school term in the U.S. = ¼ of an academic year = about 12 weeks.

quaver
A unit of relative time in music = 1/8 whole note = 1/16 breve.

quindecennium [< L: *quīndecim* = "fifteen"; adj.: quindecennial]
A traditional unit of time = 15 years = about 473,353,889.63184 s.[64]

quinquennium [< L; *quīnque* = "five"; *pl.* quinquennia; adj.: quinquennial]
A traditional unit of time = 5 years = about 157,784,629.87728 s.[65]

ráithe
A name used in Ireland for a period of 3 months.[66]

rep
In the Klingon Culture in the TV Series Star Trek, a unit of time = a second. The artifical Klingon language was developed by Mark Okrand (b. 1948) in the early 1980s.[67] See also *DIS*, *Hogh*, *jar*, *lup*, and *tup*.

RickDate
A compressed date format using a base 36 numeral system to represent a date using a minimal amount of characters. RickDate has two forms: a long form using five characters, and a short form using three characters. In the *long form*, each component of the date is represented as a base-36 number, and the three components are concatenated together in Year-Month-Day order (YYYMD). The *short form*, using only the last base-36 digit of the year, is preferred for its compactness, although a context is usually needed to determine the intended year. For example, the RickDate format of September 20, 2006 is 1JQ9K, or Q9K, for short. RickDate was invented in December 1985 and is named after its originator, Rick Wong.[68]

round
A basic unit of time, used in boxing, = 3 minutes.

sabbatical [< L: "seventh"]
Name of seventh such interval, the seventh day hence being the "Sabbath"; the sabbatical year of academe is a year of leave that became due, traditionally, every seventh year.[69]

Saka Era
(Abbreviated as **SE** or **S.E.**)
An era used in some Hindu calendars and the Indian national calendar. See *Saka calendar*.

saros
A unit of time used in astronomy, mostly in predicting solar and lunar eclipses. The saros is = 6.585.32 days (6.585 days 7 hours 23 minutes), which is exactly 223 lunar months. (This is either 10 or 11 days more than 18 years, depending on the number of leap years during the period.) Astronomers in ancient times discovered that the saros is very nearly = 19 eclipse years (6.585.78 days). This means that one saros after an eclipse, the Sun, Moon, and Earth return almost exactly to the same position and another, very similar eclipse occurs. However, because of the 7 hours 23 minutes included, the Earth has turned about one third of a revolution, and the new eclipse occurs about 116° of longitude west of the preceding one. After 3 saros, the eclipse returns nearly to its original location. As a result, eclipses at a particular location tend to repeat with a period of 3 saros or 54 years 1 month. Thus, the last total solar eclipse in North Carolina, on 1970 March 7, will repeat on 2024 April 8, and again on 2078 May 11.

season
A traditional unit of time = ¼ year. The astronomical seasons begin at the instants of equinox (for spring and fall) or solstice (for summer and winter), on or near the 21st days of March, June, September, and

[64] [HAMP, p. 328].
[65] See also: [ANDE2].
[66] [DOLA, p. 213].
[67] [OKRA].
[68] www.yak.net
[69] [FENN].

December, respectively. In meteorology, however, the seasons begin on the 1st days of March, June, September, and December.

sec or **sec.**

Often seen, but not recommended, abbreviations for second.

second (s, sec or ")

A fundamental unit of time in most modern measuring systems.

Seleucid Era

See *Anno Graecorum.*

semester (sem)

An informal unit of time. The word semester comes from the Latin words for "six months," and originally, a semester was understood to equal 6 months = ½ year. However, the word is now used chiefly to mean half the academic year at a school or college, a period of time which can vary from 15 to 21 weeks.

semibreve

A unit of relative time in music = 1 whole note = ½ breve.

semiquaver

A unit of relative time in music = 1/16 whole note = 1/32 breve.

sennight

An old English name for a week, formed as a contraction of *seven nights*. The word is pronounced like "senate."

Sept

An abbreviation for September.

septenary

Name for a period covering 7 years.

septennium

A unit of time = 7 years.

shake

An informal unit of time,[70] originated in nuclear physics, = the approximate lifetime of an individual neutron, the fission of uranium or plutonium = 10^{-8} s = 10 ns. [AU, I put the comma in there because something seemed to be missing, but I wasn't sure what.] The word shake has long been used in English to mean a very brief unit of time, as in, "I'll be there in a shake."

shift

A unit of time = the scheduled period of work at a factory or other place of business. Businesses operating on a 24-hour basis typically organize the day into three daily shifts of 8 hours each. This usage is consistent with the old English meaning of "shift" as an arrangement or division.

ship's bells

A unit of time at sea indicated by a bell struck every half hour. A single stroke is struck a half hour after the beginning of each watch, at 12:30, 4:30, and 8:30 (both am and pm). An additional stroke is added at each tolling, every half hour, so that 8 bells are struck at the end of the watch. The interval betwen strikes is either 1 or 2 seconds, alternating. In the table below, the hyphen represents a 1-second interval and the long dash a 2-second interval.

solar year

See also *astronomical years*.

This is the popular term for the length of time that the Sun takes to return to the same position, as seen from Earth. Within the solar year are four well-defined phenomena:

1. The Vernal Equinox, when the Sun, from observations in the Northern Hemisphere, crosses the celestial equator from south to north.
2. The Summer Solstice, when the Sun at noon reaches its highest position in the sky.
3. The Autumnal Equinox, when the Sun, from observations in the Northern Hemisphere, crosses the celestial equator from north to south.
4. The Winter Solstice, when the Sun at noon appears at its lowest altitude above the horizon.

Interpretation of the events has varied among cultures, but has usually been recognized with festivals and rituals around these times with themes of religion.

[70] The name of the unit is probably from the catchphrase "two shakes of a lamb's tale."

spring
A unit of time = 8,031,600 s.

stretch
British slang for longer period in jail, in particular, a year. *He served a 2-year stretch.*

summer
A unit of time = 8,082,000 s.

Sun
An abbreviation for Sunday.

śvāsa
In Tibet, a unit of time equal to 1/21,600 solar day = 4 seconds.

Swatch Internet Time
A concept introduced in 1998 and marketed by the Swatch corporation as an alternative, decimal measure of time. The timescale was announced on October 23, 1998, in a ceremony attended by Nicolas G. Hayek, President and CEO of the Swatch Group, G.N. Hayek, President of Swatch Ltd., and Nicholas Negroponte, founder and then-director of the MIT Media Lab.

swing
An informal unit of time, describing the length of one work cycle. For example, a person who works 6 days in a row and then gets 2 days off is said to have a swing of 8 days.

SY
An abbreviation for seasonal year.

tempon
A unit of time = 10^{-23} s.

Temps Universel Coordonné
See *Coordinated Universal Time*.

third (‴)
A unit of time = 1/60 second. The symbol for this rarely-used unit is a triple prime, suggesting a natural progression from the minute (′) through the second (″) to the third (‴).

Thur, Thurs, or **Thu**
An abbreviation for Thursday.

tick
An informal unit of time = the length of one cycle of a clock. A tick of a computer system's clock, also called a jiffy, is usually 0.01 s. A tick in athletics is the smallest increment of time measured in a timed competition, usually 0.1 s or 0.01 s.

tidal day
A unit of time = the period between two successive passages of the moon through the meridian (the imaginary line across the sky from due north to due south). High and low tides repeat with this period, so the unit is fundamental to predictions of these tides. The tidal day, also called the **lunar day**, is = 24 hours 50 minutes (1490 minutes).

tierce or **terce**
Name, used among the medieval Christians of Europe, for the period of the day from sunrise to midmorning. The other divisions of the day were sext, none, and vespers.

time
Statements of the time of day are made in various ways in different countries. To avoid confusion in international communications, the International Organization for Standardization (ISO) established (in 1986) International Standard 8601[71] for representation of dates and times.

time zone
A unit representing the difference in time between a given location and Universal Time. Under ISO 8601, the difference is positive if the local time is later than Universal Time and negative if it is earlier. There are 25 integer World Time Zones from −12 through 0 (GMT) to +12. Each one is 15° of Longitude as measured East and West from the Prime Meridian of the World at Greenwich, England. There are now both civilian designations, which are typically two or three letter abbreviations for most time zones, and military designations. The military designations use each letter of the alphabet (except 'J') and are known by their phonetic equivalent.[72]

[71] ISO 8601: 1988 (E) Data elements and interchange formats—Information interchange—Representation of dates and times.

[72] From: greenwichmeantime.com

time zone
An informal unit used to express differences in longitude between two places on the Earth. On the average, a time zone spans 15° of longitude. Of course, actual time zones have irregular boundaries, so this is only approximate. At the latitudes of the continental U.S., time zones average about 800 miles wide.

tithi or **thithi**
Name in vedic timekeeping for the time it takes for the longitudinal angle between the moon and the sun to increase by 12°. Tithis begin at varying times of day and vary in duration from about 19 to about 26 hours. There are 30 tithis in each lunar month.

tramp's lagging
British slang for 90 days in jail.

triennium
A period of 3 years.

trimester
A unit of time = 3 months = 1/4 year; another name for the quarter. At certain U.S. colleges, a trimester is an academic term roughly 14 weeks long. In reckoning the length of human pregnancies, a trimester is a unit of 14 weeks, with the first trimester beginning on the first day of the last menstrual period.

tropical year
See *astronomical years*.

Tue, Tues, or **Tu**
An abbreviation for Tuesday.

tup
A unit of time, used in the Klingon Culture in the TV Series Star Trek, = a minute. The artifical Klingon language was developed by Mark Okrand (b. 1948) in the early 1980s.[73]
See also *DIS*, *Hogh*, *jar*, *lup*, and *rep*.

twelvemonth
Old English name for a *year*.

vipala
A unit of time, used in the traditional Hindu practice in India, = 60 pratipalas = 1/60 pala = 1/3,600 ghatikas = 1/216,000 vara or day = 0.4 s.

wa'maH cha' pemmey wa'maH cha' rammey je [Klingon Culture (artificial language): = "12 days and 12 nights" = a long time]
A unit of time in the artificial language Klingon, used in the TV Series Star Trek.[74]

Warhol unit
A jocular unit of time = 15 minutes of fame. The name of the unit, used in the *late twentieth–early twenty-first centuries,* was taken from a famous remark by the artist Andy Warhol (*1928?–1987*) that in the future everyone would enjoy 15 minutes of fame.

watch [< OE: wæccan = "stay awake"]
A traditional unit of time, defined as the time a sentry stands watch or a ship's crew is on duty. On both land and sea, one watch is usually = 4 hours. At sea, the evening watch (16–20 hours, or 4–8 pm) is often divided into two shorter watches called "dog watches." When dog watches are in effect, sailors will have watch assignments that rotate through the day instead of falling at the same hours every day. Watches at sea are divided into 8 bells (4 bells for dog watches).
First watch = 20:00–00:00;
middle watch = 00:00–04:00;
morning watch = 04:00–08:00;
forenoon watch = 08:00–12:00;
afternoon watch = 12:00–16:00;
first dog watch = 16:00–18:00;
second dog watch or last dog watch = 18:00–20:00.

watch
Another name for a shift. This use has been popularized in the U.S. by CNN Headline News and by the NBC television series *Third Watch*.

week
A unit of time, used for cycles of work days and rest days in most cultures, comprising a few days. Historically, "weeks" have been intervals between 3 and 10 days. With few exceptions, weekly cycles are wholly

[73] [OKRA].

[74] [OKRA].

arificial and have no exact counterpart in the phenomena by which we reckon time.

3-day week

A 3-day week (aste) may have been used in prehistoric Guipuscoan Basque. The names of the weekdays: Astelehena ("week-first"), Asteartea ("week-between"), and Asteazkena ("week-last").[75]

4-day week

The Igbo culture in Nigeria and the Bakongo culture in the Kingdom of Kongo both used 4-day market weeks. The names of the Igbo days were: Afọ, Nkwọ, Eke, and Orie, and the Bakongo weekdays were called: Konzo, Nkenge, Nsona, and Nkandu. See also *Bakongo calendar* and *Igbo calendar*.

5-day week

A 5-day cycle of market days is still used in some parts of Korea, and a 5-day cycle known as the Pasaran cycle is used by the Javanese people of Indonesia. The names of the weekdays in krama: Manis, Pait, Petak, Cemeng, and Asih. See also *Javanese calendar*.

6-day week

The Akan culture in Ghana and in northern Guam used a 6-day cycle (*Nnanson*) as well as a 7-day cycle (*NnawƆtwe*). The names of the weekdays in the 6-day cycle: Fo, Nwuna, Nkyi, Kuru, Kwa, and Mono. See also *Akan calendar*.

7-day week

The 7-day week was used in ancient Babylonia, as well as by the Jews after the Babylonian captivity during the sixth century BCE. This tradition was later adopted by most ancient Near East cultures, as well as India and China.

The tradition of naming weekdays according to the Roman-Hellenistic astrology, in the order Sun, Moon, Mars, Mercurius, Jupiter, Venus, and Saturnus, became common during the second century, and is still used in many Indo-European languages. Some languages also bear the imprint of the Jewish tradition of describing the seventh day as Shabbat ("rest" day).

	Latin	Albanian	Aragonese	Aranese	Asturian	Catalan	Corsican
Sunday	diēs solis	e diel	Domingo	dimenge	domingu	diumenge	dumenica
Monday	diēs lūnae	e hënë	Luns	deluns	llunes	dilluns	luni
Tuesday	diēs martis	e martë	Martes	dimars	martes	dimarts	marti
Wednesday	diēs mercurī	e mërkurë	Miércols	dimèrcles	miércoles	dimecres	marcuri
Thursday	diēs iovis	e enjte	Chuebes	dijaus	xueves	dijous	ghjovi
Friday	diēs veneris	e premte	Biernes	diuendres	vienres	divendres	venneri
Saturday	diēs saturnī	e shtunë	Sabado	dissabte	sábadu	dissabte	sabbatu

	Dgèrnésiais	French	Friulian	Galician	Haitian creole	Italian	Jèrriais
Sunday	dinmanche	dimanche	domenie	domingo	dimanch	domenica	Dînmanche
Monday	lundi	lundi	lunis	luns	lendi	lunedì	Lundi
Tuesday	mardi	mardi	martars	martes	madi	martedì	Mardi
Wednesday	méquerdi	mercredi	miercus	mércores	mèkre	mercoledì	Mêcrédi
Thursday	jeudi	jeudi	joibe	xoves	dijedi	giovedì	Jeudi
Friday	venderdi	vendredi	vinars	venres	vandredi	venerdì	Vendrédi
Saturday	samedi	samedi	sàbide	sábado	samdi	sabato	Sanm'di

[75] See also [BAUS2].

	Judaeo-Spanish	Ligurian	Neapolitan	Normand	Occitan	Papiamento	Poitevin
Sunday	אדאה (Alhad)	duménnega	dummeneca	dîmmaunche	dimenge	djadomingo	dimenche
Monday	לוניס (Lunes)	lûnedí	lunnerì	lundi	diluns	djaluna	léndi
Tuesday	מארטיס (Martes)	martedí	marterì	mardi	dimars	djamars	mardi
Wednesday	מיירקוליס (Mierkoles)	merculedí	miercurì	mercrédi	dimècres	djarason	mécrdi
Thursday	ג'ואיב'יס (Djueves)	zœggia	gioverì	jéeudi	dijóus	djaweps	jheùdi
Friday	ב'יירניס (Viernes)	venardí	viernarì	vendrédi	divendres	djabièrna	vendrdi
Saturday	שבת (Shabat)	sabbu	sàbbato	sammedi	dissabte	djasabra	sémedi

	Old Portuguese	Provencal	Romanian	Sardinian	Spanish
Sunday	domingo	dimenche	duminică	dumíniga	domingo
Monday	lunes	dilun	luni	lunis	lunes
Tuesday	martes	dimars	marţi	martis	martes
Wednesday	miécoles	dimèdre	miercuri	mércuris	miécoles
Thursday	jueves	dijòu	joi	giòvia	jueves
Friday	viernes	divèndre	vineri	chenábura	viernes
Saturday	sábado	dissate	sâmbătă	sáppadu	sábado

In the modern Portuguese language, the names of the weekdays are described in the same way as in the Roman Rite liturgy, used in the Diocese of Rome in the Catholic Church, where the term *feria* is used to denote days of the week other than Sunday and Saturday.

	Latin (Church)	Portuguese
Sunday	dominica	Domingo
Monday	secunda feria	segunda-feira
Tuesday	tertia feria	terça-feira
Wednesday	quarta feria	quarta-feira
Thursday	quinta feria	quinta-feira
Friday	sexta feria	sexta-feira
Saturday	sabbatum	Sábado

Before the collapse of the Western Roman Empire, the Roman system of the 7-day week was also adopted by many Germanic peoples. Thus, the weekday names in various Germanic languages differed just slightly. See also (Old) *Anglo-Saxon calendar*, (Old) *Estonian calendar*, (Old) *Finnish calendar*, (Old) *High German calendar*, and (Old) *West Frisian calendar*.

The names of the weekdays in some Germanic languages:

	Proto-Germanic	Old High German	Middle Low German
Sunday	Sunnōniz dagaz	Sunnûntag	Sunnedag
Monday	Mēniniz dagaz	Mânetag	Manedag
Tuesday	Tīwas dagaz	Zîestag	Dingesdag
Wednesday	Wōdanas dagaz	Wôdanstag	Wodenesdag
Thursday	Þunras dagaz	Donarestag	Donersdag
Friday	Frijjōz dagaz	Frîjatag	Vrīdag
Saturday	Saturnus dagaz or Laugō dagaz	Sunnûnâband or Sambaztag	Sunnenavend or Satersdag

	Old Saxon	Old English	Low Saxon	Yiddish
Sunday	Sunnundag	Sunnandæg	Sünndag	זונטיק (Zuntik)
Monday	Mānundag	Mōnandæg	Maandag	מאנטיק (Montik)
Tuesday	Tiuwesdag	Tīwesdæg	Dingsdag	דינסטיק (Dinstik)
Wednesday	Wōdanesdag	Wōdnesdæg	Woonsdag	מיטוואך (Mitvokh)
Thursday	Thunaresdag	Þunresdæg	Dünnersdag	דאנערשטיק (Donershtik)
Friday	Frīadag	Frīgedæg	Freedag	פרייטיק (Fraytik)
Saturday	Sunnunāƀand or Satarnesdag	Sæternesdæg	Sünnavend or Saterdag	שבת (Shabbes)

	German	German (Swiss)	German (Swabian)	Dutch
Sunday	Sonntag	Sunntig	Sonndich	zondag
Monday	Montag	Määntig	Mendich	maandag
Tuesday	Dienstag	Tiuwesdag	Denschdich	dinsdag
Wednesday	Wutenstag, later Mittwoch	Wōdanesdag	Mittich	woensdag
Thursday	Donnerstag	Thunaresdag	Donnerschtich	donderdag
Friday	Freitag	Frīadag	Fraidich	vrijdag
Saturday	Sonnabend or Samstag	Sunnunāƀand or Satarnesdag	Samschdich	zaterdag

In the Scandinavian languages, Tuesday, Wednesday, Thursday, and Friday are weekday names derived from the Norse Gods (Týr, Odin, Thor, and Frigg), while Saturday is derived from the old word for bathing. See also (Old) *Danish calendar*, (Old) *Icelandic calendar*, (Old) *Norse calendar*, and (Old) *Swedish calendar*.

	Faroese	Danish	Norweigan (Nynorsk)	Norweigan (Bokmål)	Swedish
Sunday	sunnudagur	Søndag	sundag	søndag	söndag
Monday	mánadagir	Mandag	måndag	mandag	måndag
Tuesday	týsdagur	Tirsdag	tysdag	tirsdag	tisdag
Wednesday	mikudagur or ónsdagur	Onsdag	onsdag	onsdag	onsdag
Thursday	hósdagur or tórsdagur	Torsdag	torsdag	torsdag	torsdag
Friday	fríggjagagur	Fredag	fredag	fredag	fredag
Saturday	leygardagur	Lørdag	laurdag	lørdag	lördag

The Germanic tradition of naming weekdays has also been adopted in some other Indo-European languages.

	Afrikaans	Alsatian	Limburgish
Sunday	Sondag	Sunndi	Zóndig
Monday	Maandag	Mandi	Maondig
Tuesday	Dinsdag	Zischdi	Daensdig
Wednesday	Woensdag	Mittwuch	Goonsdig
Thursday	Donderdag	Dunnerschdi	Dónderdig
Friday	Vrydag	Fridi	Vriedig
Saturday	Saterdag	Sàmschdi	Zaoterdig

The days of the week are usually numbered from Sunday of the planetary week in Arabic, Turkic, and various languages used in India. The Islamic and Hebrew weekdays begin at sunset, whereas the Christian liturgical weekday begins with vespers in the evening and the medieval Christian weekday begins at the following midnight.

	Modern Standard Arabic	Egypt, Sudan, and Yemen	Morocco	Iran (Persian)
Sunday	يوم الأحد (yaum al-Aḥad)	الحد (el-hadd)	يوم الأحد (nhar lhedd)	یکشنبه (yek-shanbeh)
Monday	يوم الإثنين (yaum al-Ithnayn)	الاتنين (l-etnen)	يوم الإثنين (nhar letnīn)	دوشنبه (do-shanbeh)
Tuesday	يوم الثلاثاء (yaum ath-Thalaathaa')	التلات (et-talāt)	يوم الثلاثاء (nhar ttlat)	سهشنبه (se-shanbeh)
Wednesday	يوم الأربعاء (yaum al-Arba'aa')	الاربع (l-arbā')	يوم الأربعاء (nhar larb')	چهارشنبه (chahar-shanbeh)
Thursday	يوم الخميس (yaum al-Khamīs)	الخميس (el-khamēs)	يوم الخميس (nhar lekhmīs)	پنجشنبه (panj-shanbeh)
Friday	يوم الجمعة (yaum al-Jumu'ah)	الجمعة (el-gom'ā)	يوم الجمعة (nhar zhzhem'a)	جمعه (jom'e)
Saturday	يوم السبت (yaum as-Sabt)	السبت (es-sabt)	يوم السبت (nhar ssebt)	شنبه (shanbeh)

	Sanskrit	Bangla	Dzongkha	Gujarati	Hindi
Sunday	भानुवासरम् (bhānu vāsaram)	রবিবার (robibar)	གཟའ་ཟླ་བ་	રવિવાર (ravivār)	रविवार (ravivār)
Monday	इन्दुवासरम् (indu vāsaram)	সোমবার (shombar)	གཟའ་མིག་དམར་	સોમવાર (somvār)	सोमवार (somvār)
Tuesday	भौमवासरम् (bhauma vāsaram)	মঙ্গলবার (monggolbar)	གཟའ་ལྷག་པ་	મંગળવાર (maṁgaḷvār)	मंगलवार (mamgalvār)
Wednesday	सौम्यवासरम् (saumya vāsaram)	বুধবার (budhbar)	གཟའ་ཕུར་བུ་	બુધવાર (budʰvār)	बुधवार (budhvār)
Thursday	गुरूवासरम (guru vāsaram)	বৃহস্পতিবার (brihôshpotibar)	གཟའ་པ་སངས་	ગુરુવાર (guruvār)	गुरुवार (guruvār)
Friday	भ्रगुवासरम् (bhrgu vāsaram)	শুক্রবার (shukrobar)	གཟའ་སྤེན་པ་	શુક્રવાર (šukravār)	शुक्रवार (šukravār)
Saturday	स्थिरवासरम् (sthira vāsaram)	শনিবার (shonibar)	གཟའ་ཉི་མ་	શનિવાર (šanivār)	शनिवार (šanivār)

	Kannada	Kashmiri	Marathi	Nepali
Sunday	ರವಿವಾರ, ಆದಿತ್ಯವಾರ, or ಭಾನುವಾರ (bhanuvara)	آتھ وار (aath'var)	रविवार (ravivār)	रबिबार (rabibār)
Monday	ಸೋಮವಾರ (somavara)	ژٕنٛدر وار (tsander'var)	सोमवार (somavār)	सोम्बार (sombār)
Tuesday	ಮಂಗಳವಾರ (mangalavara)	بوم وار (bom'var)	मंगळवार (mangaḷavār)	मङ्गल्बार (maṅgalbār)
Wednesday	ಬುಧವಾರ (budhavara)	بۄدھ وار (budh'var)	बुधवार (budhavār)	बुध्बार (budhbār)
Thursday	ಗುರುವಾರ (guruvara)	برس وار (bres'var)	गुरूवार (guruvār)	गुरुबार (gurubār)
Friday	ಶುಕ್ರವಾರ (shukravara)	جُمھ (jummah)	शुक्रवार (shukravār)	शुक्रबार (šukrabār)
Saturday	ಶನಿವಾರ (shanivara)	بٹ وار (bat'var)	शनिवार (shanivār)	सनिचर्बार (šanicarbār)

	Oriya	Pashto	Punjabi (in India)	Punjabi (in Pakistan)
Sunday	ରବିବାର (rôbibār)	ییوه ن (yawanay)	ਐਤਵਾਰ (aitvaar)	اتوار (itwaar)
Monday	ସୋମବାର (sombār)	یدوه ن (dwanay)	ਸੋਮਵਾਰ (somvaar)	پیر (piir)
Tuesday	ମଙ୍ଗଳବାର (môṅgôlbār)	ینځمن (manzanay)	ਮੰਗਲਵਾਰ (mangalvaar)	منگل (mangal)
Wednesday	ବୁଧବାର (budʰbār)	یلنځ (salanay)	ਬੁੱਧਵਾਰ (budhvaar)	بدھ (budh)
Thursday	ଗୁରୁବାର (gurubār)	ینځپن (panzanay)	ਵੀਰਵਾਰ (veervaar)	جمعرات (jumeh'raat)
Friday	ଶୁକ୍ରବାର (šukrôbār)	نهیاد (adina)	ਸ਼ੁੱਕਰਵਾਰ (shukrvaar)	جمعہ (juma'h)
Saturday	ଶନିବାର (šônibār)	(sabtu)	ਸ਼ਨੀਵਾਰ (shanicharvaar)	هفتہ (hafta)

	Sinhalese	Tamil	Urdu (in Pakistan)
Sunday	ඉරිදා (irdaa)	ஞாயிறு (nyāyiru)	اتوار (itvār) or چری سن (sanīchar)
Monday	සඳුදා (sandudaa)	திங்கள் (tingkaḷ)	پیر (pīr) or سوموار (somwar)
Tuesday	අඟහරුවදා (anngaharuwadaa)	செவ்வாய் (cevvāy)	منگل (mangal)
Wednesday	බදාදා (badaadaa)	புதன் (putan)	بدھ (buddh)
Thursday	බ්‍රහස්පතින්දා (brahaspathindaa)	வியாழன (viyālan)	جمعرات (jum'eh'rāt)
Friday	සිකුරාදා (sikuradaa)	வெள்ளி (veḷḷi)	جمعہ (jum'ah)
Saturday	සෙනසුරාදා (senasuraadaa)	சனி (cani)	بفتہ (haftā)

	Azerbaijani	Chechen	Old Turkic	Turkish	Uzbek
Sunday	Bazar günü	К1иранде (k'irande)	birinç kün	Pazar	Yakshanba
Monday	Bazar ërtësi	Оршот (orshot)	ikinç kün	Pazartesi	Dushanba
Tuesday	Çërşënbë axşamı	Шинара (shinara)	üçünç kün	Salı	Seshanba
Wednesday	Çërşënbë günü	Кхаара (qaara)	törtinç kün	Çarşamba	Chorshanba
Thursday	Cümë axşamı	Еара (eara)	beşinç kün	Perşembe	Payshanba
Friday	Cümë günü	П1ераска (p'eraska)	altınç kün	Cuma	Juma
Saturday	Şënbë	Шот (shot)	yetinç kün	Cumartesi	Shanba

The names of the weekdays in some other languages that begin the week on Sunday:

	Basque	Biscayne Basque	Fijian	Filipino	Indonesian	Japanese	Javanese	Kapampangan
Sunday	igandea	domeka	Sigatabu	Linggo	Minggu	日曜日 (nichiyōbi)	Raditya	Domíngo
Monday	astelehena	astelena	Mōniti	Lunes	Senin	月曜日 (getsuyōbi)	Soma	Lúnes
Tuesday	asteartea	martitzena	Tūsiti	Martes	Selasa	火曜日 (kayōbi)	Anggara	Mártes
Wednesday	asteazkena	eguaztena	Vukelulu	Miyerkules	Rabu	水曜日 (suiyōbi)	Buda	Miércules
Thursday	osteguna	eguena	Lotulevu	Huwebes	Kamis	木曜日 (mokuyōbi)	Respati	Huébes
Friday	ostirala	barikua	Vakaraubuka	Biyernes	Jumat	金曜日 (kinyōbi)	Sukra	Biérnes
Saturday	larunbata	zapatua	Vakarauwai	Sabado	Sabtu	土曜日 (doyōbi)	Tumpek	Sabádo

	Korean	Livonian	Malay	Maltese	Tahitian	Tok Pisin	Tsonga
Sunday	일요일 (ilyoil)	pivāpā̄va	hari Ahad or hari Minggu	il-Ħadd	Tāpati	Sande	Sonto
Monday	월요일 (weuryoil)	ežžõmpā̄va	hari Isnin	it-Tnejn	Monirē	Mande	Musumbhunuku
Tuesday	화요일 (hwayoil)	tuoiznapā̄va	hari Selasa	it-Tlieta	Mahana Piti	Tunde	Ravumbirhi
Wednesday	수요일 (suyoil)	kuolmõndpā̄va	hari Rabu	l-Erbgħa	Mahana Toru	Trinde	Ravunharhu
Thursday	목요일 (mokyoil)	neļļõndpā̄va	hari Khamis	il-Ħamis	Mahana Maha	Fonde	Ravumune
Friday	금요일 (geumyoil)	brēćig	hari Jumaat	il-Ġimgħa	Mahana Pae	Fraide	Ravuntlhanu
Saturday	토요일 (toyoil)	pūolpā̄va	hari Sabtu	is-Sibt	Mahana Mā'a	Sarere	Mugqivela

	Tuvaluan	Vietnamese	Võro	Wallon	Wolof	Zulu
Sunday	Aso Tapu	主日(Chủ nhật)	pühäpäiv	dimenge	Dibèer	iSonto
Monday	Aso Gafua	次𠄩 (Thứ hai)	iispäiv	londi	Altine	uMombuluko
Tuesday	Aso Lua	次𠀧 (Thứ ba)	tõõsõpäiv	mårdi	Talaata	uLwesibili
Wednesday	Aso Tolu	次四 (Thứ tư)	kolmapäiv	mierkidi	Allarba	uLwesithathu
Thursday	Aso Fā	次𠄼 (Thứ năm)	neläpäiv	djudi	Alxamess	uLwesine
Friday	Aso Lima	次𦒹 (Thứ sáu)	riidi	vénrdi	Ajjouma	uLewishlanu
Saturday	Aso Ono	次𦉱 (Thứ bảy)	puulpäiv	semdi	Gaawu	uMgqibelo

In most Baltic, Slavic, and Uralic languages, the days of the week are numbered from Monday.

	Belarussian	Macedonian	Bosnian	Croatian
Monday	Панядзелак (panjadzielak)	Понеделник (ponedelnik)	ponedeljak	ponedjeljak
Tuesday	Аўторак (aŭtorak)	Вторник (vtornik)	utorak	utorak
Wednesday	Серада (sierada)	Среда (sreda)	srijeda	srijeda
Thursday	Чацьвер (čac'vier)	Четврток (chetvrtok)	cxetvrtak	četvrtak
Friday	Пятніца (pjatnica)	Петок (petok)	petak	petak
Saturday	Сыбота (sybota)	Сабота (sabota)	subota	subota
Sunday	Нядзеля (njadzielja)	Недела (nedela)	nedjelja	nedjelja

	Kashubian	Mongolian	Serbian	Russia
Monday	Pòniedzôłk	Даваа (davaa)	Понедељак (ponedeljak)	Понедельник (ponedel'nik)
Tuesday	Wtórk	Мягмар (myagmar)	Уторак (utorak)	Вторник (vtornik)
Wednesday	Strzoda	Лхагва (lkhagva)	Среда (sreda)	Среда (sreda)
Thursday	Czwiôrtk	Пүрэв (pürev)	Четвртак (četvrtak)	Четверг (chetverk)
Friday	Piątk	Баасан (baasan)	Петак (petak)	Пятница (pyatnitsa)
Saturday	Sobòta	Бямба (byamba)	Субота (subota)	Суббота (subbota)
Sunday	Niedzela	Ням (nyam)	Недеља (nedelja)	Воскресенье (voskresen'ye)

In Swahili, the weekday begins at sunrise rather than sunset, and therefore Saturday is the first day of the week, as this day includes the first night of the week in the Arabic and Hebrew calendar.

	Swahili
Saturday	jumamosi
Sunday	jumapili
Monday	jumatatu
Tuesday	jumanne
Wednesday	jumatano
Thursday	alhamisi
Friday	ijumaa

8-day week

The Burmese zodiacal calendar uses an 8-day cycle. The names of the weekdays: Taninganwe, Taninla, Inga, Boddahu, Rahu, Kyathabade, Thaukkya, and Sanay.

During the eighth century BCE, an 8-day market week was adopted by the Etruscans. This cycle, known as the nundinal cycle, was later adopted by the Romans, but the 7-day cycle became more popular after the introduction of the Julian calendar, and the 8-day week soon became obsolete.

The Celts used to signify the length of 9 nights and 8 days as *co cend nomaide*, which divided the sidereal month of 27 nights into three parts.

9-day week

The Medieval Welsh calendars may, according to Cyfraith Hywel, have used a 9-day week before the final conquest of England between 1277 and 1283.

A lunisolar calendar, used in the Grand Duchy of Lithuania during the fourteenth century, divided each month into three 9-day weeks.

10-day week

10-day market weeks were used in China, Japan, and Korea.

week (wk) [*pl.* weeks]

A unit of time = 7 d = 168 h = 10,080 min = 604,800 s. In pre-literate societies, weeks of 4–10 days were observed; those weeks were typically the interval from one market day to the next. Four to 10 days gave farmers enough time to accumulate and transport goods to sell. The 7-day week was introduced in Rome in the first century AD by Persian astrology fanatics. The idea was that there would be a day for the five known planets, plus the sun and the moon, making seven; this was an ancient West Asian idea. However, when Christianity became the official religion of the Roman empire in the time of Constantine (c. 325 AD), the familiar Hebrew-Christian week of 7 days, beginning on Sunday, became conflated with the pagan week and took its place in the Julian calendar. Since none of the units of Roman datekeeping (the month, the quarter, and the year) equal a whole number of weeks, this made it necessary for the first time to have tables (what we call calendars!) showing the ever-changing relationship between the days of the week and the dates of the month. In western countries, most calendars show Sunday as the first day of the week, but the International Organization for Standardization (ISO) specifies that the week begins with Monday. There are also different ideas about how to number the weeks of the year, which is sometimes necessary for business purposes. The official solution to this question is that week 1 of the year is the week (beginning with Monday) that contains January 4. Week 1 of 2001 was the week January 1–7, but week 1 of 2002 was the week December 31–January 6. When, in 1752, the calendar in England changed from Julian to Gregorian, the week was preserved, though not the days of the month: Sept. 14 followed Sept. 2, but Thursday followed Wednesday, as always. Eleven days disappeared from the calendar, but not from the week!

week

A more loose use of the prior unit, even including a second complete weekend = 9 days in a row.

weekend
A unit of time, such as the pair of days Saturday and Sunday, plus, for a long weekend, the whole of the relevant Friday or Monday, and usually including the prior evening.

weekend
British slang for a few days in jail.

whole note or **semibreve**
A unit of relative time in music. See *semibreve* and *note*.

winter
A unit of time = 7,693,200 s.

Wk
An abbreviation for week.

year
(Abbreviated as **a**, **y**, or **yr**)
[< OE: ȝēr; abbreviation a < Fr.: *année* = "year", or L: *annum* = "year"]
Various intervals of time, all roughly based on the time required for the Earth to make one journey around the sun.
We need a whole number of days for the *calendar year* used in ordinary life. We now know the correct figure is about 365.24219879 days in a tropical year. If we use 365 as the number of days in every calendar year, the extra 0.24219872 day adds up quickly and causes large errors in predicting the seasons. To solve this problem, the Roman emperor Julius Caesar decreed, in 46 BCE, that the calendar year should have 365 days generally, but that every fourth year should have an extra, or 366th, day. The longer year is called a leap year. In this Julian calendar, 4 years equal exactly 1461 days, so the average Julian year is exactly 365.25 days. This was a big step toward accuracy in the calendar, but the Julian year is too long by about 0.0078 day = 11.232 minutes. By the time of the Renaissance, these 11-minute errors had accumulated to a total error of about 10 days, so that the spring equinox was occurring near March 11 instead of March 21. In 1582, Pope Gregory XIII decreed that 10 days should be dropped from the calendar: the day after October 4 that year was thus October 15. To reduce future errors, the pope further decreed that years divisible by 100 are not leap years unless they are also divisible by 400. Thus, 2000 and 2400 are leap years, but 2100, 2200, and 2300 are not. It took many years, but the Gregorian calendar has now been accepted as the civil calendar in all countries of the world. With the Gregorian adjustment, there are exactly 146,097 days in every 400 years, and the average Gregorian year is exactly 365.2425 days. The Gregorian year is still too long, but only by 0.00030121 day, or about 26 seconds. It takes 3323 years for this error to accumulate to 1 day, so the calendar year and the tropical year are in good enough agreement to last us a long time.

y/o
A common symbol for "years old".

yr
A not recommended but common abbreviation for year.

Z [The German word for time is *Zeit*]
A symbol for universal time, used with a 4-digit statement of the time in hours and minutes; thus, 9:26 UT is written as 0926 Z. The symbol is often pronounced "zulu" (zoo loo), the name of the letter Z in the international radio alphabet.[76]

zulu time
A time scale used by the U.S. Navy, as well as civil aviation. The letter "Z" (phonetically "zulu") refers to the time at the prime meridian.

[76] See [SANZ].

Ancient Systems of Weights, Measures and Currencies

In this section, I have chosen to gather information on some of the countless number of ancient and medieval sovereign states and kingdoms, about which I found some reliable and relevant information. The immensely complex relationship between them, albeit chronologically and geographically scattered, has been a major challenge to illustrate in a certain sense. Here, we also must take into account their geographic location, commercial activities, technological knowledge and the ability of their rulers.

In the introductory text to each state, I have almost consistently chosen to briefly describe its historical development and essential connections to previous and subsequent sovereign states. Then again, there is often a short description of the measurement systems used, and their possible connection to, or influence by, systems used by other cultures. The main currency and payment systems used by each culture is also presented briefly and chronologically in the header. This is followed by a list of the main articles, books, personal interviews and/or correspondences that has been used for this particular chapter. To make the following table section more legible, I have usually chosen only to use references here to highlight unique data or conclusions made by different scholars. The table section for systems of weights and measures is presented under headings like "units of quantity," "units of length," "units of area," "units of volume," "units of dry capacity," "units of liquid capacity" and "units of weight."

1 Achaemenid Empire (c. 550 BCE–330 BCE)

This empire was founded by Cyrus II, and was centered in southwest Iran and lower Mesopotamia. It achieved its greatest reach during the reign of Darius I (521–486 BCE), stretching from the Aegean sea to the Indus river, from Egypt to the modern central Asian Republics.

An official system of weights and measures, developed from past custom and practice, was established in the area during the reign of the Achaemenid dynasty. Their trade with the eastern Mediterranean empires was rather extensive. This means that most of their units of measurement came to influence many other ancient cultures' measurement systems. In 1933, as many as 30,000 or more tablets and fragments were unearthed at Persepolis, present-day Takht-I Jamshid. Those tablets, now known as the *Persepolis Fortification tablets*, came from the middle of the reign of Darius I (509–494 BCE). Most tablets were in the Elamite language, some were in Aramaic, and a few were written in Akkadian, Greek and Anatolian.

Main sources: [CART2], [GERS], [HALL3], [HALL4], [HENN2], [LEHM2], [MITC], [REGL], [SCHM2], and [TUPL]

J. Gyllenbok, *Encyclopaedia of Historical Metrology, Weights, and Measures*, Science Networks. Historical Studies 56, https://doi.org/10.1007/978-3-319-57598-8_5

1.1 Currency

Daric (gold coin) and siglos (silver coin)

1.2 Units of Length

Proposed Avestan system based on the *Yašt*s, the *Vidēvdād* and the *Nērangistān*

						Metric
tačar						~10.44 km
2	**hāθra**					~5.22 km
6000	3000	**vibāzu**				~1.74 m
12,000	6000	2	**gāya** or **gāman**			~870 mm
20,000	10,000	3⅓	1⅔	**frārāθni**		~522 mm
30,000	15,000	5	2½	1½	**paδa**	~348 mm

Achaemenid-Elamite system, upper scale

						Metric
stathmos[a] or **mansion**						~24 or ~30 km
4 or 5	**parasang**[b]					~6 km
1000 or 1250	250	**chebel** or **daca kswacsh**[c]				~24 m
8000 or 10,000	2000	8	**daca trayas**[d]			~3 m
16,000 or 20,000	4000	16	2	**panka**		~1.5 m
40,000 or 50,000	10,000	40	5	2½	**kswacsh dva**[e]	~600 mm

[a]In concept, one day's march on the Persian Royal Road. The distance from Sardes to the palace of Memnon in Susa, estimated as being about 2699 km, took about 90 days on foot (described by the Greek researcher and storyteller Herodotus of Halicarnassus in his "The Histories" (5.52–53))
[b]In concept, the distance a horse could walk in 1 h
[c]100 feet
[d]10 feet
[e]6 handbreadths

Achaemenid-Elamite system, lower scale

						Metric
kswacsh dva						~600 mm
1⅕	**panka dva**[a]					~500 mm
1½	1¼	**Remen**				~400 mm
2	1⅔	1⅓	**trayas** or **zereth**			~300 mm
6	5	4	3	**dva**		~100 mm
30	25	20	15	5	**aiwas**	~20 mm

[a]5 handbreadths or a cubit

1.3 Units of Dry Capacity

Babylonian system

				Metric
talent				~25 L
50	sacred **mina**			~500 mL
60	1⅕	profane **mina**		~417 mL
3000	60	50	**shekel**	~8.33 mL

Achaemenid-Elamite system

							Metric
achanē[a]							1258.2 L
45	**artabē**[a]						27.96 L
135	3	**BAR**[b] or **grīw**					9.32 L
450	10	3⅓	**bawiš**				2.796 L
900	20	6⅔	2	**danake**			1.398 L
1350	30	10	3	1½	**QA** or **hōfan**		932 mL
7200	160	53⅓	16	8	5⅓	**halluru**	175 mL

[a]According to Herodotus, 1 **achanē** = 2 505.15 L and 1 **artabē** = 55.67 L
[b]Elamite measure **kurrima** (See also [HALL3])

1.4 Units of Liquid Capacity

Achaemenid-Elamite system

		Metric
marriš		9.32 L
4	**kapithē** or **QA**[a]	2.33 L

[a]Probably also equal to 1 **it-ba-mi-ya**, according to [HALL4, p. 73]

1.5 Units of Weight

A tradition of iron-shaped weights can be traced back to the Late Assyrian period during the eighth century BCE. When the Persians came to dominate the Near East, they adopted much from this earlier administrative system.

Presumed Babylonian system, based on [LEHM2]

				Metric
biltu or **talent**				29.472 kg
60	**manū**			491.2 g
3600	60	**šiqlu**		8.2 g
7200	120	2	**zūzu**	4.1 g

Presumed late Babylonian system

										Metric
?[a]										120.96 kg
2	**?**[b]									60.48 kg
4	2	**talent**[c]								30.24 kg
24	12	6	**?**[b]							5.04 kg
240	120	60	10	**mina**						504 g
1440	720	360	60	6	**karša** or **karschā**					84.0 g
14,400	7200	3600	600	60	10	**shekel**[d]				8.40 g
21,600	10,800	5400	900	90	12	1½	**šiqlu**[e]			5.60 g
115,200	57,600	28,800	4800	480	80	8	5⅓	**dânake**		1.05 g
2,592,000	1,296,000	648,000	108,000	10,800	1800	180	120	22½	**gran** (wheat grain)	46.7 mg

[a]A large lion weight from Susa, see [MITC, p. 174], weighed about 121 kg
[b]Two weights from the Persepolis excavations, both perceptibly chipped, were inscribed 10 minas and 20 minas. Those specimens weigh, respectively, 4.930 g and 9.950 g. See [SCHM2, pp. 105–107]
[c]The **talent** or **biltu** had been used as a measure for large amounts of coins before that. A puzzling artefact is the lion weight from Abydos. The Aramaic inscription on the weight, reading *ʾsprn l-qbl stryʾ zy kspʾ*, may be translated as "correct according to the staters of silver," possibly referring to the use of a weight standard on silver stater coins. This item now weighs 31.808 kg, which is about 5% in excess over the Babylonian talent. Of course, one can assume that this specific weight might have been used for checking payments subject to some kind of surcharge
[d]For gold. Later, probably during the reign of Darius the Great, also called a **daric**
[e]For silver

Official system for the entire Achaemenid Empire, enforced by Darius I around 515 BCE

								Metric
talent or **biltu**								30.240 kg
60	**mina**							504.0 g
360	6	**karša** or **karschā**						84.0 g
3600	60	10	**shekel** or **šiqlu**					8.40 g
7200	120	20	2	**zwz** or **zūzu**				4.20 g
28,800	480	80	8	4	**dânake** or **danik**			1.05 g
144,000	2400	400	40	20	5	**ḫallūru**		0.21 g
648,000	10,800	1800	180	90	22½	4½	**gran** (wheat-grain)	46.7 mg

During the reign of Alexander the Great, about 330 BCE

		Metric
Euboic stater		17.28 g
4	**Attic drachma**	4.32 g

2 Aksumite Empire (*c.* 100–*c.* 940)

This empire was an important trading nation in northeastern Africa, exporting tortoise shell, salt, gold, iron, ivory and emeralds, and importing silk and spices. They traded with Roman traders, as well as with Indian, Egyptian and Persian merchants.

Roman, Egyptian, Persian, and Indian systems of measurement were probably all extensively used.

Main sources: [JENK], [MANN], and [MUNR]

2.1 Currency

Native gold and silver coins.

3 Amorite Culture (*c.* Twentieth–Seventeenth Century BCE)

The Amorites represent the indigenous population of present-day Syria, Lebanon, and Israel. They were primarily a nomadic people who left behind no written texts of their own, but were mentioned in Sumerian texts around 2400 BCE. At any rate, they developed a sophisticated culture, based in urban centres such as Ebla, Hamath, and Qatna. Around 2200 BCE, they gradually immigrated into eastern Mesopotamia. The powerful cities of Ashur, Babylon, Kish, Larsa, and Sippar were all ruled by the Amorites around 2000 BCE. For nearly five hundred years, they ruled much of southern Mesopotamia.

Main source: [BRYC]

3.1 Units of Area

				Metric
imēru[a]				~9000 m^2
5	**iku**			~1800 m^2
20	4	**kumānu**		~450 m^2
200	40	10	**puridu**	~45 m^2

[a]The amount of land that could be sown with an ass-load of seed

4 Ancient Arabia (*c.* 900 BCE–*c.* 632 CE)

In Pre-Islamic Arabia, there were many Arabic kingdoms, such as Saba, Hadhramaut, Awsan, Qataban, Qedar, and Himyar, established in the Arabian peninsula.

Main sources: [CARD], [DOUR], [ECON], [DECO], [HOUT], and [PAUL]

4.1 Units of Length

The ancient Arabian system, like in most Asiatic cultures, used the cubit (**deraga**) as a unit of length, but their finger differed from that of the Egyptians.

Pre-islamic upper scale

يوم سفر	بريـــد	فرسخ				قصـــبة		ذراع	Metric
a day's travel									45,962.955 m
2	**barid**								22,981.478 m
8	4	**farsakh**							5745.369 m
24	12	3	**mille**						1915.123 m
200	100	25	8⅓	**ghalva**					229.815 m
1200	600	150	50	6	chain				38.303 m
12,000	6000	1500	500	60	10	**qasab**			3.830 m
24,000	12,000	3000	1000	120	20	2	**kathouah**		1.915 m
72,000	36,000	9000	3000	360	60	6	3	**deraga**	638.4 mm

Pre-islamic lower scale

ذراع	قــدم عربيــة	قبضــــة	إصـــبع			Metric
deraga						638.4 mm
2	arabic foot					319.2 mm
8	4	**cabda**				79.8 mm
32	16	4	**assbā**			19.95 mm
192	96	24	6	barley grain		3.325 mm
1152	576	144	36	6	horsehair	554 µm

4.2 Units of Capacity

Ancient system

								Metric
den or **cor**								264 L
4	**artaba**							66 L
8	2	**cafiz**						33 L
16	4	2	**khoull**					16.5 L
32	8	4	2	**ouebye**				8.25 L
64	16	8	4	2	**makouk**			4.125 L
96	24	12	6	3	1½	**saa** or **saga**		2.75 L
192	48	24	12	6	3	2	**kaledje** or **cadaa**	1.375 L

Greek system used later

										Metric
chilaga										3.303 L
3	**daurak**									1.101 L
6	2	**cauz**								551 mL
12	4	2	**cymba**							276 mL
36	12	6	3	**socarga**						92 mL
60	20	10	5	$1\frac{2}{3}$	**natl**					55 mL
120	40	20	10	$3\frac{1}{3}$	2	(small) **cymba**				28 mL
$166\frac{2}{13}$	$55\frac{5}{13}$	$27\frac{9}{13}$	$13\frac{11}{13}$	$4\frac{8}{13}$	$2\frac{10}{13}$	$1\frac{5}{13}$	**estor**			20 mL
360	120	60	30	10	6	3	$2\frac{1}{6}$	**megrapha**		9 mL
720	240	120	60	20	12	6	$4\frac{1}{3}$	2	**misqal**	4 mL

4.3 Units of Liquid Capacity

Pre-islamic system, based on [HOUT]

						Metric	Metric
kurr						1650.0 kg	–
6	**wasḳ**					275.0 kg	–
30	5	**ḳafīz**				55.0 kg	55.0 L
240	40	8	**makkūk**			6.87 kg	6.87 L
360	60	12	1½	**ṣā**		4.58 kg	4.58 L
1440	240	48	6	4	**mudd**	1.15 kg	1.15 L

4.4 Units of Weight

Pre-islamic system, upper scale

								Metric
artaba								66.00 kg
6¾	(large) **batman**							9.778 kg
9	1⅓	(small) **batman**						7.333 kg
54	8	6	**oka**					1.222 kg
90	13⅓	10	1⅔	**menna**				733.4 g
108	16	12	2	1⅕	**rotl**			611 g
180	26⅔	20	3⅓	2	1⅔	**yusdroman**		367 g
216	32	24	4	2⅖	2	1⅕	**cheky**	305.5 g

Pre-islamic system, lower scale

							Metric
cheky							305.5 g
100	**dirham**						3.055 g
400	4	**onolosat**					764 mg
600	6	1½	**danik**				509 mg
1200	12	3	2	**qirāt**			254 mg
2400	24	6	4	2	**tassoudj**		127 mg
4800	48	12	8	4	2	**chabba**	64 mg

5 Argaric Culture (*c.* 1800 BCE–*c.* 1200 BCE)

This was an Early Bronze Age culture in the southeast of Spain.

Main source: [JIMÉ]

5.1 Units of Liquid Capacity

Large storage jars, called **pithos**, were used for wine.

6 Kingdom of Armenia (*c.* 331 BCE–428 CE)

After the fall of the Achaemenid Empire in 336 BCE, the area was divided into about 120 territories, ruled by nakharars. These territories were united in 190 BCE by Artaxias I. In 66 BCE, Armenia became a Roman vassal state. In 387 CE, the kingdom was split into Byzantine Armenia in the west and Persian Armenia in the east. The Byzantine part soon became a province of the Roman Empire, while the Persian part remained a kingdom until 428 CE, when the Sassanids took over the throne.

Main source: [MART3]

6.1 Currency

1 talentum = 60 mina = 100 libra = 1200 uncia = 9600 drachme = 48,000 obolus

6.2 Units of Length

Greek system, based on [MART3]

											Metric
milliare											1664.400 m
7½	**stadium**										221.920 m
60	8	**plethrum**									27.740 m
600	80	10	**acena**								2.774 m
1000	266⅔	16⅔	1⅔	**orgyia**							1.664 4 m
2400	320	40	4	2⅖	**passus**						693.5 mm
4800	640	80	8	4⅘	2	**cubitus**					346.7 mm
7680	1024	128	12⅘	7 17/25	3⅕	1⅗	**spithama**				216.7 mm
38,400	5120	640	64	38⅖	16	8	5	**palmus**			43.3 mm
76,800	10,240	1280	128	76⅘	32	16	10	2	**pugnus**		21.7 mm
153,600	20,480	2560	256	153⅗	64	32	20	4	2	**digitus**	10.8 mm

6.3 Units of Area

Greek system, based on [MART3]

			Metric
plethrum			769.51 m^2
100	**acena**		7.695 1 m^2
6400	64	**cubitus**	12.024 dm^2

6.4 Units of Dry Capacity

Greek system, based on [MART3]

							Metric
medimnus							52.600 L
5	**modius**						10.520 L
10	2	**dadix**					5.260 L
15	3	1½	**addix**				3.507 L
60	12	6	4	**chænix**			877 mL
120	24	12	8	2	**sextarius**		438 mL
240	48	24	16	4	2	**cotyla**	219 mL

6.5 Units of Liquid Capacity

Greek system, based on [MART3]

								Metric
metreta								21.040 L
1⅓	**amphora**							15.780 L
2⅔	2	**cophinus**						7.890 L
8	6	3	**lagena**					2.630 L
16	12	6	2	**maristus**				1.315 L
24	18	9	3	1½	**chænix**			877 mL
48	36	18	6	3	2	**sextarius**		438 mL
96	72	36	12	6	4	2	**cotyla**	219 mL

6.6 Units of Weight

Greek system, based on [MART3], upper scale

										Metric
talentum										21.388 kg
60	**mina**									356.467 g
100	1⅔	**libra**								213.880 g
1200	20	12	**uncia**							17.823 g
1600	2⅔	16	1⅓	**hexadrachmum**						13.368 g
2400	4	24	2	1½	**tetradrachmum**					8.912 g
3200	5⅓	32	2⅔	2	1⅓	**tridrachmum**				6.684 g
4800	80	48	4	3	2	1½	**didrachmum**			4.456 g
9600	160	96	8	6	4	3	2	**drachma**		2.228 g
24,000	400	240	20	15	10	7½	5	2½	**scrupulum**	891 mg

Greek system, based on [MART3], lower scale

							Metric
scrupulum							891 mg
2	**obolus**						446 mg
3	1½	**thermus**					297 mg
4	2	1⅓	**ciccabus**				223 mg
6	3	2	1½	**ceration**			149 mg
12	6	4	3	2	**chalcus**		74 mg
24	12	8	6	4	2	**sitarium**	37 mg

7 Assyrian Culture (c. 2000 BCE–c. 612 BCE)

Assyria was one of the leading powers of the Middle East in ancient times. Centred upon the city of Assur (*c*. 2000–*c*. 1500 BCE), later upon Kalakh (*c*. 1500–*c*. 900 BCE), Dur-Sharrukin (*c*. 900–*c*. 700 BCE), and finally Nineveh (*c*. 700–612 BCE), Assyria became a powerful empire that, for a few decades, controlled all of the Fertile Crescent. The main Assyrian eras is generally divided into the Assyrian Empire (*c*. 1365–1076 BCE) and the Neo-Assyrian Empire (*c*. 934–609 BCE).

Main sources: [DAWB], [FREI], [MERC], [OPPE], [OPPE2], [SAYC], and [SAYC2]

7.1 Units of Length

Babylonian-Assyrian Royal system (Pechys basilikos)

											Metric
double **kaspu**											23,016.96 m
2	**kaspu**										11,508.48 m
4	2	half **kaspu**									5754.24 m
12	6	3	**šar**								1918.08 m
36	18	9	3	**šui**							639.36 m
72	36	18	6	2	**ner**						319.68 m
720	360	180	60	20	10	**sus**					31.968 m
4320	2160	1080	600	120	60	6	**qanu**				5.328 m
25,920	12,960	6480	3600	720	360	36	6	**u**			888 mm
155,520	77,760	38,880	21,600	4320	2160	216	36	6	**su**		148 mm
777,600	388,800	194,400	108,000	21,600	10,800	1080	180	30	5	**šu-si**	29.6 mm

System, based on [SAYC2]

						Metric
kaspu						5.702 km
30	**us** or **sussu**					190.08 m
1800	60	**sa** or **gar**				3.168 m
3600	120	2	**qanu**			1.584 m
21,600	720	12	6	**u** or **ammat**		264 mm
1,296,000	43,200	720	360	60	**uban**	4.40 mm

arû system *c*. 1000 BCE

			Metric
rod			*c*. 9 m
12	arû cubit		*c*. 750 mm
288	24	big finger	*c*. 31 mm

Reed measure system *c*. 1000 BCE

				Metric
rod				7 m
2	Reed			3.5 m
14	7	cubit		0.5 m
336	168	24	finger	20.8 mm

Cable reed measure system *c*. 1000 BCE

					Metric
cable					60 m
2	chain				30 m
10	5	rod			6 m
100	50	10	cable-cubit		0.5 m
2400	1200	240	24	finger	20.8 mm

7.2 Units of Area

arû system *c*. 1000 BCE

						Metric
šar or **shar**						874.8 ha
60	**būru**					14.58 ha
180	3	**eblu** or **eshe**				48,600 m^2
1080	18	6	**ikû**			8100 m^2
2160	36	12	2	**ubû**		4050 m^2
108,000	1800	600	100	50	**mušaru** = 1 rod × 1 rod	81 m^2

arû seed measure system *c*. 1000 BCE

					Metric
kurru or **gur**					81,000 m^2
5	**pānu** or **bariga**				16,200 m^2
10	2	**Ikû**			8100 m^2
30	6	3	**sūtu** or **ban**		2700 m^2
300	60	30	10	**qû** or **sila**	270 m^2

Cable reed measure system *c*. 1000 BCE

			Metric
ikû = 1 40 mušaru			3600 m^2
4	1 cable × 1 cable		900 m^2
100	25	**mušaru** = 1 rod × 1 rod	36 m^2

Reed measure system *c*. 1000 BCE

						Metric
1 reed × 1 reed						12.25 m^2
7	1 reed × 1 cubit					1.75 m^2
49	7	1 cubit × 1 cubit				25 dm^2
c. 168.269	*c*. 24.038	*c*. 3.434	1 reed × 1 finger			7.28 dm^2
175	25	*c*. 3.571	*c*. 7.28	1 cubit × 1 finger		1 dm^2
4375	625	*c*. 89.286	*c*. 182	25	1 finger × 1 finger	4 cm^2

Cable seed measure system c. 1000 BCE

						Metric
gur						13,500 m^2
5	**bariga**					2700 m^2
30	6	**ban**				450 m^2
180	36	6	**sila**			75 m^2
1800	360	60	10	**nindan**		7.5 m^2
c. 1,929,600	*c*. 385,920	*c*. 64,320	*c*. 10,720	*c*. 1072	grain	70 cm^2

7.3 Units of Dry Capacity

During the Nuzian period *c*. fourteenth century BCE

			Metric
imēru			134 L
10	**sûtu**		13.4 L
100	10	**qa**	1.34 L

During later Assyrian period

					Metric
imēru					100.440 L
1 ¼	**imēru** (small)				80.352 L
1⅔	1⅓	**PI**			60.264 L
10	8	6	**sûtu**		10.044 L
100	80	60	10	**qa**	1.004 4 L

7.4 Units of Weight

Old Assyrian system–heavy system, based on [EB11, Vol. 28, p. 486] and on [SAYC]

						Metric	Metric
talent						30.1 kg	29.70 kg
30	**maneh**[a]					1.003 kg	990 g
180	6	**stone**				167.2 g	165 g
1800	60	10	**shekel**			16.72 g	16.5 g
10,800	360	60	6	**sikhir**		2.79 g	2.75 g
648,000	21,600	3600	360	60	**um**	46 mg	45.8 mg

[a]During the reign of Shulgi (2029–1982 BCE), according to [SAYC], = 980 g. During the reign of Shalmaneser V (727–722), according to [ALBE], = 1.004 72 kg or 1.008 45 kg

Old Assyrian system–light system, based on [EB11, Vol. 28, p. 486] and on [SAYC]

						Metric	Metric
talent						30.12 kg	29.70 kg
60	**maneh**[a]					502 g	495 g
360	6	**stone**				83.6 g	82.5 g
3600	60	10	**shekel**			8.36 g	8.25 g
21,600	360	60	6	**sikhir**		1.39 g	1.375 g
1,296,000	21,600	3600	360	60	**um**	23 mg	22.9 mg

[a]At Carchemish = 561 g, according to [SAYC]. During the reign of Nebuchadnezzar II (605–562 BCE) = 489.15 g

Heavy scale at Sippara, based on [SAYC]

				Metric
talent				23.61 kg
30	**maneh**			787 kg
1800	60	**shekel**		13.1 g
10,800	360	6	**sikhir**	2.2 g

Light scale at Sippara, based on [SAYC]

				Metric
talent				28.92 kg
60	**maneh**			482 g
3600	60	**shekel**		8.25 g
21,600	360	6	**sikhir**	1.375 g

For gold and for silver, based on [SAYC]

				Metric	Metric
maneh[a]				410 g	546 g
60	**shekel**			6.83 g	9.10 g
360	6	**sikhir**		1.39 g	1.52 g
21,600	360	60	**um**	23 mg	25 mg

[a]For gold at Sippara = 392 g, according to [SAYC]

Assyrian Carthaginian system

						Metric
talent						29.376 kg
1½	**sicle**					19.584 kg
60	40	**mine** (large)				489.60 g
120	80	2	**mine** (small)			244.80 g
6000	4000	100	50	**drachme**		4.896 g
36,000	24,000	600	300	6	**obole**	816 mg

Assyrian Chaldean system

							Metric
talent (heavy)							60.523 kg
2	**talent** (light)						30.262 kg
60	30	**mine** (heavy)					1.009 kg
120	60	2	**mine** (light)				504.36 g
3600	1800	60	30	**shekel** (heavy)			16.812 g
7200	3600	120	60	2	**shekel** (light)		8.406 g
1,296,000	648,000	21,600	10,800	360	180	**gran** (barleycorn)	46.7 mg

Assyrian system in Nineveh (weights made of bronze)

			Metric
talent			58.141 kg
4	Lion weight		14.933 kg
60	15	**mâna**	969 g

Assyrian system in Nineveh (weights made of bronze)

			Metric
talent			61.271 kg
4	Duck weight		15.318 kg
60	15	**mâna**	1.021 g

Assyrian Egyptian system

					Metric
talent					29.376 kg
50	**mine**				587.52 g
1000	20	**outen**			29.376 g
2000	40	2	**sicle**		14.688 g
3600	72	3⅗	1⅘	**kitti**	8.16 g

Assyrian Egyptian system

				Metric	Metric
talent				20.40 kg	21.25 kg
40	**mine**			510.0 g	531.25 g
1666⅔	41⅔	**outen**		12.24 g	12.75 g
2500	62½	1½	**kitti**	8.16 g	8.50 g

Assyrian Egyptian system

				Metric
talent				29.376 kg
40	**mine**			734.40 g
1000	25	**outen**		29.376 g
3600	90	3⅗	**kitti**	8.16 g

8 Aztec Empire (1428–1521)

In 1250, the Aztecs arrives in the Basin of Mexico. Acamapichtli became the first Aztec ruler in 1325. In 1428, the Aztecs allied themselves with the city-states of Texcoco and Tlacopan to form the Triple Alliance of the three Nahua groups: Acolhua, Mexica and Tepanec. These groups ruled the area in and around the Valley of Mexico until they were defeated by the Spanish conquistadores and their local allies, such as the Totonacs, in 1521.

Main sources: [BRIN], [CARR], [CAST], [DOBZ], [HARV], [KEEN], [MOLI], [OROZ], [SIME], and [VANT]

8.1 Units of Length

Aztec linear measures were calibrated to the human body. After the Spanish invasion, the Aztec system was, in general, correlated to the Castilian system, e.g., the Aztec equivalent of the Spanish vara was the *yollotli* (the measure from the center of the chest to an outstretched hand).

Some reported measures that referred to body part dimensions:

1 **tlalmecatl** [Nahuatl*: tlacatl* = "man"] = 20 tlacaxilantli;
1 **tlanahuatectli** [Nahuatl*: tlacatl* = "man"] (used to measure the circumference of the object measured. = the distance between the tips of the fingers of outstreched arms);
1 **cenequetzalli**, **tecauhyocuiliztli**, **tecuauhyoanalitzli**, **tetamachiliztli, toctacayo**,
or **totamachiuhca** ("stature," = the distance from the ground to the top of the head) = ~1.60 m;
1 **tlacaxilantli** [Nahuatl*: tlacatl* = "man," *xillantili* = "navel"] (= the perpendicular distance from the ground to a standing man's navel);
1 **ciácatl** ("armpit," = the distance from the extended fingertips of an outstrectched arm to the armpit) = ~720 mm;
1 **matzotzopaztli** or **matzutzupatzli** ("forearm," = the distance from the elbow to the wrist of the same arm) = 386 mm;
1 **miztitl** ("jeme") = ~180 mm;
1 **íztetl** or **íztitl** (= the distance between the tip of the thumb and the tip of the outstretched index finger) = ~150 mm;
1 **macpalli** (= the width of the hand across the palm) = ~100 mm;
1 **tzontecomatl** (= the size of a head of wheat or chia (*Salvia Hispanica*)) = ~1 mm;

Upper scale for presumed system, based on the correspondence of *yollotli* to the Castilian vara

						Metric
mpohualmatl						32.04 m
2	**caxtolmapan**					25.08 m
6²⁄₁₅	3	**macuimatl**				8.359 m
7⅔	3¾	1¼	**chicuematl**			6.687 m
6	4⅘	1⅗	1⁷⁄₂₅	**ematl**		5.225 m
11½	9	3	2⅖	1⅞	**matlacicxitla**[a]	2.786 m

[a]Also maltacicxitlatamachiualoni

Middle scale for presumed system, based on the correspondence of *yollotli* to the Castilian vara

						Metric
matlacicxitla or **maltacicxitlatamachiualoni**						2.786 m
1⅑	**maitlneuitzanantli** or **tlalquahuitl**					2.508 m
1⅓	1⅕	**niquizantli**[a]				2.090 m
1⅔	1½	1¼	**maitl**[b,c]			1.672 m
2²⁄₉	2	1⅔	1⅓	**mitl**[d]		1.254 m
3⅓	3	2½	2	1½	**yollotli**[e]	835.9 mm

[a] = the distance from the ground beneath one foot to the extended fingers of the upraised opposite arm. Also called a **cemmatl**
[b] = Also named tlanahuatectli
[c] = the distance between the outstretched hands
[d] = the distance from the elbow to the ends of the fingers of the other hand
[e] = the distance from the middle of the sternum to the tips of the fingers of an outstretched arm

Lower scale for presumed system, based on the correspondence of *yollotli* to the Castilian vara

									Metric
yollotli									835.9 mm
–	**ahcolli**[a]								775.0 mm
1⅕	–	**tlacxitl** or **ciácatl**							696.5 mm
2	–	1⅔	**molicpitl**[b]						417.9 mm
	–	2¹⁄₁₂	1¼	**omitl** or **matzu-tzupatzli**[c]					334.4 mm
3	534/192	2½	1½	1⅕	**xocpalli** or **tlacxita-machihualoni**				278.6 mm
4	178/48	3⅓	2	1⅗	1⅓	**macpalli**[d]			209.0 mm
6	89/16	5	3	2⅖	2	1½	**centlacol icxitl**		139.3 mm
48	44½	40	24	19⅕	16	12	8	**mahpilli**[e]	17.4 mm

[a] = the distance from the tip of the shoulder to the end of the hand
[b] = the distance from the elbow to the ends of the fingers of the same arm
[c] = the distance from the elbow to the wrist of the same arm
[d] = the size of the palm of the hand. Also called **cemmapilli**
[e] = the size of the finger of the hand. Also called **cemizteltl**

8.2 Units of Area

1 **cemmecatl** = a plot of land.

8.3 Units of Dry Capacity

Weights were not in use anywhere in Mesoamerica at the time of the Spanish conquest, nor were scales known.[1] The Aztecs used large wooden bins, called quauhchiaquihuitl (referred to as troxe by the Spaniards), for corn and seeds of different kinds. The capacity of such a bin has been estimated[2] at between 8000 and 10,000 bushels (= 281,920–352,400 L) or at 4000–5000 fanegas (= 222,800–278,500 L).

Some reported measures:

1 **acalli** (used for grain) = the volume that could be held in a canoe;
1 **cemmecatl** = a string of garlic cloves, onions, or chili peppers;
1 **testal** = the quantity of cornmeal necessary to make a tortilla for one person;
1 **centlamapictli** (for peas and the like) = a handful;
1 **centlamazolli** or **centlamazololli** (for grain) = a handful.

For grain[a]

		Metric
cuauhacalli or **cencaauhacalli**		27.26 L
6	**cuauha-caltontili** or **cuauhâcaltôntli**[b]	4.54 L

[a]The conquerors tried to impose their system for measurement, while at the same time adopting the native terms
[b]The **tlacahcic cuauhâcaltôntli** = about 1.25 L

8.4 Units of Liquid Capacity

Graded sizes of jars were used to measure liquid commodities.

Some reported measures:

1 **acalli** (used for water) = the volume that could be held in a canoe;
1 **cuauhacalli** = estimated as a fanega, about 55 L;
1 **centlachipiniltontli** = estimated as a quarter pint;
1 **cemixcolli** or **cenxumatli** (for pharmacy use) = a spoonful;
1 **cuauxomahtli**, **cemixcolli** or **xomahtli** = a spoonful;
1 **centlachipinilli** or **centlachipintli**= a drop.

9 Babylonian Culture (*c.* 1894 BCE–*c.* 1120 BCE)

See also *Achaemenid Empire*, *Assyrian culture*, and *Neo-Babylonian Empire*.

Babylon was founded as an independent city state by Sumu-Abum in 1894 BCE. During the reign of Hammurabi (1792–1750 BCE), a bureaucracy was established, with taxation and centralized government, and Babylon became the central power of Mesopotamia. The Kassite dynasty gained control of Babylon after the fall of the Old Babylonian Empire. They ruled the area until 1157 BCE, when they were conquered by the Elam king Shutruk-Nakhunte. This short-lived Elamite dynasty was defeated by Nebuchadnezzar I in 1120 BCE.

Main sources: [FRIB], [KAHN], [NISS3], [POWE2], [PROU], [ROBS2], and [SAYC]

9.1 Units of Length

Arû measures for lengths [ROBS2]

			Metric
rod			9 m
12	*arû* cubit		75 cm
288	24	finger	3.1 cm

[1] See [KEEN, p. 84].
[2] See [DOBZ, p. 89].

Cable 'reed measures' for lengths [ROBS2]

					Metric
cable					~60 m
2	chain				~30 m
10	5	rod			~6 m
100	50	10	cable-cubit		~0.5 m
2400	1200	240	24	finger	~2 cm

'Reed measures' for lengths [ROBS2]

				Metric
rod				~7 m
2	reed			~3.5 m
14	7	cubit		~0.5 m
336	168	24	finger	~2 cm

(Old Babylonian scale names written in roman font = sumerian; in italic = akkadian)

								Metric
danna or ***bēru***								10.9 km
30	**uš/ush** or ***šiddu***							363.0 m
180	6	**esh/ninni** or ***ašlu***						60.5 m
1800	60	10	**ninda** or ***nindanu***					6.05 m
3600	120	20	2	**gi** or ***qânu***				3.024 m
21,600	720	120	12	6	**kùš/kush** or ***ammatu***			504 mm
648,000	21,600	3600	360	180	30	**shu-si** or ***ubânu***		16.8 mm
3,888,000	129,600	21,600	2160	1080	180	6	**še** or ***uṭṭetu***[a]	2.8 mm

[a]The length of a barley grain

Later scale

								Metric
(great) **kasbu**								11.38 km
2	**parasang** or **kasbu**							5688 m
60	30	**sos, soss** or **stade**						189.6 m
1800	900	30	**gar**					6.32 m
3600	1800	60	2	**qanu, reed** or **ânu**				3.16 m
21,600	10,800	360	12	6	**ammatu, ell,** or **kus**			526.7 mm
129,600	64,800	2160	72	36	6	**qat**		87.8 mm
648,000	324,000	10,800	360	180	30	5	**uban**[a] or **ubanu**	17.6 mm

[a]A finger-breadth that was divided into 180 parts. According to [SAYC, p. 266], 1 uban = about 16.6 mm

During the first century BCE

			Metric
qanu			3.53 m
7	**ammatu**		504 mm
168	24	**uban** or **ubanu**	21 mm

Cable 'reed measures' for area [ROBS2]

			Metric
ikû			~0.36 ha
4	*1 cable × 1 cable*		~900 m^2
100	25	***mušaru*** *(1 rod^2)*	~36 m^2

9.2 Units of Area

Cable 'seed measures' for area [ROBS2]

						Metric
kurru						~1.35 ha
5	***pānu***					~0.27 ha
30	6	***sūtu***				~450 m^2
180	36	6	***qû***			~75 m^2
1800	360	60	*10*	***akalu***		~7.5 m^2
1,944,000	388,800	64,800	*10,800*	*1080*	*grain*	~70 cm^2

Arû measures for area [ROBS2]

						Metric
šar						~875 ha
60	***būru***					~14.6 ha
180	3	***eblu***				~4.86 ha
1080	18	6	***ikû***			~0.81 ha
2160	36	12	2	***ubû***		~0.4 ha
108,000	1800	600	100	50	***mušaru*** *(1 rod^2)*	~81 m^2

'Reed measures' for area [ROBS2]

	Metric
1 reed × 1 reed	~12.25 m^2
1 reed × 1 cubit	~1.75 m^2
1 cubit × 1 cubit	~0.25 m^2
1 reed × 1 finger	~730 cm^2
1 cubit × 1 finger	~100 cm^2
1 finger × 1 finger	~4 cm^2

Arû 'seed measures' for area [ROBS2]

					Metric
kurru					~8.1 ha
5	***pānu***				~1.62 ha
10	*2*	***ikû***			~0.81 ha
30	6	3	***sūtu***		~0.27 ha
300	60	30	10	***qû***	~270 m^2

Upper scale (names written in roman font = sumerian; in italic = akkadian), two reported scales

					Metric	Metric
šár.gal or ***?***					~230 km^2	~233.28 km^2
6	**šár'u** or ***?***				~40 km^2	~38.8 km^2
60	10	**sár**, **shar**, or ***?***			~ 4 km^2	~3.88 km^2
360	60	6	**bùr'u** or ***?***		~0.66 km^2	~0.648 km^2
3600	600	60	10	**bùr** or ***buru***	~66,522 m^2	~ 64,800 m^2

Lower scale (names written in roman font = sumerian; in italic = akkadian)

							Metric
bùr, **gan**, or ***bŭru***[a]							~66,522 m^2
3	**eše**, **eshe**, or ***eblu***						~21,174 m^2
18	6	**iku** or ***ikŭ***[b]					~3528.5 m^2
36	12	2	**ubu**				~ 1764.5 m^2
1800	600	100	50	**šar** or ***mŭšaru***			~ 35.29 m^2
108,000	36,000	6000	3000	60	**gin** or ***šiqlu***		~ 0.59 m^2
19,440,000	6,480,000	1,800,000	540,000	10,800	180	**še/she**	~0.003 3 m^2

[a]Special, absolute value signs were used to write multiples (10, 60, 600, 3600, and 3600^2) of the búr
[b]Units from the iku upward were not written explicitly. Instead, special unit-specific notations were used

9.3 Units of Quantity and Volume

Brick Measures:

The Sexagesimal Place Value System is transliterated with space separating the sexagesimal places. A semi-colon marks the integer-fraction boundary.

1 brick sar = 12 00 bricks = *c*. 720 bricks;
1 small unbaked brick = 15 × 10 × 5 fingers = *c*. 25 × 17 × 8 cm;
1 sar (of small bricks) = 1 26 24 = 7; 13 brick sar = *c*. 5184 bricks
1 square baked brick = 20 × 20 × 5 fingers = *c*. 33 × 33 × 8 cm;
1 sar (of square bricks) = 32 24 = 2; 42 brick sar = *c*. 1944 bricks.

9.4 Units of Dry Capacity

Old Babylonian scale (names written in roman font = sumerian; in italic = akkadian), two reported scales

						Metric	Metric
gur or ***šiqlu***[a]						~300 L	~188 L
5	**barig** or ***qŭ***					~60 L	~37.6 L
30	6	**bán** or ***sutu***				~10 L	~6.3 L
300	60	10	**síla/ka** or ***parsiktu/pānu***			~1 L	~630 mL
18,000	3600	600	60	**gín** or ***kurru***		~ 1/60 L	~10 mL
3,240,000	648,000	108,000	10,800	180	grain	~1/10,800 L	–

[a]Multiples of the gur were written with the sexagesimal place value system

Kassite system for grain and other commodities *c*. 1500 BCE

					Metric
gur					~180 L
5	**barig**				~36 L
30	6	**bán**			~6 L
180	36	6	**síla**		~1 L
18,000	3600	600	100	**gín**	~0.01 L

9.5 Units of Weight

Traditional system used from *c*.1500–*c*.1100 BCE

									Metric
manu									516.00 g
60	**shiqlu**								8.60 g
180	3	**shalashu**							2.87 g
240	4	1⅓	**rebutu**						2.15 g
300	5	1⅔	1¼	**khummushu**					1.72 g
360	6	2	1½	1⅕	**shuddu**				1.43 g
480	8	2⅔	2	1⅗	1⅓	**pitqu**			1.075 g
600	10	3⅓	2½	2	1⅔	1¼	**khalluru**		860.0 mg
1440	24	8	6	4⅘	4	3	2⅖	**giru**	358.3 mg

For gold, silver and copper (names written in roman font = sumerian; in italic = akkadian) during the reign of Hammurapi (d. 1750 BCE)

				Metric
gú/gun or ***biltu/ biltûm***[a]				30.298 kg
60	**ma.na** or ***mine*/*manû***[b]			0.505 kg
3600	60	**gín** or ***shiqlu/ šiklûm /shekel***		8.416 g
648,000	10,800	180	**še/she** or ***uttatu***	0.046 7 g

[a][KAHN] reported 30.27 kg. Multiples of the gún, also sometimes called a **talent**, were written with the sexagesimal place value system
[b]Early Dynastic weight standards were heavier (about 0.55–0.68 kg) (Powell, M. A. "Masse und Gewichte". In: D. O. Edzard. ed. *Reallexicon der Assyriologie*, vol. 7 (1987–90). Berlin: Walter de Gruyter, p. 508)

Other reported units:

1 **pim** or **pym** (for silver during the reign of King Saul, *c*. 1000 BCE) =2/3 shekel = varying between 7.18 and 8.13 g;
1 **zūzu** =1/2 shekel = 4.09 g.

10 Bithynia (c. 330 BCE–74 BCE)

Bithynia was a kingdom in the northwest of Asian Minor. They traded in wine, cheese, figs and various kinds of wood. It became a Roman possession in 74 BCE, and then adopted the Roman systems of measurement.

Main sources: [MARE2] and [UMAR]

11 Bosporan Kingdom (c. 63–341)

See also *Kingdom of Pontus* and *Roman Empire*.

This kingdom was part of the Roman Empire until 341.

11.1 Currency

1 Bosporan solidus

12 Byzantine Empire (c. 330–1453)

See also *Arab Egypt* and *Roman Egypt*.

The systems of weights and measures used during the Byzantine period were developed entirely under state control, and mainly based on earlier ancient systems of measurement.

Main sources: [BEND], [BEND2], [DECO], [ENTW], [LEFO], [MANA2], [RATH], [SCHI], [SCHI2], [VIKA], and [WILC]

12.1 Currency

1 Gold Solidus = 24 Siliqua = 180 Nummus = 7200 Solidus

12.2 Units of Length

System used in commerce and crafts

			Metric
orguïà haplè			1.87 m
6	foot		311.7 mm
96	16	finger	19.5 mm

Used by surveyors

			Metric
orguïà philétairique			2.1 m
9	**spitham** (span)		233.7 mm
108	12	finger	19.5 mm

12.3 Units of Area

Values, based on [RATH] and [SCHI]

				Metric [RATH]	Metric [SCHI]
kha-ta or **jata**				276,000 m^2	252,334.0 m^2
10	**khat** or **jat**			27,600 m^2	25,233.40 m^2
100	10	**aroura**		2760 m^2	2523.34 m^2
200	30	2	**remen**	138 m^2	126.167 m^2

12.4 Units of Capacity

For grain in Egypt, based on [WILC]

			Metric
artabe[a]			29.18 L
3⅓	**modius**		8.754 L
177⁷⁄₉	53⅓	**sextar**	164.1 mL

[a]Also reported as 27.13 L

Some other reported measures (see [YOUT] and [BOAK]):

1 **sargane** (for chaff during the third century) = ~150 L;
1 **modius** = 583.170 L.

12.5 Units of Weight

Gold coin system, established *c*. 310 by Constantine I, used as base weights for weighing

										Metric
kentenarion										32.232 kg
2	**payvasik**									16.116 kg
100	50	**logarike litra**[a]								322.320 g
1200	600	12	**oungia**							26.860 g
7200	3600	72	6	**solidus**[b]						4.477 g
11,520	5760	115½	9³⁄₅	1³⁄₅	**semissis**					2.78 g
172,800	86,400	1728	144	24	15	**keratia**[c]				186 mg
230,400	115,200	2304	192	32	20	1⅓	**pşit**			139.5 mg
345,600	172,800	3456	288	48	30	2	1½	**lepton**		93 mg
691,200	345,600	6912	576	96	60	4	3	2	**sitokokka** (barley grain)	47 mg

[a]There was also another litra, 1 **argyrike litra** (silver coin used in Cyprus and Trebizond) = 333.333 g
[b]Also called an **exagion**
[c]Also called a **keration**

System, based on the system established in *c*. 310 by Constantine I

					Metric
talent					40.800 kg
1¼	**kentenarion**				32.640 kg
2½	2	**payvasik**			16.320 kg
125	100	50	**litra** or **logarike litra**		326.4 g
10,000	8000	4000	80	**dram**	4.08 g

System of weight, established in *c*. 310 by Constantine I

			Metric	Metric	Metric	Metric	Metric	Metric
litra			327.6 g	324	322	320	319	313
12	**oungia**		27.3 g	27 g	26.8 g	26.7 g	26.6 g	26.1 g
72	6	**nomisma**	4.55 g	4.5 g	4.5 g	4.4 g	4.4 g	4.3 g

The estimated values above are valid for the early fourth century, the fourth–sixth centuries, the sixth–seventh centuries, the seventh–ninth centuries, the ninth–thirteenth centuries, and the fourteenth century. See also [ENTW, pp. 14–15], and [BEND2, pp. 6–7]

Commercial scale, used before the ninth century, based on [BEND] and [VIKA]

										Metric
libra or **pondius**										327.60 g
2	**semis**									163.80 g
3	1½	**triens**								109.20 g
4	2	1⅓	**quadrans**							81.90 g
6	3	2	1½	**sextans**						54.60 g
12	6	4	3	2	**oungia**					27.30 g
24	12	8	6	4	2	**semi-oungia**				13.65 g
72	36	24	18	12	6	3	**nomisma** or **solidus**			4.55 g
144	72	48	36	24	12	6	2	**semissis**		2.27 g
216	108	72	54	36	18	9	3	1½	**tremissis**	1.52 g

Commercial scale, used after the ninth century

								Metric
khankhar								45.333 kg
6666⅔	**siklos**							6.80 g
10,000	1½	**dahekan** or **nomisma**						4.53 g
$14,117\frac{11}{17}$	$2\frac{2}{17}$	$1\frac{7}{17}$	**sater**[a]					3.21 g
30,000	4½	3	2⅛	**trimission**				1.51 g
40,000	6	4	2⅚	1⅓	**grammarion**			1.13 g
60,000	9	6	4¼	2	1½	**snig**		755.5 mg
240,000	36	24	17	8	6	4	**carat**	188.9 mg

[a]Also reported as 3.4 g

For wheat in Cairo

		Metric
irdabb		72.3 kg
6	**waybas**	12.05 kg

For wheat in Faiyum

		Metric
irdabb		103.22 kg
9	**waybas**	11.67 kg

For olive oil

		Metric
thalassion		7.68 kg
30	**soualia litra**	256 g

13 Cappadocia (*c.* 332 BCE–17 CE)

A kingdom in eastern Asia Minor until 17 CE, when the emperor Tiberius made Cappadocia a Roman province. The Mesopotamian system for weights and measures was in wide use until Cappadocia became part of the Roman Empire.

Main source: [ORLI]

13.1 Units of Length

1 **ayak** = the length of a man's foot.

13.2 Units of Weight

1 **oḳḳa** = about 3.2 kg.

14 Carthage (*c.* 814 BCE–146 BCE)

Carthage was originally founded around the year 814 BCE in North Africa by the Phoenicians from Tyre. The empire stretched from the Strait of Gibraltar in the west, along the Mediterranean coast of Africa, up to current eastern Libya. The current Spanish coast, Majorca and parts of Sicily were also parts of the empire. The city was completely destroyed during the Third Punic War (149–146 BCE).

Carthage was mainly influenced by the Israelite measurement system, but also by the Assyrian and Attic systems.

Main sources: [ARBU], [KENR], and [ROTT4]

14.1 Currency

No coined money was in use prior to their subjection to the Greeks.

14.2 Units of Length

Hebrew system

					Metric
parasa					~3648 m
8000	**amah**				~456 mm
16,000	2	**zeret**			~228 mm
48,000	6	3	**tefah**		~76 mm
192,000	24	12	4	**etzba**	~19 mm

Other reported measures:

1 **Punic foot** = 294.1 mm.

14.3 Units of Capacity

Attic system

			Metric
cor			~397 L
10	**metretæ**		~39.7 L
100	10	**omer**	~3.97 L

14.4 Units of Weight

Hebrew system

				Metric
kikkar				~57.6 kg
60	**litra**			~960 g
3600	60	**shekel**		~16 g
72,000	1200	20	**gerah**	~0.8 g

15 Çatalhöyük (In Present-Day Turkey) (c. 7500 BCE–c. 5700 BCE)

I have not found any reliable sources of information on this culture.

16 Chaldean Culture

See *Neo-Babylonian Empire*.

17 Ancient China (c. 2100 BCE–c. 1368 CE)

The Xia Dynasty is, according to traditional Chinese historiography, the first dynasty in what is today's China. It is now usually said to have existed from about 2070 BCE to 1555 BCE. The concept of one China as a unified kingdom arose when the Emperor Qin Shi Huang took power through a military coup in 221 BCE. The resulting Qin Dynasty dissolved in 210 BCE. Over more than 2000 years, there were alternated periods of fragmentation and decentralization with the creation of new imperial dynasties. The last imperial dynasty ended in 1912, when the modern Republic of China was founded. In 1949, the Communists established the People's Republic of China on the mainland, while the Nationalists retreated to Taiwan, officially known as the Republic of China.

In ancient times, the units of length were based on parts of the human body. The small unit **fēn** (分) has been, for more than 3000 years, the basis of a consistent decimal system of measurement. As a verb, fēn means to divide, and as a noun, it means the smallest unit into which something can be divided. It has been used as a unit of length, area, weight, money and time. Qin Shi Huang, who reigned from 247 to 221 BCE, unified the system of measurement in 221 BCE, using the basic units: 1 **shih** or **tan** = about 60 kg, 1 **chih** = about 25 cm, and 1 **chang** = about 3 m.

Main sources: [DAUD], [FERG2], [FERG3], [MA], [MARA], [MORS], [NEED], [SCHI3], [WANG], and [WU]

17.1 Units of Length

Traditional system, based on [NEED, p. 84f]

yin											
1¼	**phi**										
2½	2	**liang**									
5	4	2	**tuan**								
6¼	5	2½	1¼	**chhang**							
10	8	4	2	1⅗	**chang**						
12½	10	5	2½	2	1¼	**hsün**					
20	16	8	4	3⅕	2	1⅗	**mo**				
25	20	10	5	4	2½	2	1¼	**jen**[a]			
100	80	40	20	16	10	8	5	4	**chhih**		
125	100	50	25	20	12½	10	6¼	5	1¼	**chih**	
1000	800	400	200	160	100	80	50	40	10	8	**tshun**

[a]Also reported as 7 or 8 chhih

17.1.1 Shang or Yin Dynasty (c. 1600–1046 BCE)

Scale according to prof. Qiu Guangming

丈	尺	寸	分
zhàng			
10	**chǐ**		
100	10	**cùn**	
1000	100	10	**fēn**

According to [SCHI3, p. 421]

			Metric
li			301.50 or 304.20 m
300	**bú**		1.005 or 1.014 m
1800	6	**chǐ**	167.5 or 169 mm

17.1.2 Western Zhou Dynasty (1046–770 BCE)

Scale according to prof. Qiu Guangming

丈	步	尺	寸	分
zhàng				
1⅔	**bù**			
10	6	**chǐ**		
100	60	10	**cùn**	
1000	600	100	10	**fēn**

As devised by the Emperor Wu of Zhou, according to [SCHI3, p. 421]

			Metric
li			358.20 m
300	**bù**		1.194 m
1800	6	**chǐ**	199 mm

17.1.3 Eastern Zhou Dynasty (771–221 BCE)

Scale according to Prof. Qiu Guangming

丈	寻 or 仞	墨	尺	寸	分
zhàng					
1 ¼	**xún** or **rèn**				
2	$1\frac{3}{5}$	**mò**			
10	8	5	**chǐ**		
100	80	50	10	**cùn**	
1000	800	500	100	10	**fēn**

According to [SCHI3, p. 421]

			Metric
li			396.00, 408.60 or 415.80 m
300	**bu**		1.320, 1.362 or 1.386 m
1800	6	**chi**	220, 227 or 231 mm

In about 300 BCE, the mathematician Sun Tzu (who lived between the **third** and **fifth** centuries BCE) gave the following standard:

fēn				
10	**lí**			
100	10	**hao**		
1000	100	10	**miao**[a]	
10,000	1000	100	10	**hu**[b]

[a]Replaced by the **ssu** during the Song Dynasty (960–1279)

[b]1 **hu** = the diameter of freshly spun silk threads

17.1.4 Qin Dynasty (221–207 BCE)

Scale according to Prof. Qiu Guangming

丈	尺	寸	分
zhàng			
10	**chǐ**		
100	10	**cùn**	
1000	100	10	**fēn**

According to [SCHI3, p. 421]

			Metric
li			406.80 m
300	**bu**		1.356 m
1800	6	**chi**	226.0 mm

17.1.5 Western Han Dynasty (207–9 BCE)

Scale according to Prof. Qiu Guangming

引	丈	尺	寸	分
yǐn				
10	**zhàng**			
100	10	**chǐ**		
1000	100	10	**cùn**	
10,000	1000	100	10	**fēn**

According to [SCHI3, p. 421]

			Metric
li			428.58 or 414.0 m
300	**Bu**		1.428 6 or 1.380 m
1800	6	**chǐ**	238.1 or 230.0 mm

17.1.6 Han Dynasty (207 BCE–220 CE)

According to [HILL2, p. xx-xxi] and [TZUH]

			Metric
li			415.80 m
300	**bu** or **pu**		1.386 m
1800	6	**chǐ** or **ch'ih**	231.0 mm

Some sources also reported 1 **rèn** (仞) = 7 chǐ (尺)

17.1.7 Eastern Han Dynasty (25–220)

Scale according to Prof. Qiu Guangming

引	丈	尺	寸	分
yǐn				
10	**zhàng**			
100	10	**chǐ**		
1000	100	10	**cùn**	
10,000	1000	100	10	**fēn**

According to [SCHI3, p. 421]

			Metric
li			430.20 m
300	**Bu**		1.434 m
1800	6	**chǐ**	239.0 mm

Some sources also reported 1 **rèn** (仞) = 5⅗ chǐ (尺)

Three Kingdoms (220–265), Jin Dynasty (265–420), Northern and Southern Dynasties (420–589) and Sui Dynasty (589–618)

Scale according to Prof. Qiu Guangming

引	丈	尺	寸	分
yǐn				
10	**zhàng**			
100	10	**chǐ**		
1000	100	10	**cùn**	
10,000	1000	100	10	**fēn**

In 220 CE and 600 CE, according to [SCHI3, p. 421]

			Metric	Metric
li			433.80 m	459.00 m
300	**bu**		1.446 m	1.434 m
1500	5	**chi**	241.0 mm	255.0 mm

17.1.8 Tang Dynasty (618–907)

Scale according to Prof. Qiu Guangming

引	丈	尺	寸	分
yǐn				
10	**zhàng**			
100	10	**chǐ**		
1000	100	10	**cùn**	
10,000	1000	100	10	**fēn**

According to [SCHI3, p. 421]

			Metric	Metric
li			369.75 m	443.25 m
300	**Bu**		1.235 m	1.477 5 m
1500	5	**chi**	246.5 mm	295.5 mm

Alternative scale according to [SCHI3, p. 421]

			Metric	Metric
li			443.88 m	531.90 m
360	**bu**		1.235 m	1.477 5 m
1800	5	**chi**	246.5 mm	295.5 mm

17.1.9 Northern Song Dynasty (960–1127)

Scale according to Prof. Qiu Guangming

丈	尺	寸	分	厘	毫
zhàng					
10	**chǐ**				
100	10	**cùn**			
1000	100	10	**fēn**		
10,000	1000	100	10	**lí**	
100,000	10,000	1000	100	10	**háo**

According to [SCHI3, p. 421]

			Metric
li			462.00 m
300	**bu**		1.540 m
1500	5	**chi**	308.0 mm

Alternative scale according to [SCHI3, p. 421]

			Metric
Li			554.40 m
360	**bu**		1.540 m
1800	5	**chi**	308.0 mm

17.1.10 Southern Song Dynasty (1127–1279)

Scale according to Prof. Qiu Guangming

丈	尺	寸	分	厘	毫
zhàng					
10	**chǐ**				
100	10	**cùn**			
1000	100	10	**fēn**		
10,000	1000	100	10	**lí**	
100,000	10,000	1000	100	10	**háo**

According to [SCHI3, p. 421]

			Metric
li			405.00 m
300	**bu**		1.350 m
1500	5	**chi**	270.0 mm

Alternative scale according to [SCHI3, p. 421]

			Metric
li			486.00 m
360	**bu**		1.350 m
1800	5	**chi**	270.0 mm

17.1.11 Yüan Dynasty (1206–1368)

Scale according to Prof. Qiu Guangming:

丈	尺	寸	分	厘	毫
zhàng					
10	**chǐ**				
100	10	**cùn**			
1000	100	10	**fēn**		
10,000	1000	100	10	**lí**	
100,000	10,000	1000	100	10	**háo**

Scale, based on [CHAO]

						Metric
p'i[a]						16.32 m
4⅘	**zhàng**					3.4 m
48	10	**chǐ**				340 mm
480	100	10	**cùn**			34 mm
4800	1000	100	10	**fēn**		3.4 mm
48,000	10,000	1000	100	10	**lí**	340 μm

[a]A bolt of cloth. See [CHEN, p. 99]

17.2 Units of Area

1 **shuāng** = the amount of land that a pair of oxen could plow in a day.

In Yunnan (during Warring States, Chin, and Han dynasty)

雙			
shuāng			
4	**jiao**		
5	1¼	**mu**	
1200	300	240	**bu²**

17.2.1 Yüan Dynasty (1206–1368)

Scale, based on [CHAO]

			Metric
ch'ing			69,360 m^2
100	**mu**		693.6 m^2
2400	240	**pu**[2]	2.89 m^2

Other reported measures:

1 **shuang** = about 4–5 mu = 2772–3465 m^2 (based on [LIAN, p. 326]).

17.3 Units of Volume

By the time of the mathematician Sun Tzu (who lived between the third and fifth centuries), volume was measured by the following system:

ho					
10	**shao**				
100	10	**tsho**			
1000	100	10	**miao**		
10,000	1000	100	10	**kuei**	
60,000	6000	600	60	6	**ru**

Other reported measures:

1 **bāo** [包] = during the Song Dynasty, a package of a definitive (yet unknown) size.

17.4 Units of Liquid Capacity

17.4.1 Yüan Dynasty (1206–1368)

Scale, based on [CHEN]

					Metric
shih					94.88 L
2	**hu**				47.44 L
10	5	**tou**			9.488 L
100	5	10	**sheng**		948.8 mL
1000	500	100	10	**ko**	94.88 mL

Shí zhí system (metric-linked market system)

石	斗	升				Metric
Dan						100 L
10	**dòu**					10 L
100	10	**sheng**, **cheng**, or **shêng**				1 L
1000	100	10	**hé**			100 mL
10,000	1000	100	10	**shao**		10 mL
100,000	10,000	1000	100	10	**cuo**	1 mL

17.5 Units of Weight

Estimated values listed below, according to [WU]:

1 **lĭang** (during the Western Zhou Dynasty (1046–770 BCE) and the Eastern Zhou Dynasty (770–256 BCE)) = 14.93 g;

1 **lĭang** (during the Qin Dynasty (221–207 BCE) and the former Han Dynasty (207 BCE-8 CE)) = 16.14 g;

1 **lĭang** (during the Hsin Mang Dynasty (9–24), the Eastern Han Dynasty (25–220), the Wei Dynasty (220–265), the Western Tsin Dynasty (265–316) and the Eastern Tsin Dynasty (317–430)) = 13.92 g;

1 **lĭang** (during the Southern Ch'i Dynasty (479–501)) = 20.88 g;

1 **lĭang** (during the Liang and Chen Dynasties (502–588)) = 13.92 g;

1 **lĭang** (during the Later Wei and Western Wei Dynasties (386–557)) = 13.92 g;

1 **lĭang** (during the Northern Ch'i Dynasty (550–557)) = 27.84 g;

1 **lĭang** (during the Northern Chou Dynasty (566–581)) = 15.66 g;

1 **lĭang** (during the Sui Dynasty (581–607)) = 41.76 g;

1 **lĭang** (during rhe Sui Dynasty (607–618)) = 13.92 g;

1 **lĭang** (during the Tang Dynasty (618–907), the Five Dynasties (907–960), the Song Dynasty (960–1279), and the Yüan Dynasty (1279–1368)) = 37.30 g.

In 221 BCE, Qin Shi Huang issued an edict fixing the standard.

During the Qin Dynasty (221–207 BCE)

				Metric
shih				59.9 kg
232	**jin**			258.2 g
3712	16	**lĭang**[a]		16.14 g
89,088	384	24	**chu**[b] or **zhu**	672 mg

[a][MORS, p. 125] reported it as 16.35 g
[b]In concept equal to the weight of 100 milled rice grains

During the Han Dynasty (207 BCE–8 CE)

	銖	Metric
lĭang		16.35 g
24	**zhū**[a]	680 mg

[a]In the Western Han, reported as ~640–650 mg. In 621, it was replaced by the **qian**

During the Yüan Dynasty (1279–1368)

					Metric
jin or **chin**					596.82 g
16	**lĭang**				37.30 g
160	10	**ch'ien**			3.73 g
1600	100	10	**fen**		373 mg
16,000	1000	100	10	**li**	37.3 mg

During the Ming Dynasty (1368–1644)

鈞	觔
jun	
30	**jin**

17.5.1 Lahu People

Lahu communities are located in about 20 counties in southwestern Yunnan along the Sino-Burman borders. The Lahu people had no writing system until the early 1920s, when American Baptist missionaries arrived from Burma.

Main source: [MATI]

17.6 Units of Length

Traditional system

tê chîʔ[a]		
2	**tê kû**[b]	
16	8	**tê khɛʔ** or **tê tɛʔ**[c]

[a]Traditionally said to equal the distance from the point of the elbow to the tip of the closed fist
[b]Traditionally said to equal the width of eight fingers
[c]Traditionally said to equal the width of a finger

Other reported measures:

1 **tê jâʔ** = the distance between the elbow and the tip of the extended index finger;

1 **tê thu** = the distance between the tip of the little finger and the tip of the thumb when the fingers are spread as far as possible;

1 **tê tîʔ** = the breadth of four fingers when the fist is clenched around an object;

1 **tê cí** = the distance from one finger joint to another.

17.7 Units of Weight

For the opium trade during the **twentieth** century

		Metric
cò̀y or **cẁɛ**		1600 kg
2	**hā-khàn**	800 kg

18 Dilmun (c. 2300 BCE–c. 1700 BCE)

The exact location of Dilmun is unclear, but might be nearby present-day Bahrain. The people of Dilmun are mentioned by Mesopotamian cultures as a trade partner.

They may have used two systems of weights and measures, one derived from the sexagesimal system in Mesopotamia, and the other from the binary system used among the Indus Valley cultures. The former system had bullet-shaped weights made of hematite, while the latter had cubical-shaped weights usually made of fine-veined stones.

Main sources: [BIBB], [CRAW4], [NAYE], and [POTT]

18.1 Units of Weight

Even if excavated weights fit into a metrological system, Harappan signs have only been found on a triangular seal from Maysar and on a copper seal from Ras Al Junayz. This may indicate a less bureaucratic controlled trading.

Harappan system, based on [BIBB]

						Metric
Dilmun mina						~1.37 kg
2	**Dilmun pound**					~685 g
8	4	**Dilmun quarter**				~170 g
50	25	6¼	**Dilmun shekel**			~27 g
100	50	12½	2	**Dilmun beka**		~13.5 g
800	400	100	16	8	**Dilmun gera**	~1.7 g

19 Ancient Egypt (c. 5500 BCE–c. 332 BCE)

The dynastic period dates back to *c*. 3100 BCE, when the empire was established by uniting the upper and lower kingdoms.

The ancient Egyptians used different systems of units for length, area, volume, and weight. Each unit had a basic system of multiples. Some of these systems were rather complex, particularly for units of volume. Systems with the glyph for cubit measure as a unit of length might date back to the late Pre-Dynastic period (prior to 3100 BCE). One system, based on the Horus-Eye binary fractions (see below), was used by surveyors to reestablish the metes and bounds of fields after the inundation (the Egyptian season of akhet), compare the maximum annual Nile River volume (for calculation of taxes) and measure long distances such as roads and canals. Another system, essentially a septenary system, was developed from body measures and used to measure commodities such as rations of grain and beer.

Main sources: [ARMO], [BECK], [BERR], [CART], [CHAC], [COLB], [COUR], [COUR2], [DAVI4], [EISE], [GARD], [GENT], [GRIF], [HANN2], [HELC], [LEAK], [LEPS], [PETR], [POMM], [REDF], [REVI2], [ROBI2], [ROSS4], [SETH2], [SLOL], [SPA], [SPIE], [STRU], [TIRI], [VLEM], and [VYMA]

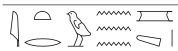
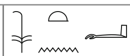
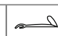
E-mail source: [eMETZ]

The Egyptian script is written only in consonants. In order to make it possible to pronounce, Egyptologists conventionally insert a short “e” where necessary.

19.1 Units of Length

The basic unit of linear measure was the cubit, defined as the length of the forearm from the elbow to the tip of the middle finger. Individuals’ limbs varied in length, of course, but two “standard” cubits came into common use. A valid standard cubit throughout Egypt did not exist, and some cubits encountered in Egypt appear to be non-Egyptian. The most ubiquitous cubit was *mH nsw* (the royal cubit), subdivided into 7 palms or 28 digits. This division probably had mystical relationships to the 7-day week and the 28-day lunar month by which time was reckoned. The length of this cubit has been determined to be an average of cubit rods that have been placed in tombs or temples as ritual objects, and is usually reported as 523–525 mm. The second most ubiquitous cubit, *m H šrr* (the short cubit), was subdivided into 6 palms or 24 digits, and is usually reported as 448–450 mm.

Ancient upper scale (with approximate values usually used in standard textbooks)

							Metric
ĭtrw[a]							10,460 m
~200	***xt-n(y)-nwH***[b]						52.5 m
~16,000	80	***nbiw***[c]					656 mm
~20,000	100	1 ¼	***mH ní-swt***[d]				525 mm
~23,350	~117	~1.46	~1.17	***mH nḏs*** or ***mH šrr***[e]			448 mm
~27,893	140	1 ¾	1⅖	~1⅕	***rmn***[f]		375 mm
~34,867	175				1 ¼	***ḏsr***[g]	300 mm

[a]The *ĭtrw*, = "river" or "river measure," was the longest measure used for larger fields and for itenerary purposes. Sometimes also written as *ỉtrwn sq̱dwt* = "itrw of towing." This was equal to the distance a boat could be towed along the Nile River in 1 day. Often written by scholars as **iteru** or **ater**

[b]The *xt-n(y)-nwH*, = "rod" or "cord," used for field measurement, is usually written as **khet**, **hayt**, **jet**, or **chet** by scholars

[c]The *nbiw*, = "wooden pole," is usually written as **nebiu** by scholars

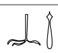
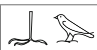
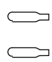
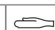
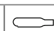
[d]The *mH ní-swt*, = "royal cubit" or "royal ell," was the most common linear measure. Written by scholars as **meh nesut** or **meh nisut**

[e]The *mH nḏs* or *mH šrr*, = "short cubit" or "small cubit," was made of wood, basalt, stone, bronze, or slate. Written by scholars as **meh nedjes** or **meh scherer**

[f]The *rmn* = "upper arm," is usually written as **remem** by scholars. A *double-remen*, 2 × 375 mm = 750 mm, was estimated to be approximately equal to the length of the diagonal of a square cubit, making it equal to about 525 mm × √2 = about 742.5 mm

[g]The *ḏsr* = "the bent arm," is usually written as **djeser** by scholars

Ancient lower scale (with approximate values usually used in standard textbooks)

								Metric
ḏsr								300 mm
1⅐	***šAt ^{c}A***[a]							262.5 mm
1⅓	1⅙	***šAt nḏs***[b]						225 mm
2	1¾	1½	[c]					150 mm
2⅔	2⅓	2	1⅓	***xf***[c d]				125 mm
3⅕	2⅘	2⅖	1⅗	1⅕	***mH*** or ***Amm***[e]			93.75 mm
4	3½	3	2	1½	1 ¼	***šsp***[f]		75 mm
16	14	12	8	6	5	4	***ḏb^{c}***[g]	18.75 mm

[a]The *šAt ^{c}A* = "great span," is usually written as **pedj aa** or **shat aa** by scholars

[b]The *šAt nḏs* = "small span," is usually written as **pedj scherer**, **pedj nedjes,** or **shat nedjes** by scholars

[c]The hieroglyph for "two hands with back of hand bent down," is usually written as **schesepuj** by scholars

[d]The hieroglyph for the "fist," is usually written as **khefa** by scholars

[e]The *mH* or *Amm* = "handsbreadth", is usually written as **amem** by scholars

[f]The *šsp* = "hand" or "palm," is usually written as **schesep** by scholars

[g]The *ḏb^{c}* = "finger," "fingerbreadth" or "digit," is usually written as **djeba** or **theb** by scholars. It was subdivided into 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9, 1/10, 1/12, 1/14, and 1/16

System used from Dynasty IV until Dynasty XVIII

						Metric
schoenus						6240–6320 m
$3\frac{21}{33}$	**atru**[a]					1716–1897 m
300	$82\frac{1}{2}$–90	**khet**				20.8–21.1 m
3000	825–900	10	**neut**			2.08–2.11 m
4000	1100–1200	$13\frac{1}{3}$	$1\frac{1}{3}$	**xylon** or **xilon**		1.56–1.58 m
12,000	3300–3600	40	4	3	**mahi**	520–527 mm

[a] In the XVIIIth Dynasty, found as a multiple of khet. [SPA]

System based on [GENT] and [LEPS]

					Metric
oregma					1092 m
$33\frac{2}{5}$	**schoenus**				32.7 m
40	$1\frac{33}{167}$	**plethron**			27.3 m
797		$19\frac{37}{40}$	**xylon**		1.37 m
2391		$59\frac{31}{40}$	3	**mahi**	457 mm

During the late Dynasty XXX , based on [MART3] and [TIRI]

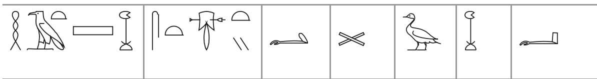
							Metric
milliare or **chibrat barah**							1890.720 m
9	**stadium** or **reison**						210.080 m
3600	400	**cubitus** or **amma**					525.2 mm
7200	800	2	**pes** or **panham**				262.6 mm
9600	$1066\frac{2}{3}$	$2\frac{2}{3}$	$1\frac{1}{3}$	**spithama** or **zereth**			197.0 mm
28,800	3200	8	4	3	**palmus** or **tofach**		65.7 mm
115,200	12,800	32	16	12	4	**digitus** or **esban**	16.4 mm

19.2 Units of Area

The Egyptians developed several methods for measuring land at a very early date. The oldest glyphs related to agricultural area measure date back to the Protodynastic Period (3100 BCE–3000 BCE).

The approximate relations between the double-remen, the remen, and the cubit enabled areas to be doubled and halved merely by changing the units while preserving the proportions of the figures.

Ancient system (before the XXVIth Dynasty and from the XXVIth Dynasty)



								Metric	Metric
xA-tA[a]							1000 × 100 cubits	27,562.5 m^2	28,005.3 m^2
10	***st̲A.t*** [b]						100 × 100 cubits	2756.25 m^2	2800.53 m^2
20	2	***rmn***[c]					50 × 100 cubits	1378.12 m^2	1400.265 m^2
40	4	2	***Hsb***[d]				25 × 100 cubits	689.06 m^2	700.132 m^2
80	8	4	2	***sA***[e]			12½ × 100 cubits	344.53 m^2	350.066 m^2
100	10	5	2½	1¼	**xA**[f]		10 × 100 cubits	275.625 m^2	280.053 m^2
1000	100	50	25	12½	10	***mH-tA*** [g]	1 cubit × 100 cubits	27.562 m^2	28.005 3 m^2

[a]The *xA-tA* is usually written as **chata**, **khata** or **jata** by scholars
[b]The *st̲A.t* or *sôt* is usually written as **setat**, **setshat** or **setjat** by scholars. This unit is often translated as **aroura** or **arura**, a Greek term for this land area
[c]The *rmn*, a fractional division of the *st̲A.t* found in the Old Kingdom, is usually written as **remen** by scholars
[d]The *Hsb*, a fractional division of the *st̲A.t* found in the Old Kingdom, is usually written as **heseb** or **hebes** by scholars
[e]The *sA*, a fractional division of the *st̲A.t* found in the Old Kingdom, is usually written as **sa** by scholars
[f]The *xA* is usually written as **cha** by scholars
[g]The *mH-tA* is usually written as **ta** or **mech-ta** by scholars. This long rectangle of 100 cubits by 1 cubit is often called a *cubit-strip*

Other measures during the late Pharaonic time:

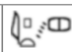
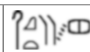
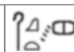
1 **bikos** = 1½ hammata = 216 square cubits = 64.599 6 m^2;
1 **hamma** = 144 square cubits = 1/64 aroura = 43.066 4 m^2;
1 ground cubit (*mḥ-itn*) = 96 square cubits = 1/100 aroura = 28.710 9 m^2;
1 **kalamos** = 36 square cubits = 10.766 6 m^2.

19.3 Units of Capacity

Presumed upper scale, based on [POMM] (with approximate values based on a hekat = 4.805 L)

											Metric
?											1,441,500 L
10	?										144,150 L
20	2	?									72,075 L
25	2½	1¼	?								57,660 L
33⅓	3⅓	1⅔	1⅓	?							43,245 L
50	5	2½	2	1½	?						28,830 L
100	10	5	4	3	2	?					14,415 L
250	25	12½	10	7½	5	2½	?				5766 L
1000	100	50	40	30	20	10	4	?			1441.5 L
3000	300	150	120	90	60	30	12	3	?		480.5 L
30,000	3000	1500	1200	900	600	300	120	30	10	deka-hekat	48.05 L

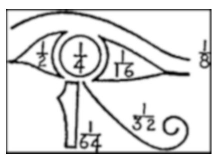
Ancient system (with approximate values usually used in standard textbooks)

					Metric
ḫ3r[a]					76.880 L
3⅕	***ỉpt-n-pr*** [b]				24.025 L
4	1¼	***ỉpt*** [c]			19.220 L
8	2½	2	***ḥḳ3tỉ*** [d]		9.610 L
16	5	4	2	***ḥḳ3t***[e]	4.805 L

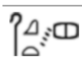
[a]The *ḫ3r* is usually written as **khar** or **kor** by scholars. This is the value used from Dynasty XX onward. In the Old Kingdom and Middle Kingdom, the value was about 48 L, and one *ḫ3r* was equal to 10 *ḥḳ3*. In the *Rhind Mathematical Papyrus*, it was found to be equal to 20 *ḥḳ3* = about 96.5 L. For storage granaries, even larger units were needed, e.g., 1 cubic cubit = 30 *ḥḳ3* = about 144.75 L and 100 oipe = 400 *ḥḳ3* = about 1930 L
[b]The *ỉpt-n-pr* is usually written as **oipe-neper** by scholars
[c]The *ỉpt* is usually written as **oipe**, **quadruple-hekat** or **fourfold-hekat** by scholars
[d]The *ḥḳ3tỉ* is usually written as **double-hekat** by scholars
[e]The *ḥḳ3t* is usually written as **hekat** by scholars. This unit was generally used for barley, corn, grain, and wheat. The subdivisons of the hekat were 1/2, 1/4, 1/8, 1/16, 1/32, and 1/64. These fractions were written as Horus-eye fractions and used solely for grain

The Eye of Horus is a stylized representation of the eye of the falcon god, Horus. According to the myth, Horus was a child of Osiris and Isis. He was born after his father, Osiris, had been murdered by his jealous brother, Seth. Seth cut up the body of Osiris and scattered the pieces all over Egypt. But Isis, who was a magician, put the pieces together again. Still, Osiris could not return to earth because one piece was missing. Instead, Osiris became the ruler of the underworld. When Horus grew up, he fought with Seth to avenge his father. It was a terrible fight. Seth knocked out Houru´s eye, which fell to the ground and broke in half. Then, one half bounced up, fell, and broke in half again. That fourth part bounced and broke in half again, and so on. Eventually, the eye became divided into a sixty-fourth part. Isis, his mother, picked up the pieces and put her son´s eye back together again. She found all the parts of the fractions to total 63/64. The missing 1/64 part was supplied by Djehuti (usually written as Thoth in English), the god of wisdom.

The Horus-Eye binary fractions: The Eyebrows were equivalent to 1/8, the pupil 1/4, the left side of the pupil 1/2, the right side of the pupil 1/16, the bottom down sweep line under the eye 1/32, and the bottom diagonal eye represented 1/64.



For medical prescriptions

				Metric
ḥḳ3t				4.805 L
10	***hnw*** [a]			480.5 mL
14⁹⁄₁₁	1⁵⁄₁₁	***ds***[b]		330.3 mL
320	8	5½	***r3***[c]	60.1 mL

[a]The *hnw* is usually written as **hin** or **hinu** by scholars
[b]The *ds* is usually written as **dja** by scholars. In the Middle Kingdom, = 1/64 hekat = about 75 mL, and in the New Kingdom, = 1/16 hekat = about 300 mL. [POMM]
[c]The *r3*, is usually written as **ro** by scholars

Submultiples of *ḥk3t*

1/2 *ḥk3t*	
1/4 *ḥk3t*	
1/8 *ḥk3t*	
1/16 *ḥk3t*	
1/32 *ḥk3t*	
1/64 *ḥk3t*	

Multiples of *r3*

4 *r3*		
3 *r3*		
2 *r3*		
r3		

Other measures:

1 **des-jug** (for beer) = about 500 mL, according to [STRU];

1 **pesu** (cooking ratio) = number of loaves or des-jugs /(number of hekats), according to [CHAC].

After the Syrian conquest and control of Egypt, the Syrian-Phoenician units of capacity became the most common in Egypt *c*. 1500 BCE.

19.4 Units of Weight

More than 3000 different weights have been recovered from ancient Egypt. The base unit for the weight system appears to have been the **kite**, which varied from one dynasty to another, ranging from about 4.5 g to about 30 g. The values shown below are commonly-used approximations. In addition, they also differed across the various dynasties.

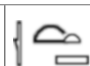
[PETR] mentioned some cylindrical stones from graves at Nagada. They weighed 7.9 g, 27.9 g, 39.3 g, 52.7 g, 77.6 g, 145.4 g, 185.7 g, 266.4 g, 281.6 g, 378.4 g, and 512.9 g. [PETR] concluded that they represented multiples of a weight with a mean of 13.15 g. No additional finds have been made to date that can back this theory. The Nagada II era ends around 3300 BCE.

According to [COUR2], 32 weights can be dated to before the Old Kingdom, but it is not possible to identify whether these weights were balance weights. The first dated and inscribed balance weights, according to [BECK], are from the reign of Senofru (2639–2589 BCE). The deben-kedet system was used from the Old Kingdom until well into the Late Period. During the late Middle Kingdom, there seem to have been two different debens in use, a "small" deben of gold = about 13.6 g and a "large" deben of copper = about 27 g. During the New Kingdom, the value of the deben was changed to about 91 g.

System used during Old Kingdom (*c*. 2649–*c*. 2150 BCE), according to [HELC]

	Metric
(gold) **deben**, **debrr**, or **beqa**	13.6–13.9 g

System used during New Kingdom (*c*. 1550–*c*. 1069 BCE)

				Metric
[a]				910 g
10	***dbn***[b]			91 g
100	10	***qd.t***[c]		9.1 g
120	12	1⅕	***šn3ti*** or ***sh3ts***[d]	7.6 g

[a]This hieroglyph is usually written as **sep**
[b]The *dbn* = "metal ring" is usually written as **deben** or **debrr** by scholars
[c]The *qd.t* = "the weight of the finger ring" is written as **kedet**, **kite**, **kvedeti**, **qat**, **qedety**, **qité**, or **quedety** by scholars. According to [SLOL], about 9.5 g
[e]The *šn3ti* or *sh3ts* is written as **sheaty**, **anello**, **anillo**, **sénious**, **senius**, **shates**, **shat**, or **shâts** by scholars

Babylonian system at the Amarna site, during the reign of Akhenaten, mid-fourteenth century BCE

				Metric
biltu				~30 kg
60	**manu**			~500 mg
3600	60	**shiglu**		~8.3 g
648,000	10,800	180	**se'u**	~46 mg

The **kedet** was a most important rating unit. There were many different kedets in use, and this probably reflects the pre-eminence of Egypt as a centre to which traders came from all parts of the known world. [BERR, p. 86] list some Egyptian kedet weights from the New Kingdom.

The values [BERR] proposed for kedet were: 69.4 g, 140 g, 189 g, 210 g, 218.75 g, 230.4 g, 240 g, 243 g, 245 g and 291.6 g.

System used between *c*.1100 and *c*.900 BCE

			Metric
sep			940 g
10	**deben**		94.0 g
100	10	**kedet**	9.4 g

Arabian-linked system for fine use

			Metric
Baqila			2.34 g
4	**schamuna**		585 mg
12	3	**qirat**	195 mg

20 Gaul (*c.* 168 BCE–486 CE)

The area encompassing present-day Belgium, France, Luxembourg, and most of Switzerland, as well as parts of Germany, Italy, and the Netherlands.

Main sources: [BOUR2], [PENN], and [ROTT4]

20.1 Units of Length

During the third century

		Metric
rast		4.417 5 m
2	**leuca**, **leuga**, or **lieue**	2.208 75 m

1 **Vindonissa foot** = 292.5 mm

20.2 Units of Area

1 **arapennus**, **arepenna**, **arapenne**, or **arpendia** (land measure) = 1248.92 m^2.

20.3 Units of Dry Capacity

1 **bulgā** = a sackfull.

21 Ancient Greece (*c.* 776 BCE–323 BCE)

Traditionally, the Classical Greek period began with the date of the first Olympic Games in 776 BCE, and ended with the death of Alexander the Great in 323 BCE. The Ancient Greek culture came to be immensely influential on modern Western European languages, philosophy, architecture, educational systems, and politics.

The ancient Greek civilization took advantage of many previous centuries of metrological experience, but the units of measurement were mainly built upon the Egyptian and Babylonian decimal systems. Even if standards of measurement within the ancient Greek world varied according to location and epoch, some units of measurement were found to be convenient for trade within the Mediterranean region. As the calibration and use of measuring devices became more sophisticated, the need for official standards rose. Officially checked standard weights were kept in the temples or in other generally accessible places. These standard weights were generally made of brass, whereas the market weights, for daily use in market commerce, were usually made of lead. Some of these market weights bear an embossed seal and some carry the added word METPONOMΩ, which certified that they were officially adjusted by the local weightmaster.

Main sources: [FENN], [HITZ], [HULT], [JOHN], [KISC], [MART3], [MENO], [PURV], [SAIG], [SMIT3], and [SMIT8]

21.1 Currency

1 talent = 60 minai = 3000 staters = 6000 drachmai = 36,000 obols

21.2 Units of Length

Ancient Greek measures of length were based on the relative length of body parts. The basic unit of length was the foot (pous).

Uppermost scale

σχοινός	παρασάγγες	δόλιχος	μίλιον	ἱππικόν	δίαυλος	στάδιον
schoinos[a]						
1⅓	**parasanges**					
3⅓	2½	**dolichos**				
5	3¾	1½	**milion**			
10	7½	3	2	**hippikon**		
20	15	6	4	2	**diaulos**	
40	30	12	8	4	2	**stadion**[a]

[a]These were itinerant distances that had no absolute values. In addition, the schoinos varied with terrain, and there were several regional variants of each

Upper scale

στάδιον	πλέθρον	ἅμμα	ἄκαινα	ὀργυιά
stadion[a]				
6	**plethron**[b]			
10	1⅔	**hamma**		
60	10	6	**akaina** or **kalamos**	
100	16⅔	10	1⅔	**orgyia** or **orguia**[c]

[a]In concept, the standard length of the furrow made by plowing with a team of oxen
[b]In concept, the width of a gyes (a unit of land area)
[c]In concept, the distance between the tips of the fingers of the outstretched arms

Middle scale

ὀργυιά	διπλοῦν βῆμα	ἁπλοῦν βῆμα	πῆχυς βασιλήιος	πῆχυς	πυγών	πυγμή	ποῦς
orgyia or **orguia**							
1⅕	**diploun bēma** or **bema diplun**[a]						
2⅖	2	**haploun bēma** or **bema haplun**[a]					
3 5/9	2 26/27	1 13/27	**pēchys basilēïos**				
4	3⅓	1⅔	1⅛	**pēchys**[b]			
4⅘	4	2	1 7/20	1⅕	**pygōn**[c]		
5⅓	4 4/9	2 2/9	1½	1⅓	1⅑	**pygmē**[d]	
6	5	2½	1 11/16	1½	1¼	1⅛	**pous**

[a]In concept, the length of a step
[b]In concept, the distance from the point of the elbow to the end of the little finger
[c]In concept, the distance from the point of the elbow to the first joint of the fingers
[d]In concept, the distance from the point of the elbow to the knuckles

Lower scale

ποῦς	σπιθαμή	ὀρθόδωρον	λιχάς	διχάς or ἡμιπόδιον	παλαιστή (or παλαστή) or δῶρον	κόνδυλος	δάκτυλος
pous[a]							
1⅓	**spithamē**[b]						
1 5/11	1 1/11	**orthodōron**					
1⅗	1⅕	1 1/10	**lichas**[c]				
2	1½	1⅜	1¼	**dichas** or **hēmipodion**			
4	3	2¾	2½	2	**palaistē** or **dōron**[d]		
8	6	5½	5	4	2	**kondylos**[e]	
16	12	11	10	8	4	2	**daktylos**[f]

[a]In concept, the length of a foot
[b]In concept, the distance between the tip of the thumb and the tip of the outstretched little finger
[c]In concept, the distance between the tip of the thumb and the tip of an outstretched first finger
[d]In concept, the width of the human palm
[e]In concept, the length of the middle joint of a finger
[f]In concept, the width of a finger

The specific values assigned to these units varied according to location and epoch, but the relative proportions were generally the same throughout the Greek world. The table below shows some presumed local scale.

	Attic scale during the Salomon era (*c*. 971–931 BCE)	Aeginetic scale	Delphi scale	Olympic scale	Miletus scale	late Miletus scale	Cretic scale
stadion	178.2 m	199.8 m	147.75 m	184.8 m	191.4 m	190.38 mm	199.89 m
plethron	29.7 m	33.3 m	24.625 m	30.8 m	31.9 m	31.73 m	33.32 m
akaina	2.97 m	3.33 m	2.462 5 m	3.08 m	3.19 m	3.173 m	3.332 m
orgyia	1.78 m	2 m	1.477 5 m	1.85 m	1.91 m	1.904 m	1.999 m
pechys	444 mm	500 mm	369.4 mm	462 mm	478.5 mm	475.9 mm	499.8 mm
pous	296 mm	333 mm	246.2 mm	308 mm	319 mm	317.3 mm	333.2 mm
palaiste	74 mm	83.3 mm	61.6 mm	77 mm	80 mm	79.3 mm	83.3 mm
daktylos	18.50 mm	20.83 mm	15.4 mm	19.25 mm	20 mm	19.8 mm	20.8 mm

	Late Delphi scale	Late Olympic scale	Philiterian scale	Pergamene era (*c*. 281–133 BCE)	Ptolemaic era (*c*. 305 BCE–30 CE)
stadion	177.5 m	192.27 m	214.8 m	198.0 m	213 m
plethron	29.6 m	32.045 m	35.8 m	33.0 m	35.5 m
akaina	2.96 m	3.204 m	3.58 m	3.30 m	3.55 m
orgyia	1.77 m	1.92 m	2.15 m	1.98 m	2.13 m
pechys	444 mm	480.7 mm	537 mm	495 mm	532.8 mm
pous	296 mm	320.4 mm	358 mm	330 mm	355.2 mm
palaiste	74 mm	80.11 mm	89.5 mm	82.5 mm	88.8 mm
daktylos	18 mm	20.03 mm	22.38 mm	20.6 mm	22.2 mm

Upper scale of the Attic system

μίλιον	στάδιον	πλέθρον	ἅμμα	ἄκαινα	ὀργυιά	βῆμα	Metric
milion							1388.520 m
7½	**stadion**						185.136 m
45	6	**plethron**					30.856 m
75	10	1⅔	**hamma**				18.513 60 m
500	66⅔	11 1/19	6⅔	**akaina**			2.777 04 m
750	100	16⅔	10	1½	**orgyia**		1.851 36 m
1800	240	40	24	3⅗	2⅖	**bema**	771.40 mm

Lower scale of the Attic system

βῆμα	πῆχυς	ποῦς	σπιθαμή	διχάς	παλαιστή	κόνδυλος	δάκτυλος	Metric
bema								771.40 mm
1¼	**pēchys**							617.12 mm
2½	2	**pous**						308.56 mm
3⅓	2⅔	1⅓	**spithamē**					231.42 mm
5	4	2	1½	**dichas**				154.28 mm
10	8	4	3	2	**palaistē**			77.14 mm
80	64	32	24	16	8	**kondylos**		9.64 mm
160	128	64	48	32	16	2	**daktylos**	4.82 mm

Estimated magnitudes for the Attic stadion

Herodotus, according to [SCHR2]	165.99–179.03 m
Polybius, according to [SCHR2]	174.77–179.13 m
Herodotus, according to [HOW]	185.4 m
Herodotus, according to van Groningen	177.6 m
According to [LEHM]	178.2–179.28 m

Upper scale of the Olympic scale, based on [MART3]

δόλιχος	ἱππικόν	δίαυλος	στάδιον	πλέθρον	ἅμμα	ἄκαινα	ὀργυιά		πῆχυς	ποῦς	Metric
dolichos											2216.250 m
3	**hippikon**										738.750 m
6	2	**diaulos**									369.375 m
12	4	2	**stadion**								184.887 5 m
72	24	12	6	**plethron**							30.781 2 m
120	40	20	10	1⅔	**hamma**						18.468 7 m
720	240	120	60	10	6	**akaina**					3.078 1 m
1200	400	200	100	16⅔	10	1⅔	**orgyia**				1.846 9 m
2880	960	480	240	40	24	4	2⅖	**passus**[a]			769.53 mm
4800	1600	800	400	66⅔	40	6⅔	4	1⅔	**pechys**		461.72 mm
7200	2400	1200	600	100	60	10	6	2½	1½	**pous**	307.81 mm

[a]The distance from where one heel is raised to where it is set down again

Lower scale of the Olympic scale, based on [MART3]

ποῦς	σπιθαμή	ὀρθόδωρον	λιχάς	διχάς	παλαιστή	κόνδυλος	δάκτυλος	Metric
pous								307.81 mm
1⅓	**spithamē**							230.86 mm
1 5/11	1 1/11	**orthodōron**						211.62 mm
1⅗	1⅕	1⅒	**lichas**					192.38 mm
2	1½	1⅜	1¼	**dichas**				153.91 mm
4	3	2¾	2½	2	**palaistē**			76.9 mm
8	6	5½	5	4	2	**kondylos**		38.5 mm
16	12	11	10	8	4	2	**daktylos**	19.2 mm

Delphian scale, based on [MART3]

στάδιον	πλέθρον	ἄκαινα	ὀργυιά		πῆχυς	ποῦς	σπιθαμή	παλαιστή	δάκτυλος	Metric
stadion										147.750 m
6	**plethron**									24.625 m
60	10	**akaina**								2.462 5 m
100	16⅔	1⅔	**orgyia**							1.477 5 m
240	40	4	2⅖	**passus**						615.625 mm
400	66⅔	6⅔	4	1⅔	**pechys**					369.375 mm
600	100	10	6	2½	1½	**pous**				246.250 mm
2400	400	40	24	10	6	4	**spithamē**			61.562 mm
4800	800	80	48	20	12	8	2	**palaiste**		30.781 mm
9600	1600	160	96	40	24	16	4	2	**daktylos**	15.39 mm

Upper scale of the Philiterian system used during the Heron of Alexandria era (*c*. 10–70)

σχοινός	μίλιον	δίαυλος	στάδιον	ὄργυρον	πλέθρον	ἅμμα	ἄκαινα	ὀργυιά	Metric
schoinos									6393.60 m
4	**milion**								1598.40 m
15	3¾	**diaulos**							426.24 m
30	7½	2	**stadion**						213.12 m
90	22½	6	3	**orgyron**					71.04 m
180	45	12	6	2	**plethron**				35.52 m
300	75	20	10	3⅓	1⅔	**hamma**			21.312 m
1800	450	120	60	20	10	6	**akaina**		3.552 m
3000	750	200	100	33⅓	16⅔	10	1⅔	**orgyia**	2.131 2 m

Lower scale of the Philiterian system used during the Heron of Alexandria era (*c*. 10–70)

ὀργυιά	ξύλον	βῆμα	πῆχυς	πυγών	ποῦς βασιλήιος	ποῦς ιταλικος	σπιθαμή	διχάς	παλαιστή	δάκτυλος	Metric
orgyia											2.131 2 m
1⅓	**xylon**										1.598 4 m
2⅖	1⅘	**bema**									888.0 mm
4	3	1⅔	**pēchys**								532.8 mm
4⅘	3⅗	2	1⅕	**pygōn**							444.0 mm
6	4½	2½	1½	1¼	**pous basilēïos**						355.2 mm
7⅕	5⅖	3	1⅘	1½	1⅕	**pous italikos**					296.0 mm
8	6	3⅓	2	1⅔	1⅓	1⅑	**spithamē**				266.4 mm
12	9	5	3	2½	2	1⅔	1½	**dichas**			177.6 mm
24	18	10	6	5	4	3⅓	3	2	**palaistē**		88.8 mm
96	72	40	24	20	16	13⅓	12	8	4	**daktylos**	22.2 mm

Upper scale, based on [JOHN]

σταθμός	δόλιχος	δίαυλος	στάδιον	πλέθρον	ἄκαινα	ὀργυιά	ξύλον	βῆμα	πῆχυς	πυγών	ποῦς	Metric
stathmos[a]												25,762.428 864 m
11⅗	**dolichos**											2220.899 04 m
69⅗	6	**diaulos**										370.149 84 m
139⅕	12	2	**stadion**									185.074 92 m
835⅕	72	12	6	**plethron**								30.845 82 m
8352	720	120	60	10	**acaena**[b]							3.084 582 00 m
13,920	1200	200	100	16⅔	1⅔	**orgyia**						1.850 749 202 m
18,560	1600	266⅔	133⅓	22²⁄₉	2²⁄₉	1⅓	**xylon**					1.388 061 90 m
33,408	2880	480	240	40	4	2⅖	1⅘	**bema**				771.145 50 mm
55,680	4800	800	400	66⅔	6⅔	4	3	1⅔	**pēhys**			462.687 30 mm
66,816	5760	960	480	80	8	4⅘	3⅗	2	1⅕	**pygōn**		385.572 75 mm
835,200	7200	1200	600	100	10	6	4½	2½	1½	1¼	**pous**	308.458 2 mm

[a]One day's travel. It was dependent on terrain. Varied between 5 and 10 parasangs, according to [PURV]. Often said to equal 7⅓ parasangs in ancient Greece, but for former empires, often reported as 4 or 5 parasangs. [LIBA, p. 50] uses the value 150 stades = about 26,400 m

[b]Also reported, by Hesychius, as 9⅔ πήχεις

Lower scale, based on [JOHN]

ποῦς	σπιθαμή	διχάς	παλαιστή	κόνδυλος	δάκτυλος	Metric
pous						308.458 2 mm
1⅓	**spithamē**					231.343 6 mm
2	1½	**dichas**				154.229 1 mm
4	3	2	**palaistē**			77.114 5 mm
8	6	4	2	**kondylos**		38.557 3 mm
16	12	8	4	2	**daktylos**	19.278 6 mm

21.3 Units of Area

Olympic scale and Delphic scale, based on [MART3]

πλέθρον	ἄρουρα	ἕκτοζ	ἄκαινα	ἑξαπόδης	ποῦς	Metric	Metric
plethron						947.48 m^2	606.390 m^2
4	**aroura**					236.87 m^2	151.597 m^2
6	1½	**hektos**				157.91 m^2	101.06 m^2
100	25	16⅔	**akaina**			9.474 8 dm^2	6.063 9 dm^2
277 7/9	69 4/9	46 8/27	2 7/9	**hexapodēs (quadratus)**		3.410 9 dm^2	2.183 0 dm^2
10,000	2500	1666⅔	100	36	**pous (quadratus)**	9.474 8 cm^2	6.063 9 cm^2

Attic scale, mainly based on [SMIT8]

πλέθρον	ἄρουρα	ἕκτος	ἡμίεκτος	ἄκαινα	ἑξαπόδης	ποῦς	Metric
plethron							952.093 m^2
4	**aroura**						238.023 m^2
6	1½	**hektos**					158.682 m^2
12	3	2	**hēmiektos**				79.341 m^2
100	25	16⅔	8⅓	**akaina**			9.521 m^2
277 7/9	69 4/9	46 8/9	23 1/7	2 7/9	**hexapodēs**		3.427 m^2
10,000	2500	1666⅔	833⅓	100	36	**pous**	95.21 dm^2

21.4 Units of Dry Capacity

System, based on [MART3]

μέδιμνος	τρίτοζ	ἕκτοζ	ἡμίεκον	χοῖνιξ	ξέστηζ	κοτύλη	ὀξὺβαφον	κὺαθοζ	κοχλάριν	Metric
medimnos										52.526 7 L
3	**tertius**									17.508 9 L
6	2	**sextus** or **modius**								8.754 4 L
12	4	2	**semimodius**							4.377 2 L
48	16	8	4	**choenix**						1.094 3 L
96	32	16	8	2	**sextarius**					547.15 mL
192	64	32	16	4	2	**kotyle**				273.58 mL
768	256	128	64	16	8	4	**oxybaphon** or **acetabulum**			68.39 mL
1152	384	192	96	24	12	6	1½	**kyathos**		45.60 mL
11,520	3840	1920	960	240	120	60	15	10	**cochliarion**	4.56 mL

Attic system *c*. 584 BCE, based on [FENN]

μέδιμνος	ἑκτεύς	ἡμί ἑκτεύς	χοῖνιξ	κοτύλη	Metric
medimnos					55.6 L
6	**hekteus** or **heldius**				9.27 L
12	2	**hemihekteus**			4.63 L
48	8	4	**choenix**[a]		1.16 L
192	32	16	4	**kotyle**	289.6 mL

[a] In Athens, one person's daily grain rations

System mainly based on [JOHN]

μέδιμνος		ἑκτεύς	ἡμίεκτον	χοῖνιξ	κοτύλη	Metric
medimnos or **medimnus**						51.801 441 6 L
$1^{51}/_{141}$	**cados**					38.042 321 3 L
6	$4^{13}/_{32}$	**hekteus**				8.633 574 4 L
12	$8^{13}/_{16}$	2	**hemiekton**			4.316 787 2 L
48	35¼	8	4	**choenix** or **khoinix**		1.079 196 7 L
192	141	32	16	4	**kotyle**	269.799 2 mL

21.5 Units of Liquid Capacity

Upper scale, based on [MART3]

μετρητής	διότα	χόοζ	ξέστηζ	κοτύλη	τέταρτον	σξύβαφον	Metric
metrētēs							39.395 0 L
2	**diota**						19.697 5 L
12	6	**congius**					3.282 9 L
72	36	6	**sextarius**				547.15 mL
144	72	12	2	**kotyle**			273.58 mL
288	144	24	4	2	**quartarius**		136.79 mL
576	288	48	8	4	2	**oxybaphon** or **acetabulum**	68.39 mL

Lower scale, based on [MART3]

σξύβαφον	κύαθοζ	κόγχη	μύστρον	χήμη	κοχλάριν	Metric
oxybaphonor **acetabulum**						68.39 mL
1½	**kyathos**					45.60 mL
3	2	**konche**				22.80 mL
6	4	2	**mystron**			11.40 L
7½	5	2½	1¼	**cheme**		9.12 mL
15	10	5	2½	2	**cochliarion**	4.56 mL

Attic scale *c*. 584 BCE, based on [FENN]

μετρητής	αμφορεύς	χοῦς	ἡμίχουν	ξέστης	κοτύλη	Metric
metrētēs						28.95 L
1 7/18	**amphora**					20.84 L
8 1/3	6	**chous**				3.47 L
16 2/3	12	2	**hemichous**			1.74 L
50	36	6	3	**xestes**[a]		579 mL
100	72	12	6	2	**kotyle**[b]	289.5 mL

[a][JOHN] reported it as 616.683 8 mL
[b][JOHN] reported it as 308.341 9 mL

Attic scale, based on [SMIT8]

μετρητής	κεράμιον	χοῦς	ξέστης	κοτύλη, τρύβλιον, or ἡμίνα	τέταρτον or ἡμικοτύλη	Metric
metrētēs						39.3 L
1½	**keramion**					26.2 L
12	8	**chous**[a]				3.27 L
72	48	6	**xestēs**			545.5 mL
360	240	30	5	**kotylē**, **trublion**, or **hēmina**		272.8 mL
900	600	75	2	2½	**tetarto** or **hēmikotylē**	136.4 mL

[a][JOHN] reported it as 3.237 590 1 L

Attic system, mainly based on [CARD]

μετρητής	ἀμφορεύς	μάρις	χοεύς	κοτύλη	Metric
metrētēs					38.852 L
2	**amphoreus**				19.426 L
6	3	**maris**			6.475 L
12	6	2	**khous**		3.238 L
144	72	24	12	**kotyle**	269.8mL

Attic upper scale c. 584 BCE (for liquids and dry goods)

δικότυλη	κοτύλη	ἡμικοτύλη	σξύβαθον	κύαθος	Metric
dikotyle					579.6 mL
2	**kotyle**				289.8 mL
4	2	**hēmikotylē**			144.9 mL
8	4	2	**oxybayhon**		72.45 mL
12	6	3	1½	**kyathos**	48.30 mL

Attic lower scale c. 584 BCE (for liquids and dry goods), based on [FENN]

κύαθος	κόγχη	χήμη	μύστρον	κύστρα	χήμη	κοχλιάριον	Metric
kyathos							48.30 mL
2	**konchē**						24.15 mL
2½	1 ¼	**chēmē**					19.32 mL
3 1/3	1 2/3	1 1/3	**mystron**				14.49 mL
4	2	1 3/5	1 1/5	**kystra**			12.08 mL
5	2½	2	1½	1¼	(small) **chēmē**		9.66 mL
10	5	4	3	2½	2	**kochliarion**	4.83 mL

Aeginetic scale (for liquids and dry goods), based on [FENN]

μετρητήζ	ἀρτάβη	σατον	ξέστης	κοτύλη	Metric
metrētēs					61.38 L
1⅔	**artabē**				36.83 L
3	3	**saton**			12.28 L
90	54	18	**xestēs**		682 mL
180	108	36	2	**kotyle**	341 mL

Euboic upper scale (for liquids and dry goods), based on [FENN]

δικότυλη	κοτύλη	ἡμικοτύλη	ὀξὐβαφον	κὐαθοζ	Metric
dikotyle					538.80 mL
2	**kotyle**				269.40 mL
4	2	**hemikotyle**			134.70 mL
8	4	2	**oxybaphon**		67.35 mL
12	6	3	1½	**kyathos**	44.90 mL

Euboic lower scale (for liquids and dry goods), based on [FENN]

κύαθοζ	κόγχη	χήμη	μύστρον	χήμη	κοχλάριν	Metric
kyathos						44.90 mL
2	**konche**					22.45 mL
2½	1¼	**chēmē**				17.96 mL
3⅓	1⅔	1⅓	**mystron** or **mystrum**			13.47 mL
5	2½	2	1½	(small) **chēmē**		8.98 mL
10	5	4	3	2	**cochliarion**	4.49 mL

21.6 Units of Weight

Upper standard Attic scale, based on table in [PERN] and [KISC]

στατήρ	μνᾶ	τριτημόριος	τεταρτημόριον	ἡμίτριτον	τέταρτος	ἑκτημόριος	Metric
statēr							873.20 g
2	**mna**						436.60 g
3	1½	**tritēmorios**					291.07 g
4	2	1⅓	**tetartemorion**				218.30 g
6	3	2	1½	**hēmitriton**			145.53 g
8	4	2⅔	2	1⅓	**tetartos**		109.15 g
12	6	4	3	2	1½	**hektemorios**	72.77 g

Lower standard Attic scale, based on table in [PERN] and [KISC]

ἑκτημόριος	ὄγδοον	πεντάδραχμος	τετράδραχμος	τρίδραχμος	δίδραχμος	δραχμίον	Metric
hektemorios							72.77 g
1⅓	**ogdoon**						54.57 g
3⅓	2½	**pentadrachmos**					21.83 g
4⅙	3⅛	1¼	**tetradrachmos**[a]				17.46 g
5⅝	4⅙	1⅔	1⅓	**tridrachmos**			13.10 g
8⅓	6¼	2½	2	1½	**didrachmos**		8.73 g
16⅔	12½	5	4	3	2	**drachmē**[b]	4.37 g

[a]Also reported as **tetrachmon**
[b]1 drachmē = 96 barleycorns. In this table, I have used the value: 1 barleycorn = about 45.5 mg. Some scholars use the value 44.3 mg for the barleycorn, making the drachmē = 4.25 g

System based on [NISS]

τάλαντον	πεντακισχίλιοι	δισχίλιοι	σχίλιοι	πεντακόσιοι	ἑκατόν	πεντήκοντα	δεκάδραχμος	πεντέδραχμος	δραχμή
talanton									
1⅕	**pentakischilioi**								
3	2½	**dischilioi**							
6	5	2	**schilioi**						
12	10	4	2	**pentakosioi**					
60	50	20	10	5	**hekaton**				
120	100	40	20	10	2	**pentēkonta**			
600	500	200	100	50	10	5	**dekadrachmos**		
1200	1000	400	200	100	20	10	2	**pentedrachmos**	
6000	5000	2000	1000	500	100	50	10	5	**drachmē**

Upper scale, based on [MART3]

Τάλαντον	μνᾶ	δίδραχμος	δραχμή	τετρώβολον	Διόβολος	ὀβολός	Metric
talanton							20.998 542 kg
60	**mna**						349.976 g
3000	50	**didrachmon**					69.995 g
6000	100	2	**drachmē**				349.98 mg
12,000	150	6	1½	**tetrōbolum**			233.32 mg
24,000	300	12	3	2	**diobolus**		116.66 mg
48,000	600	24	6	4	2	**obolus**	58.29 mg

Lower scale, based on [MART3]

ὀβολός	ἡμιὀβολός	χάλκοῦς	λεπτός	Metric
obolus				58.29 mg
2	**hēmiobolus**			29.16 mg
8	4	**chalkous**		7.29 mg
56	28	7	**leptus**	1.04 mg

Attic upper scale (*c*. 584 BCE)

Τάλαντον	μνᾶ	δραχμή	γράμμα	ὀβολός	Metric
talanton					29.0 kg
60	**mna** (grand)				483.1 g
6000	100	**drachmē** (grand)			4.831 g
18,000	300	3	**gramma**		1.610 g
36,000	600	6	2	**obolus**	805.20 mg

Attic lower scale (*c*. 584 BCE)

ὀβολός	θερμός	κεράτιον	χάλκοῦς	σιτάριον	Metric
obolus					805.20 mg
1½	**thermos**				536.80 mg
3	2	**keration**			268.40 mg
8	5⅓	2⅔	**chalkous**		100.65 mg
12	8	4	1½	**sitarion**	67.1 mg

Aeginetic scale

τάλαντον	μνᾶ	δραχμή	ὀβολός	Metric
talanton				37.8 kg
60	**mna**			630 g
6000	100	**drachme**		6.3 g
36,000	600	6	**obolus**	1.05 g

Euboic scale

τάλαντον	τάλαντον	μνᾶ	δραχμή	Metric
talanton of Rhegium				32.4 kg
1⅔	**talanton**[a]			19.44 kg
100	60	**mna**		324 g
10,000	6000	100	**drachmē**	3.24 g

[a]Equal to the weight of 1 amphora of water

Alexandrian scale

τάλαντον	μνᾶ	Πτολεμαϊκά μνᾶ	λίτρα	ὀγκία	σίγλος	δραχμή	ὀβολός	Metric
talanton[a]								46.0 kg
50	**mna**							920 g
100	2	**Ptolemaic mna**						460 g
125	2½	1¼	**litra**[b]					368 g
1500	30	15	12	**uncia**				30.7 g
3000	60	30	24	2	**siglos**			15.3 g
12,000	240	120	96	8	4	**drachmē**		3.8 g
60,000	1200	600	480	40	20	5	**obolus**	767 mg

[a]Equal to 1 metrete of water
[b]Later came to be a Roman libra

Philiterian scale

τάλαντον	μνᾶ	λίτρα	ὀγκία	σίγλος	δραχμή	Metric
talanton[a]						34.5 kg
60	**mna**					575 g
100	1⅔	**litra**				345 g
1200	20	12	**uncia**			28.75 g
3000	50	30	2½	**siglos**		11.5 g
6000	100	60	5	2	**drachmē**	5.75 g

[a]Equal to 1 Philiterian bath of water

Some other reported measures:

1 talent = the quantity of gold whose value was equal to that of an ox = about 8.4 g (according to [RIDG]).

22 Ancient Hindu, Buddhist and Jain Cultures (*c.*1700 BCE–*c.*150 BCE)

Information about weights and measures used during the Vedic period is often found in classical Sanskrit literature. During the Vedic period, the measurement systems of the Arabs had already penetrated north of India, and had replaced the old Babylonian measures. As different ages and provinces followed different standards, it is essential that we do not confuse the different systems. The names for various measures used in southern India remained in use well into the nineteenth century.

Main sources: [COLE3], [BARN3], [GOVE], [GUPT], [HULT3], [JERV], [PRIN2], [SIRC], [SHAS2], [SHRI], and [VERM]

22.1 Units of Length

One aṅgula, the breadth of a finger, may be considered to be the basic unit of length. When the sources fail to give any information on the size of the aṅgula, I have estimated it as being about 19 mm.

Upper scale, based on Śulbasūtras (written sometime between 800 BCE and 200 CE)

							aṅgula	Metric
vyāma							120	2.28 m
–	**akṣa**, **daṇḍa**, **musala**, or **nālika**						104	1.98 m
–	–	**vyayāma**					96	1.82 m
–	–	–	**iṣa**				88	1.67 m
–	–	–	–	**yuga**			86	1.63 m
3⅓	2⁸⁄₉	2⅔	2⁴⁄₉	1⁷⁄₉	**báhu**[a]		36	684 mm
3¾	3¼	3	2¾	2¹¹⁄₁₆	1⅛	**jānu**	32	608 mm

[a]Two cubits, based on [WILS]

Lower scale, based on Śulbasūtras (written sometime between 800 BCE and 200 CE)

							Metric
prakrama							570 mm
1¼	**vitasti**						456 mm
1 7/18	1 1/9	**pāda**					285 mm
2½	2	1 4/5	**pradeśa**				228 mm
3	2 2/5	1½	1 1/5	**ksudrapada**			190 mm
30	24	15	12	10	**aṅgula**[a]		19 mm
1020	816	510	408	340	34	**tila**	560 μm

[a]Considered to equal 14 grains of anu plant (*Panicum milliaceum*) or 34 sesame seeds

Upper scale, based on the Arthaśāstra (believed by most scholars to have been written between the fourth century BCE and second century CE)

							aṅgula	Metric
yojana							384,000	7,315.2 m
4	**goruta**						96,000	1828.8 m
400	100	**rajju**					960	18.288 m
2000	500	5	**Brahma deyadhanus**				192	3.658 m
3555 5/9	888 8/9	8 8/9	1 7/9	**gārhapad yadhanus**			108	2.057 m
4000	1000	10	2	1 1/8	**daṇḍa**		96	1.829 m
4571 3/7	1142 6/7	11 3/7	2 2/7	1 2/7	1 1/7	**vyāma**	84	1.600 m

Lower scale, based on the Arthaśāstra (believed by most scholars to have been written between the fourth century BCE and second century CE)

							Metric
kiṣku							800.1 mm
1 5/16	**kisku** or **kama**						609.6 mm
1¾	1 1/3	**aratni**					457.2 mm
3	2 2/7	1 5/7	**pada**, **śala**, or **śama**				266.7 mm
3½	2 2/3	2	1 1/6	**vitastl**			228.6 mm
42	32	24	14	12	**aṅgula**		19.05 mm
336	256	192	112	96	8	**yava**	2.38 mm

Scale based on Mārkaṇḍeya Puraṇa (probably written in its first editions during the third–fifth centuries)

										Metric
yojana										58,521.6 m
4	**gavyūti**									14,630.4 m
16	4	**krośa**								3657.6 m
32,000	8000	2000	**daṇḍa**							1.829 m
64,000	16,000	4000	2	**nadika**[a]						914.4 mm
73, 142 6/7	18, 285 5/7	4571 3/7	2 2/7	1 1/7	**kisku**					800.1 mm
128,000	32,000	8000	4	2	1¾	**hasta** or **hattha**				457.2 mm
256,000	64,000	16,000	8	4	3½	2	**vitasti**			228.6 mm
3,072,000	768,000	192,000	96	48	42	24	12	**aṅgula**		19.05 mm
24,576,000	6,144,000	1,536,000	768	384	336	192	96	8	**yava**	2.38 mm

[a]According to Adityapurana

Scale according to Abhidhānappadīka (Buddhist texts, probably from the third century BCE)

							Metric
yojana							10,241.3 m
4	**goruta**						2560.3 m
320	80	**usabha**					3.20 m
6400	1600	20	**yaṣti**				1.60 m
44,800	11,200	140	7	**ratana**			228.6 mm
537,600	134,400	1680	84	12	**aṅgula**		19.05 mm
3,763,200	940,800	11,760	588	84	7	**yava**	2.72 mm

Scale according to Bakṣali manuscript (usually considered to be from between the second century BCE and third century CE)

							Metric
yojana							29.26 km
2	**gavyūti**						14.63 km
16	8	**krośa**					1828.8 m
16,000	8000	1000	**daṇḍa**				1.830 m
64,000	32,000	4000	4	**hasta**			457.2 mm
1,536,000	768,000	96,000	96	24	**aṅgula**		19.05 mm
9,216,000	4,608,000	576,000	576	144	6	**yava**	3.17 mm

Upper scale, based on Varāhamihira (505–587) from Ujjani

						Metric
yojana[a]						7.315 km
3200	**puruṣa**[b]					2.286 m
4000	1 ¼	**dhanus** or **daṇḍa**[c]				1.830 m
16,000	5	4	**hasta**[d], **sama**, or **aratni**			457.2 mm
32,000	10	8	2	**vitasti**		228.6 mm
384,000	120	96	24	12	**aṅgula**[e]	19.05 mm

[a]Also reported as 32,000 hastas
[b]Also reported as being 3½ hastas. According to Kauṭilya, there were three types of purusa, namely 1 **khāta- puruṣa** or **vyāma** (for ropes or moats) = 84 aṅgulas, 1 **puruṣa** = 4 aratnis, and 1 **puruṣa** (for measuring sacrificial altars) = 108 aṅgulas.
[c]1 **daṇḍa** was also reported as 6 hastas
[d]1 **hasta** (for measuring forests) = 54 aṅgulas, and 1 **hasta** (for measuring pastures) = 28 aṅgulas.
[e]According to a stanza of Viśvakarman, there were three kinds of aṅgula, the largest aṅgula = 8 yavas, the middle aṅgula = 7 yavas, and the lowest aṅgula = 6 yavas. Varāhamihira defined a practical aṅgula, called a **karamāṅgula,** as eight husked barley grains placed breadthwise touching each other

Lower scale, based on Varāhamihira (505–587) from Ujjani

							Metric
aṅgula							19.05 mm
8	**yava**						2.38 mm
64	8	**yūkā**					0.298 mm
512	64	8	**likṣā**				0.037 mm
4096	512	64	8	**vālāgra**			4.65 μm
32,768	4096	512	64	8	**rajas**		0.58 μm
262,144	32,768	4096	512	64	8	**paramāṇu**[a]	0.07 μm

[a]Usually stated as the most minute particle

Scale according to Gujarati commentary on Pātiganita (written by Śrihara (*c*.870–*c*.930))

							Metric
yojana							21.946 km
4	**krośa**						5486.4 m
2666⅔	666⅔	**vamśa**					8.230 m
8000	2000	3	**daṇḍa**				2.743 m
64,000	16,000	24	8	**hasta**			342.9 mm
1,152,000	288,000	432	144	18	**aṅgula**		19.05 mm
6,912,000	1,728,000	2592	864	108	6	**yava**	3.175 mm

Scale based on Gaṇitasārasangraha (written by Mahāvīra, Jain mathematician from Gulbarga during the ninth century)

							Metric
krosa							1828.8 m
2000	**daṇḍa**						914.4 mm
8000	4	**hasta**					457.2 mm
16,000	8	2	**vitasti**				228.6 mm
32,000	16	4	2	**pada**			114.3 mm
192,000	96	24	12	6	**aṅgula**		19.05 mm
1,536,000	768	192	96	48	8	**yava**	2.38 mm

Scale according to Śrīdhara's Gaṇita tilaka (*c*. 1040)

							Metric
yojana							14,630.4 m
4	**krośa**						3657.6 m
8000	2000	**daṇḍa**					1.829 mm
32,000	8000	4	**hasta**				457.2 mm
64,000	16,000	8	2	**Vitasti**			228.6 mm
768,000	192,000	96	24	12	**aṅgula**		19.05 mm
4,608,000	1,152,000	576	144	72	6	**yava**	3.175 mm

Upper scale according to Samarāngana Sŭtradhāra (written by King Bhoja of Dhar (*c*. 1000–1055))

						aṅgula	Metric
yojana						768,000	14,630.4 m
8	**krośa**					96,000	1828.8 m
–	**–**	**dhanus**				106	2.019 m
–	**–**	**–**	**yuga**, **naḍi**, or **daṇḍa**[a]			96	1.829 m
–	**–**	**–**	1⅐	**vyāma**		84	1.600 m
–	**–**	**–**	2²⁄₇	2	**kiṣku**	42	800.1 mm

[a]Also refers to a daṇḍa of 106 aṅgulas

Lower scale according to Samarāngana Sŭtradhāra (written by King Bhoja of Dhar (*c*. 1000–1055))

							Metric
aratni							457.2 mm
$1\frac{5}{7}$	**pada**						266.7 mm
2	$1\frac{1}{6}$	**vitasti**					228.6 mm
$2\frac{2}{5}$	$1\frac{2}{5}$	$1\frac{1}{5}$	**sayatala**				190.5 mm
4	$2\frac{1}{3}$	2	$1\frac{2}{3}$	**karapāda**			114.3 mm
24	14	12	10	6	**aṅgula**		19.05 mm
72	42	36	30	18	3	**yava**	6.35 mm

Scale according to Rajāditya's Vyavaharaganita (*c*. 1120)

						Metric
yojana						14,630.4 m
4	**krośa**					3657.6 m
800	200	**daṇḍa**				18.288 m
32,000	8000	40	**muḷam**			457.2 mm
64,000	16,000	80	2	**cān**		228.6 mm
768,000	192,000	960	24	12	**aṅgula**	19.05 mm

Scale according to Bhākaracārya's Līlāvati (*c*. 1150)

								Metric
yojana								14,630.4 m
4	**krośa**							3657.6 m
400	100	**rajju**						36.576 m
3200	800	8	**vamśa**					4.572 m
8000	2000	20	2½	**daṇḍa**				1.829 m
32,000	8000	80	10	4	**hasta**			457.2 mm
768,000	192,000	1920	240	96	24	**aṅgula**		19.05 mm
6,144,000	1,536,000	15,360	1920	768	192	8	**yava**	2.38 mm

Scale according to Mayamatam and Mānasāra

									Metric
yojana									14,630.4 m
4	**gavyūti**								3657.6 m
16	4	**krośa**							914.4 m
1000	250	62½	**rajju**						14.630 m
8000	2000	500	8	**daṇḍa**					1.829 m
32,000	8000	2000	32	4	**hasta** or **kiṣku**				457.2 mm
64,000	16,000	4000	64	8	2	**vitasti**			228.6 mm
768,000	192,000	48,000	768	96	24	12	**aṅgula**		19.05 mm
6,144,000	1,536,000	384,000	6144	768	192	96	8	**yava**	2.38 mm

Scale according to Viśwakarma-vastuśāstram

								Metric
Brahma daṇḍa								7.315 m
2	**rājadaṇḍa**							3.658 m
4	2	**dhanur daṇḍa**						1.829 m
8	4	2	**dhanur muṣti**					914.4 mm
16	8	4	2	**hasta**				457.2 mm
32	16	8	4	2	**vitasti**			228.6 mm
384	192	96	48	24	12	**aṅgula**		19.05 mm
1152	576	288	144	72	36	3	**vrihi**	6.35 mm

							Metric
yojana							20,480 m
4	**kos** or **krośa**						5120 m
3200	800	**vamśa**					6.40 m
8000	2000	2½	**daṇḍa**				2.56 m
32,000	8000	10	4	**hasta**			640 mm
768,000	192,000	240	96	24	**aṅgula**[a]		26.67 mm
6,144,000	1,536,000	1920	768	192	8	**yava** (barley grain)	3.33 mm

[a]According to Hindu and Jaina literature

During the mid-sixteenth century, Akbar the Great decreed that the cos was divided into 100 tenab, each of 4 bambous or 50 guz.

22.2 Units of Area

Land areas were usually measured by a measuring rod, made of bamboo or wood, that had the length of a recognised number of cubits. The cubit (*hasta* or *kai*) was often measured by the length of the forearm of a particular individual in the king´s service. In Kannada inscriptions, other units of measurement are used, such as the span (*genu*) and the foot (*kalu*).

The local measuring rods were sometimes mentioned in inscriptions, e.g., *Eḍenāḍa-danḍa* (the measuring rod of the district of Eḍenāḍu), *Samataṭīya-nala* (the measuring rod of the district of Samataṭa country), and *Palṭiyamattavurada danḍa* (the measuring rod of the village of Paltiyamattavura). In Kannaḍa inscriptions, particular measuring rods are mentioned by name, e.g., *Dharaṇidevana kolu* (the rod of a person named Dharaṇideva), *Gaṅgana ghale* (the rod of a person named Gaṅga) and *Māṇikesvarada kolu* (the rod of the god Māṇikesvara).

One of the most commonly mentioned units of land areas is the **nivartana**.

Written source	Value given to 1 nivartana	Metric
Sātātapa and Bṛhaspati	300 × 300 square cubits = about 4 ¾ acres	~19,200 m^2
Kauṭilīya (by Arthasāstra)	240 × 240 square cubits = about 3 acres	~12,000 m^2
Bhāskarācārya (by Līlāvatī)	200 × 200 square acres = about 2 acres	~8000 m^2
Sukranītisāra	112 × 112 or 140 × 140 square cubits = about 3/5 acre or about 1 acre	~2400 or ~4000 m^2
Vasiṣṭha	100 × 100 square cubits = about 1/2 acre	~2000 m^2

1 **nivartana** = 20 vansa × 20 vansa = 16,384 m^2.

Another common unit of land area was the **gocarman**, which has been defined as the area of land which could be covered by the hides of cows slaughtered in a sacrifice. Below are some other definitions:

Written source	Description
Mahābhārata	a plot of land, large enough to be encompassed by straps of a single cow's hide
Bṛhaspatisamhitā and Parāsarasamhita	a plot of land, where one thousand cows could freely graze in the company of a hundred bulls
Viṣṇusamhita	a plot of land, sufficient to maintain a person a whole year with its produce
Dānasāgara	a plot of land, measuring about 150 × 150 square cubits = about 2 acres

Another unit of land area was the **hala**. It was usually said to equal a land area that could be cultivated by a pair of oxen over a year.

Scale during the age of the Gupta Empire[a]

kulyavāpa		
8	**droṇavāpa**	
32	4	**āṇḍavāpa**

[a]These measures were said to equal the area that was required to seed grains of one kulya, one droṇe and one āḍhaka

According to the British civil servant Frederick Eden Pargiter (1852–1927), one kulyavapa was about 3⅟₄₀ bīghās = a little more than one acre.

Usual scale in Sanskrit literature

			Metric
niranga			~81.9 m^2
20	**ban²**		~4.1 m^2
200	10	**hattha²**	~41 dm^2

22.3 Units of Capacity

Ordinary[a] measures for both dry commodities and liquids, based on Varāhamihira (505–587) from Ujjani

droṇa				
4	**āḍhaka**			
16	4	**prastha**		
64	16	4	**kuḍava**	
256	64	16	4	**pala**

[a]Probably based on Kāliṅnga-māna

Māgadha-māna measures for both dry commodities and liquids, based on Varāhamihira (505–587) from Ujjani

droṇa[a]				
4	**āḍhaka**[b]			
16	4	**prastha**		
64	16	4	**kuḍava**[b]	
200	50	12½	3⅛	**pala**

[a]Kauṭilya mentioned drone measures constituted of 200, 187½, 175 and 162½ palas
[b]For measuring rain-water

For dry commodities, as reported in the Hinoo Poorans (Buweeshyu, Pudmu, Skundu, and Varaha) during the thirteenth century.

baha								
10	**koombha**							
12½	1¼	**karika**						
200	20	16	**dronu**					
800	80	64	4	**adhuka**				
3200	320	256	16	4	**pooshkulu**			
12,800	1280	1024	64	16	4	**kooduva**[a]		
25,600	2560	2048	128	32	8	2	**prusritu**	
51,200	5120	4096	256	64	16	4	2	**pula**[b]

[a]Sometimes called a koonchee. The Varaha Pooran reported 1 koonchee = 4 prusritu
[b]A handful

					Metric
chari					264 L
16	**drona**				16.5 L
64	4	**adhaca**			4.125 L
256	16	4	**prastha**		1.031 L
1024	64	16	4	**kadaba** or **cudaba**	258 mL

22.4 Units of Weight

Manu-smṛiti (written any time between 220 BCE and 200 CE; 8:132 ff. and Yājñavalkya-smṛiti (written during the third or fourth century; 1:361 ff. system for general use

kṛishṇala or **raktikā**[a]					
3	**yava**[b]				
18	6	**gaura-sarshapa**[c]			
54	18	3	**rāja-sarshapa**[d]		
162	54	9	3	**likshā**[e]	
1296	432	72	24	8	**trasa-reṇu**

[a]The krishnala = the black seed of the ganjá creeper, and the raktika or ratti = the red seed. A rattiká has been said by some to equal 4 grains of rice and by others two large barley-corns
[b]Middle-sized barley-corn
[c]White mustard-seed
[d]Black mustard-seed
[e]Minute poppy-seed

Manusmṛti (written any time between 220 BCE and 200 CE; 8:132 ff. and Yājñavalkya-smṛiti (written during the third or fourth century; 1:361 ff. system for copper and gold

						Metric
dharaṇa[a]						733.2 g
10	**pala** or **nishka**					73.32 g
40	4	**karsha**, **aksha**, **tolaka**, or **suvarṇa**[b]				18.33 g
640	64	16	**māsha**[c]			1.146 g
3200	320	80	5	**kṛishṇala** or **raktikā**		229 mg
5120	512	128	40	8	**rdti**	143 mg

[a]Only for gold
[b]One pala has also been reported as being equal to 5 suvernas
[c]There have also been reported four varieties of mishas, 4, 5, and 16 raktikás, respectively, and a fourth consisting of 2 raktikás

Brihaspati-smṛiti (written during the third or fourth century; x: 13–15) system for copper

dīnāra		
12	**dhānaka**	
48	4	**karsha**, **aṇḍikā**[a], **kārshāpaṇa**, or **paṇa**

[a]Also used for silver

Nārada-smṛiti (written any time between 100 BCE and 400 CE; App., p. 57 ff.) system for silver

suvarṇa or **dīnāra**				
12	**dhānaka**			
48	4	**kārshāpaṇa** or **aṇḍikā**		
960	80	20	**māsha** or **pala**	
3840	320	80	4	**kākaṇīs**

Alternative scale for silver during the fourth century

āchita					
10	**bhāra**				
1000	100	**hāra**			
2000	200	2	**tulā**		
200,000	20,000	200	100	**nishka** or **pala**	
1,000,000	100,000	1000	500	5	**suvarṇa**

Ordinary measures, based on Varāhamihira (505–587) from Ujjani

bhāra						
20	**tulā**					
2000	100	**Pala**				
8000	400	4	**karṣa**			
20,000	1000	10	2½	**dharaṇa**		
128,000	6400	64	16	6⅖	**māṣaka**	
640,000	32,000	320	80	32	5	**kṛṣṇala**

For precious stones, based on Varāhamihira (505–587) from Ujjani

taṇḍula			
8	**sarṣapa**[a]		
48	6	**marīci**	
288	36	6	**dhvaṁsīs**

[a]Sometimes reported as 1 **rakta-sarṣapa** (rape-seed), and sometimes as 1 **sita-sarṣapas** (white mustard seed)

Gaṇita-sāra-saṅgraha (written by Mahā-vīra of Gulbarga during the ninth century) system for gold

pala					
4	**karsha**				
8	2	**dharaṇa**			
64	16	8	**paṇa**		
320	80	40	5	**guñja**	
1280	320	160	20	4	**gaṇḍakas**

Gaṇita-sāra-saṅgraha (written by Mahā-vīra of Gulbarga during the ninth century; 1:39–41) system for silver (Magadha standard)

pala					
4	**karsha** or **purāṇa**				
10	2½	**dharaṇa**			
160	40	16	**māsha**		
320	80	32	2	**guñja**	
640	160	64	4	2	**dhānya** (grain seed)

Gaṇita-sāra-saṅgraha (written by Mahā-vīra of Gulbarga during the ninth century; 1:42–44) system for other metals

satera						
2	**dināra**					
4	2	**drakshūṇa**				
24	12	6	**bhāga**			
96	48	24	4	**amśa**		
384	192	96	16	4	**yava**	
2400	1200	600	100	25	6 ¼	**kalā**

Gaṇita-sāra-saṅgrahas (written by Mahā-vīra of Gulbarga during the ninth century) second system for other metals

bhāra			
10	**tulā**		
125	12½	**prastha**	
2000	200	16	**pala**

In 1150, Bhaskara Achārya ("Bhaskara the teacher", 1114–1185), an Indian mathematician, described two different measuring systems for Hindus in his book Līlāvatī.

First Bhaskara system

						Metric
gadyāṇaka						5.664 kg
1⅐	**dhaṭaka**					4.956 kg
2	1¾	**dharaṇa**				2.832 kg
16	14	8	**valla**			354 mg
48	42	24	3	**Raktikā** (*Abrus precatorius*)		118 mg
96	84	48	6	2	large barleycorn	59 mg

Second Bhaskara system

nishka (of silver)				
16	**dramma** (of silver), **berma** (of silver), or **purāṇa** (of shells)			
256	16	**pana** or **kārshāpaṇa**		
1024	64	4	**kākaṇī**	
20,480	1280	80	20	**varāṭak** or **kapardaka** (cowry shell)

Atharvaveda-pariśishṭa system (for food commodities; xxxiii:3)

droṇa					
4	**āḍhaka**				
16	4	**prastha**			
512	128	32	**pala**		
32,768	8192	2048	64	**māshaka**	
163,840	40,960	10,240	320	5	**krishṇala**

First Purāṇa system (earliest written source from the third–fourth centuries)

kumbha						
20	**droṇa**					
80	4	**āḍhaka**				
320	16	4	**pushkala**			
2560	128	32	8	**kuñchī**		
10,240	512	128	32	4	**prasṛiti**	
20,480	1024	256	64	8	2	**mushṭi** or **pala**

Second Purāṇa system (earliest written source from the third–fourth centuries)

vāha									
10	**kumbha**								
200	20	**khārī**							
3200	320	16	**droṇa**						
12,800	1280	64	4	**āḍhaka**					
51,200	5120	256	16	4	**prastha**				
204,800	20,480	1024	64	16	4	**kuḍava** or **setikā**			
409,600	40,960	2048	128	32	8	2	**prasṛiti**		
819,200	81,920	4096	256	64	16	4	2	**pala**	
2,867,200	286,720	14,336	896	224	56	14	7	3½	**tolaka**

Gaṇita-sāra-saṅgraha (written by Mahā-vīra of Gulbarga during the ninth century; 1:36 ff.) system for general use

kumbha									
5	**vāha**								
20	4	**pravartikā**							
100	20	5	**khārī**						
400	80	20	4	**māni**					
1600	320	80	16	4	**droṇa**				
6400	1280	320	64	16	4	**āḍhaka**			
25,600	5120	1280	256	64	16	4	**prastha**		
102,400	20,480	5120	1024	256	64	16	4	**kuḍaha**	
409,600	81,920	20,480	4096	1024	256	64	16	4	**shoḍaśikā**

Śārṅgadhara wrote a comprehensive table (see below) giving the standard of Magadha.[3] He states that from the guñja to the kuḍava, dry and liquid measures were the same, and that from the prastha to the tulā, liquids were measured by a standard double that of dry materials.

Śārṅgadhara Saṃḥitā (written about 800 AD; i:I:15 ff.) system for medical use (Magadha standard), upper scale

khārī							
$2\frac{6}{125}$	**bhāra**						
4	$1\frac{61}{64}$	**droṇī**, **goṇī**, or **vāha**					
8	$3\frac{29}{32}$	2	**śūrpa** or **kumbha**				
16	$7\frac{13}{16}$	4	2	**droṇa**, **ghaṭa**, **kalaśa**, **nalvaṇa**, **rāśi**, or **unmana**			
$40\frac{24}{25}$	20	$10\frac{6}{25}$	$5\frac{3}{25}$	$2\frac{14}{25}$	**tulā**		
64	31¼	16	8	4	$1\frac{9}{16}$	**āḍhaka**	
256	125	64	32	16	6¼	4	**prastha**

Śārṅgadhara saṃḥitā (written about AD 800; i:I:15 ff.) system for medical use (Magadha standard), middle scale

prastha							
2	**śarāvā** or **mānikā**						
4	2	**kuḍava** or **añjali**					
8	4	2	**prasṛiti**				
16	8	4	2	**pala**, **āmra**, **mushṭi**, **prakuñcha**, or **vilva**			
32	16	8	4	2	**śukti**		
64	32	16	8	4	2	**karsha**, **aksha**, **haṃsa-pada**, **pāṇi-mānikā**, **pāṇi-tala**, **pichu**, **tinduka**, **savarna**, **udumbara**, or **viḍāla-padaka**	
128	64	32	16	8	4	2	**kola**

[3] According to [WEBE, p. 82], the relation was: 1 droṇa = 4 a'ṭaka = 16 pratha = 512 pala = 32 768 māsha = 163 840 rāti.

Śārṅgadhara Saṃḥitā (written about 800 CE; i:I:15 ff.) system for medical use (Magadha standard), lower scale

kola									
2	**dharaṇa**								
8	4	**māshaka**, **dhānyaka**, or **hema**							
48	24	6	**guñja** or **raktikā**						
192	96	24	4	**yava**					
1536	768	192	32	8	**sarshapa**				
4608	2304	576	96	24	3	**rājikā**			
27,648	13,824	3456	576	144	18	6	**marīchi**		
165,888	82,944	20,736	3456	864	108	36	6	**trasa-reṇus** or **vāṃśī**	
4,976,640	2,488,320	622,080	103,680	25,920	3240	1080	180	30	**paramāṇu**

Śārṅgadhara Saṃḥitā (written about 800CE; i:I:15 ff.) system for medical use (Kaliṅga standard), the rest of the table is similar to the Magadha standard (se above)

kuḍava									
4	**pala**								
16	4	**karsha**							
26⅔	6⅔	1⅔	**gadyāna**						
40	10	2½	1½	**nishka**, **ṭaṅka**, or **śāṇa**					
160	40	10	6	4	**māsha**[a]				
426⅔	106⅔	26⅔	16	10⅔	2⅔	**valla**			
1280	320	80	48	32	8	3	**guñja**		
2560	640	160	96	64	16	6	2	**yava**	
30,720	7680	1920	1152	768	192	72	24	12	**gaura-sarshapa**

[a]Also reported as 7 guñjas

For paddy, based on Kullūka-bhaṭṭa (fifteenth century) and Raghunandana (sixteenth century)

						Metric
kulya[a]						~580.6 kg
8	**droṇa**					~72.6 kg
32	4	**ādhaka**[a]				~18.1 kg
128	16	4	**puṣkala**			~4.5 kg
1024	128	32	8	**kuñci**		~570 g
8192	1024	256	64	8	**muṣṭi**[b]	~70 g

[a]Values based on Pañcānana Tarkaratna and Medinīkara
[b]A handful

Jewellers weight system, based on Gopála Bhattá (sixteenth century)

karsha				
2	**kona**			
4	2	**tanka**, **sala**, or **dharana**		
16	8	4	**mdsha**, **hema**, or **vdnaka**	
96	48	24	6	**raktika**

Astronomical scale, based on Gopála Bhattá (sixteenth century)

						Metric
dhatáka						~5.664 kg
1000	**alaka**					~5.66 g
2000	2	**dharana**				~2.83 g
16,000	16	8	**balla**			~354 mg
48,000	48	24	3	**gunja**		~118 mg
96,000	96	48	6	2	large barley-corn	~59 mg

Upper scale

							माशा	Metric
mana								583.03 g
21	**pala**							27.76 g
40	$1\frac{19}{21}$	**seta**						14.58 g
84	4	$2\frac{1}{10}$	**carsha**					6.94 g
140	$6\frac{2}{3}$	3½	$1\frac{2}{3}$	**tola**				4.16 g
210	10	5¼	2½	1½	**gadyanaca**			2.78 g
240	$11\frac{3}{7}$	6	$2\frac{6}{7}$	$1\frac{5}{7}$	$1\frac{1}{7}$	**Dhataca**		2.43 g
1344	64	$33\frac{3}{5}$	16	$9\frac{3}{5}$	$6\frac{2}{5}$	$5\frac{3}{5}$	**masha**	433.8 mg

Lower scale, based on the barley-corn

				माशा					Metric
dhataca									3.177 1 g
$1\frac{1}{7}$	**gadyanaca**								2.780 0 g
$2\frac{2}{7}$	2	**dharana**							1.390 0 g
$3\frac{1}{21}$	$2\frac{2}{3}$	$1\frac{1}{3}$	**tanca** or **danca**						1.042 5 g
$7\frac{33}{105}$	$6\frac{2}{5}$	$3\frac{1}{5}$	$2\frac{2}{5}$	**masha**					434.38 mg
$18\frac{16}{21}$	16	8	6	2½	**valla**				173.75 mg
$36\frac{4}{7}$	32	16	12	5	2	**gunja**			86.876 mg
$73\frac{1}{7}$	64	32	24	10	4	2	**yava**[a]		43.438 mg
$117\frac{3}{105}$	$102\frac{2}{5}$	$51\frac{1}{5}$	$38\frac{2}{5}$	16	$6\frac{2}{5}$	$3\frac{1}{5}$	$1\frac{3}{5}$	**karsha**	27.149 mg

[a]The weight of one barley-corn

23 Hittites (*c.* 1750 BCE–*c.* 1180 BCE)

The Hittite Kingdom is divided into three periods: the Old Hittite Kingdom (*c*. 1750–1500 BCE), the Middle Hittite Kingdom (*c*. 1500–1430 BCE) and the New Hittite Kingdom (*c*. 1430–1180 BCE). The Hittite empire reached its height during the fourteenth century BCE, encompassing a large part of Anatolia, northwestern Syria up to about as far south as the mouth of the Litani River (a territory known as Amqu), and eastward into upper Mesopotamia.

The Hittites generally derived their weight system from the old Babylonian measures.

Main sources: [BURN], [DERO], and [MELL3]

23.1 Units of Length

Presumed scale

			Metric
cubit			~0.5 m
5	palm		~0.1 m
25–30	5–6	finger	~20–17 mm

23.2 Units of Area

1 “garden plot” = a multiple of a square cubit.

23.3 Units of Capacity

1 **qu** = ~1 L.

Shekels and barley-corns were also used for fractions of capacity.

23.4 Units of Weight

Presumed scale

				Metric
talent				~19.2 kg
60	**Mina**			~320.4 g
2400	40	**shekel**		~8.0 g
432,000	7200	180	**gran** (barley-corn)	~44.5 mg

24 Hurrian Cultures (*c.* fifteenth–thirteenth Century BCE)

The Hurrians lived in the Ancient Near East during the Bronze Age, its major influential nation being the Kingdom of Mitanni, which reached its height of power during the fourteenth century BCE.

Main sources: [KOLI] and [LACH]

24.1 Units of Area

At Nuzi, near present-day Kirkuk in Iraq, and in Niniveh, near present-day Mosul

						Metric
imēru[a]						~9000 m^2
5	**iku**					~1800 m^2
10	2	**awiḫaru**				~900 m^2
20	4	2	**kumānu**			~450 m^2
40	8	4	2	**ḫararnu**		~225 m^2
200	40	20	10	5	**puridu**	~45 m^2

[a]The amount of land that could be sown with an ass-load of seed

25 Indus Valley Cultures (With the Cities Harappa and Mohenjo Daro) (*c.* 2600 BCE–*c.* 1750 BCE)

Part of present-day Punjab in Pakistan.

Standard weights and measures were used throughout the Indus Valley, but 16 was used as the base for calculation, rather than 10. The system was even adopted in ancient Dilmun, where a number of weights, along with some clay seal impressions, with cord or sack marks on the reverse side, have been found.

Main sources: [BHAR], [HEND], [HORI], [IWAT5], [IWAT6], [KENO], [MAIN], and [RAO]

25.1 Units of Length

On ivory rulers found in Lothal, the average distance between divisions was about 1.77 mm, on a broze rod from Harappan, the distance was about 9.34 mm, and on a graduated shell ruler found in Mohenjo-daro, the nine divisions were about 6.70 mm apart. On the last ruler, every fifth division was marked with a small circle and every tenth division with a large circle. Five sub-divisions make the Harappan "inch" equal to 33.52 mm, thus making the foot equal to 335.2 mm. Twenty divisions on the Lothal ruler are approximately equal to the Mahenjo Daro "inch," the distance between two circles on the Mahenjo Daro ruler, namely 33.4 mm. Scale-marks on a terracotta rod from Kalibanga have also been found.

Ten divisons of the Lothal ruler comprise a distance of 17.7 mm, which compress favourably with one indian angula (17.86 mm). For buildings, a unit of 40 divisions on the Lothal ruler comprise a distance of 68 mm, which is approximately the same as the Mahenjo Daro measure (67.056 mm).

25.2 Units of Volume

The measurement of buildings at Harappa and Mohenjo Daro confirm that both linear and cubic systems were used.

25.3 Units of Capacity

A variety of pots made of clay, and sometimes of metal, has been discovered, but no systematic determinations of the volumes of pottery seem to have been made.

25.4 Units of Weight

Archaeologists have found 558 weights in Harappa, Mohenjo-daro and Chanhu-daro. The weights were made of agate, chert, chalcedony, limestone, or steatite in different sizes, but sixty-eight percent were made of chert. Eighty-three percent of the weights were hexahedrons, popularly known as cubical, but some spherical, cylindrical and barrel-shaped weights have also been found. This can be compared with the barrel- or duck-shaped weights of alabaster used by the Sumerians and Egyptians.

The stone weights vary in size from $11 \times 11 \times 7$ mm to about $41 \times 41 \times 34$ mm. The smallest weight found was about 0.856 5 g. Each subsequent weight was first doubled in a series (1, 2, 4, 8, . . ., 160) until the stone weighed about 54 g. Then, the weights proceed in a series in decimal multiples of sixteen (= 320, 640, 1600, 3200, 6400, 8000 and 128,000). The 13.625 g weight seems to have been the most commonly used unit in the Indus Valley.

The weights found in Lothal have been arranged in eight various groups. The mean values of these groups are 1.823 3 g, 3.448 g, 5.172 g, 6.896 g, 13.792 g, 27.584 g, 55.168 g, and 137.60 g. This is found to be in the simple ratio of 2, 4, 6, 8, 16, 32, 64 and 120. A set of truncated spheroids were found to represent four different groups, with the mean values 1.218 4 g, 4.337 0 g, 8.575 3 g, 18.165 0 g, and 32.305 2 g. These stand in the ratio of 7/2, 7, 14 and 28.

Balance scale-pans, made of copper, bronze, or ceramics, have also been found. They were probably hung from a piece of wood to make a balance, but the wood has not survivied.

26 Islamic Caliphates (*c.* 632–1258)

See also *Achaemenid Empire* and *Ancient Arabia*.

The term Caliphate refers to the political-religious states comprising the Muslim communities and peoples under its dominion in the centuries following the death of the Prophet Muhammed. The empire of the Caliphate grew rapidly to include most of Southwest Asia, North Africa, and Spain. The three generally accepted Caliphates include the Rashidun (632–661), the Umayyad (661–750) and the Abbasid (750–1258). The Caliphate ceased to exist with the Mongol destruction of Baghdad in 1258.

Islam is divided into two major branches, Sunnis and Shias. Sunnis are further divided into four major schools of religious law schools that have survived until today: the Hanafi, Hanbali, Maliki and Shafi'i. The Hanafi school, named after Abu Hanifah al-Numan ibn Thabit (697–767), is dominant in Afghanistan, Jordan, Lebanon, Pakistan, Turkey and southern Russia; Maliki, founded by Malik ibn Anas al-Asbahi (*c.*715–795), is mainly represented in Algeria, Bahrain, northern Egypt, Kuwait, Morocco, Sudan and Tunisia; Hanbali, founded by Ahmed ibn Hanbal (780–855), is represented in Saudi Arabia, Qatar and Oman; and Shafii, named after Muhammed ibn Idris al-Shafii (767–820), is mainly represented in East Africa, southern Egypt, Indonesia, Malaysia, Palestine, Syria, and the Arabian Peninsula.

Main sources: [CHVO], [HINZ], [HOUT], and [KISC]

26.1 Units of Length

The following tables provide three possible interpretations of the old Islamic measurement system. The first column descibes the units of measurement as they were presumably used during the time of Caliph Omar II (*c.* 634–644).[4] The second column is based on values presented by [HOUT]. These values may also be considered to be those that were in use after the reign of Abū Jaʿfar Abdullāh al-Māˡmūn ibn Harūn (Abbasid caliph, 813–833). The third column is based on information from a report[5] by Sheikh Abdul Azeez bin Abdur-Razzaaq Al-Ghudayaan (Judge at the General Court in Al-Khobar), and describes the units of measurement as they were applied in the countries with Sharia law, even long after the units had become obsolete.

[4] During his reign, Islamic armies conquered Syria and Mesopotamia.

[5] This report, "Simplified Table of Measuring Units ," was available at http://212.70.50.62/Adl/ENG/attach/107.pdf.

Upper Hejira scale

		فرســـخ				Metric	Metric	Metric
marhala[a]						45,965 m	46,102.4 m	47,347.2 m
2	**barīd** or **veredus**					22,982.5 m	23,051.2 m	23,673.6 m
8	4	**farsakh** or **parasang**[b]				5745.6 m	5762.8 m	5918.4 m
24	12	3	**mīl**			1915.2 m	1920.9 m	1972.8 m
200	14⅖	25	8⅓	**ghalva**		229.824 m	230.512 m	236.736 m
240	120	30	10	1⅕	**seir**	191.520 m	192.093 m	197.280 m

[a]Sometimes referred to as a village-length
[b]Sometimes referred to as the distance covered in an hour by a horse walking

Middle Hejira scale

						Metric	Metric	Metric
seir						191.520 m	192.093 m	197.280 m
50	**qasabah** or **qasab**[a]					3.830 4 m	3841 9 m	3.945 6 m
100	2	**bā'** or **orgye**[b]				1.915 2 m	1.920 9 m	1.972 8 m
266⅔	5⅓	2⅔	**khutwah**			718.2 mm	720.3 mm	739.8 mm
300	6	3	1⅛	**arsh** or **cubit**[c]		638.4 mm	640.3 mm	657.6 mm
400	8	4	1½	1⅓	**dhirā'**[d]	478.8 mm	480.2 mm	493.2 mm

[a]Sometimes referred to as a cane-length
[b]Sometimes referred to as a **kathouah** or a pace-length
[c]Also referred to as a **deraga akhdam**, and sometimes as a Hachemic or Hashemite cubit
[d]Sometimes refered to as the ell. Sheikh Abdul Azeez bin Abdur-Razzaaq Al-Ghudayaan reported that Ibrahīm ibn Muṣṭafa (died in *c*. 1910) measured the diameter of 144 barley grains fifty five times and measured the diameter of the mule's hair eighty one times, and concluded that the legal dhirā' was 485 mm. Sheikh Abdul Azeez also reported that Muhammad Baig Al-Falakī (died in *c*. 1884), measured the pool at the Tubrusiyah School, annexed to the Al-Azhar Mosque. The pool was built for the surface area of water to be 100 square dhirā, and Muhammad Baig Al-Falakī found it to be 24.332 m^2, making the dhirā = about 493.27 mm. The dhirā in Mecca has been reported as being 541.40 mm and the dhirā akhdam as 641.66 mm. According to [HOUT, p. 528], many dhirās were used in Cairo during the early twentieth century: 1 dhirā muhandase = 766.8 mm, 1 dhirā istanbulī = 676.8 mm, 1 dhirā hindāsa = 637.92 mm and 1 dhirā baladī or maşri = 576.96 mm

Lower Hejira scale

							Metric	Metric	Metric
dhirā'[a]							478.8 mm	480.2 mm	493.2 mm
2	**kadam**[b]						239.4 mm	240.1 mm	246.6 mm
2¼	1⅛	**shibr**					212.8 mm	213.4 mm	219.2 mm
6	3	2⅔	**qabdah** or **cabda**[c]				79.8 mm	80.0 mm	82.2 mm
24	12	9⅓	4	**isbā'** or **assbā**[d]			19.95 mm	20.0 mm	20.5 mm
144	72	56	24	6	**sha'irah, chabba** or **orge**		3.325 mm	3.3 mm	3.4 mm
864	432	336	144	36	6	**sha'rah**[e]	0.55 mm	0.55 mm	0.57 mm

[a]Sometimes refered to as a **deraga cabda**
[b]Sometimes refered to as a foot. Based on the writings of Abū Jaʿfar Abdullāh al-Māʾmūn ibn Harūn (Abbasid caliph, 813–833), there was also a "black" foot equal to about 540 mm
[c]Sometimes referred to as a palm-length
[d]Sometimes referred to as a finger-length or inch. According to [HOUT, p. 528], the isbā' was marked on the Nilometer of the island of al-Rawda (built in 714), where it was later stated as being 22.925 mm
[e]Sometimes referred to as a camel hair

Hanbali and Shaafi'i standard

			Metric
qabdah			2.473 m
4	**dhira**		618.34 mm
24	6	**bā'**	103.04 mm

Maliki standard

			Metric
qabdah			2.120 m
4	**dhira**		530.00 mm
36	9	**bā'**	58.88 mm

Legal standard

			Metric
qabdah			1.973 099 100 m
4	**dhira**		493.274 775 mm
24	6	**bā'**	82.212 462 mm

Some other reported measures:

1 ghalva = 720 kadam = 172.8 m;

1 dhiraa = 745 mm (in Baghdad), 700 mm (in Mosul), and 685 mm (in Aleppo).

1 deraga (during the reign of Abū Jaʿfar Abdullāh al-Māʾmūn ibn Harūn (Abbasid caliph, 813–833)) = 533 mm;

1 fiddiya (in Ad-Dawr) = 503 mm.

26.2 Units of Area

System based on a deraga = about 640 mm

فدّان									Metric
faddān or **feddan**[a]									5898.24 m^2
4	**djarib**[b]								1474.56 m^2
6	1½	**daneq**							983.04 m^2
24	6	4	**qirāt**						245.76 m^2
40	10	$5\frac{5}{9}$	$1\frac{2}{3}$	**cafiz** or **qafiz**					147.46 m^2
72	18	12	3	$1\frac{4}{5}$	**habbah**				81.92 m^2
96	24	16	4	$2\frac{2}{5}$	$1\frac{1}{3}$	**qamha**			61.44 m^2
400	100	$66\frac{2}{3}$	$16\frac{2}{3}$	10	$5\frac{5}{9}$	$4\frac{1}{6}$	**achir** or **qasaba**		14.746 m^2
14,400	3600	2400	600	360	200	150	36	**deraga** or **dirāh**	40.96 dm^2

[a]The Hejira scale (*c*. 622) has been estimated as being about 5750 m^2
[b]Sometimes reported as being a 1/2 feddan

System according to Shaykh 'Abdul Azīz

فدّان									Metric
faddān or **feddan**									3893.119 m^2
2½	**Djarīb**								1557.247 99 m^2
24	$9\frac{3}{5}$	**qirāt**							162.213 33 m^2
25	10	$1\frac{1}{24}$	**cafiz** or **qafiz**						155.724 799 m^2
72	$28\frac{4}{5}$	3	$2\frac{22}{25}$	**habbah**					54.071 11 m^2
144	$57\frac{3}{5}$	6	$5\frac{19}{25}$	2	**daniq**				27.035 55 m^2
250	100	$10\frac{10}{24}$	10	$3\frac{34}{72}$	$1\frac{53}{72}$	**ashir**			15.572 48 m^2
13,824	$5529\frac{3}{5}$	576	$552\frac{24}{25}$	192	96	$55\frac{37}{125}$	**sahtūt**		28.2 dm^2
16,000	6400	$666\frac{2}{3}$	640	$222\frac{2}{9}$	$111\frac{1}{9}$	64	$1\frac{9}{55}$	**dirāh**	24.3 dm^2

Other reported measures:

1 **donum** = 40 architect dirah^2 = 919.302 4 m^2.

26.3 Units of Capacity (Measured by Weight; 1 kg = About 1 L of Water)

Scale used by physicians like Yahya ibn Sarafyun (ninth century), Yuhanna ibn Masawaih (777–857),
Muhammad ibn Zakariyā Rāzī (865–925), ‘Ali ibn al-’Abbas al-Majusi (d. 982–994), and
Abū ʿAlī al-Ḥusayn ibn ʿAbd Allāh ibn Sīnā (*c.* 980–1037)[6]

										Roman system	Metric
dorach										1 amphora	26.026 L
8	**johem**									1 congius	3.253 L
48	6	**kist**								1 sextarius	542.22 mL
96	12	2	**korboni**							1 hemina	271.11 mL
192	24	4	2	**kiliathi**						½ cotyla	135.54 mL
288	36	6	3	1½	(large) **mustarum**					1/3 hemina	90.37 mL
384	48	8	4	2	1⅓	**kestuf**				1 acetabulum	67.78 mL
576	72	12	6	3	2	1½	**cuathum**			1 cyathus	45.18 mL
1152	144	24	12	6	4	3	2	**falgerin**		½ cyathus	22.59 mL
2304	288	48	24	12	8	6	4	2	(small) **mustarum**	1 cochleare	11.30 mL

Traditional and metric-linked upper scale

						Metric	Metric
gariba, **kor**, or **den**						261.12 kg	264 kg
4	**artabe**, **artaba**, **amphora**, or **grand saa**					65.28 kg	66 kg
5⅓	1⅓	**modius**				48.96 kg	49.5 kg
8	2	1½	**cafiz** or **caphiz**			32.64 kg	33 kg
16	4	3	2	**khoull**		16.32 kg	16.5 kg
32	8	6	4	2	**woëbe**, **ouiba**, **voeba**, or **ferk**	8.16 kg	8.25 kg

[6] See [PAUL]

Traditional and metric-linked lower scale

					Metric	Metric
woëbe, **ouiba**, **voeba**, or **ferk**					8.16 kg	8.25 kg
2	**makuk**, **makouk**, or **macuca**				4.08 kg	4.125 kg
3	1½	**sáa**			2.72 kg	2.75 kg
8	3	2	**kiladja**, **cadaa**, **caphite**, **kaledja**, or **kist**		1.36 kg	1.375 kg
16	6	4	2	**mudd**	680 g	687.5 g

Other reported measures:

1 **biršála** (for grain) = about 8.5 L.

26.4 Units of Liquid Capacity

Upper scale

					Metric
chilaga					~3.305 L
3	**daurak**				~1.102 L
6	2	**cauz**			~550.8 mL
12	4	2	**cymba**		~275.4 mL
36	12	6	3	**socarga**	~91.8 mL

Lower scale

						Metric
socarga						~91.8 mL
1⅔	**natl**					~55.08 mL
3⅓	2	(small) **cymba**				~27.54 mL
5	3	1½	**estor**			~18.34 mL
10	6	3	2	**megrapha**		~9.17 mL
20	12	6	4	2	**misqal**	~4.59 mL

26.5 Units of Weight

1 **awqiyyah** (وقية) = about 37 g.

Scale used during the pagan period in Mecca:

1 **danak** = 8⅔ habba (barley-corns of average size).

Scale used after the pagan period

				Metric
danāk				~760 mg
3⅛	**kirāt**			~234.2 mg
10	3⅕	**habba** (barley-corn)		~76 mg
40	12⅘	4	**aruzza**[a] (grain of rice)	~19 mg

[a]Value based on [KISC, Appendix 3]

For fine use

		Metric
saumna		~585 mg
4	**baquila**	~146 mg

Upper Hejira scale (*c*. 622–*c*. 900)

							Metric
heml							249.6 kg
4⁴⁄₉	**kikkar**						56.16 kg
5⁵⁄₉	1¼	**qantar**					44.928 kg
200	45	36	**oke**				1.248 kg
277⁷⁄₉	62½	50	1⁷⁄₁₈	**minah**			898.56 g
555⁵⁄₉	125	100	2⁷⁄₉	2	**rottle**		449.28 g
666⅔	150	120	3⅓	2⅖	1⅕	**yusdroman**	374.4 g

Lower Hejira scale (*c*. 622–*c*. 900)

							Metric
yusdroman							374.4 g
10	**wukiyeh**						37.74 g
80	8	**mitkal**					4.68 g
120	12	1½	**dirhem** or **dirham**				3.12 g
1920	192	24	16	**kirat**			195 mg
5760	576	72	48	3	**hebbeh**		65 mg
7680	768	96	64	4	1⅓	**kambeh**	48.75 mg

Scale used later (also called the system of the Prophet)

			مَنّ		وقيــة				Metric
kikkar									42.5 kg
1¼	**qanthar**								34 kg
31¼	25	**ocque** or **oka**							1.36 kg
62½	50	2	**mann** or **menna**						680 g
125	100	4	2	**rotl**					340 g
375	300	12	6	3	**uqiyya** or **oukia**				11.33 g
750	600	24	12	6	2	**nasch**			5.67 g
3000	2400	96	48	24	8	4	**nevat**		1.42 g
15,000	12,000	480	240	120	40	20	5	**dirham**	283 mg

Traditional system (so-called system of the Prophet)

			مَنّ		وقيــة				Metric
kikkar									42.5 kg
1 ¼	**qanthar**								34 kg
31 ¼	25	**ocque** or **oka**							1.36 kg
62½	50	2	**mann** or **mine**						680 g
125	100	4	2	**rotl**					340 g
625	500	20	10	5	**uqiyya** or **oukia**				68 g
2500	2000	80	40	20	4	**nasch**			17 g
7500	6000	240	120	60	12	3	**nevat**		5⅔ g
15,000	12,000	480	240	120	24	6	2	**dirhem**	2⅚ g

Scale used by physicians like Yahya ibn Sarafyun (ninth century), Yuhanna ibn Masawaih (777–857), Muhammad ibn Zakariyā Rāzī (865–925), 'Ali ibn al-'Abbas al-Majusi (d. 982–994), and Abū ʿAlī al-Ḥusayn ibn ʿAbd Allāh ibn Sīnā (*c*. 980–1037)[7]

[7] See [PAUL]

											Metric
manes alicatica											1.360 kg
1⅓	**ratel**										1.019 kg
16	12	**sacros**									84.96 g
36	24	2	**sextarium**								42.48 g
112	84	7	3½	**denarius**							12.14 g
128	96	8	4	1⅐	**darchimi**						3.54 g
384	288	24	12	3³⁄₇	3	**garme**					1.18 g
768	576	48	24	6⁶⁄₇	6	2	**onolossat**				590 mg
1152	864	72	36	10²⁄₇	9	3	1½	**danich**			393 mg
2304	1728	864	576	20⁴⁄₇	18	6	3	2	**kirat**		197 mg
4608	3456	288	144	41⅐	36	12	6	4	2	**kestuf**	98 mg

Scale according to Shaykh ‘Abdul Azīz

											Metric
qintār											1528.1 kg
3733⅓	**ratl**										409.5 g
12,000	3³⁄₁₄	**uqīyah**									127.34 g
24,000	6³⁄₇	2	**nash**								63.67 g
7466⅔	20	6²⁄₉	3⅑	**asqār**							20.47 g
96,000	25⁵⁄₇	8	4	1²⁄₇	**nawah**						15.92 g
33,600	90	28	14	4½	3½	**mithqāl** or **dinār**					4.55 g
48,000	128⁴⁄₇	40	20	6³⁄₇	5	1³⁄₇	**dirham**				3.185 g
672,000	1800	560	280	90	70	20	14	**qirāt**			227 mg
1,344,000	3600	1120	560	180	140	40	28	2	**tasūj**		144 mg
2,419,200	6480	2016	1008	324	252	72	50⅖	3⅗	1⅘	**qamhah**	63.17 mg

Upper scale for general use

							Metric
artaba or **qantar**							66.02 kg
6 ¾	**batman** (grand)						9.78 kg
9	1⅓	**batman**					7.34 kg
27	4	3	**batman** (small)				2.45 kg
54	8	6	2	**oka**			1.22 kg
90	13⅓	10	3⅓	1⅔	**menna**		733.56 g
108	16	12	4	2	1⅕	**rotl**	611.30 g

Middle scale for general use

				Metric
rotl				611.30 g
1⅔	**yusdroman**			366.78 g
2	1⅕	**checki** or **rotton**		305.65 g
20	12	10	**uqiya**	30.565 g

Lower scale for general use

							Metric
uqiya							30.565 g
10	**dirhem**						3.056 5 g
40	4	**Onolosat**					764.12 mg
60	6	1½	**daneq**				509.41 mg
120	12	3	2	**qirat**			254.71 mg
240	24	6	4	2	**tassoudj**		127.35 mg
480	48	12	8	4	2	**chabba**	63.68 mg

27 Kingdom of Israel (930–722 BCE/586 BCE)

See also *Kingdom of Judah.*

In 930 BCE, the United Kingdom of Israel and Judah was divided into the Kingdom of Israel and the Kingdom of Judah. The Kingdom of Israel was conquered by the Assyrian Empire in 722 BCE, and the Kingdom of Judah became part of the Babylonian Empire in 586 BCE.

The ancient Israelites used a system of measurements that appears within the Hebrew Bible, as well as in later Jewish writing, such as the Talmud. They derived their system of weights and measures from their neighbors. Neither did they have any uniformity among their standards, and may have had three or more standards at one time. In Palestine, both the Babylonian six-decimal system and the Egyptian decimal system were used simultaneously. Specific measures were adopted from the Mesopotamian system (*kor*, *se'ah*, and *shekel*), from the Egyptian systems (*ephah* and *hin*), and from the Canaanite system (*kikkar* and *letekh*). The Phoenicians and the Persians also added some units of their own.

The ascertaining of biblical measures and the determination of their values in terms of metric measures is done mainly on the basis of archaeological finds, along with explicit formulations of metrological systems in ancient litterature and expressions from which a system can be inferred. These estimated values vary considerably. The determination of the values of the measurements is further complicated by the fact that the values changed over time without necessarily changing their names. Below are mentioned a couple of possible consistent sets of values, but these relationships are still a subject fraught with uncertainty and will be so until archaeologists are able to recover the actual instruments of measurement.

Main sources: [ALBE], [DALM], [DEAN], [ECON], [EPST], [FELD], [JOSE], [KAHN], [LENZ], [LEWY], [OPPE3], [RAPO], [SING], [ZUCK], and [ZUCK2]

27.1 Units of Length

The units of length mentioned in the Bible are derived from average measures of the length of human limbs. In the early period, it was customary to measure with the limbs themselves, cf. the standard cubit was defined as the part of the arm from the elbow to the tip of the middle finger. As time progressed, absolute and more precise values and relationships were established for these natural measures, though these were often still named according to the parts of the body.

The most important and basic measure was the cubit. Attempts have been made to learn the value of the cubit in terms of present-day measures by comparison with ancient structures whose measurements are noted, such as the tunnel of Siloam or the walls of Megiddo. However, all of these calculations are unreliable. It also appears that there were many values in use during different periods.

1 cubit (Royal Babylonian) = 528.6 mm;

1 cubit (Babylonian; King Gudea) = 495 mm;

1 cubit (Hebrew, OT) = 457.2 mm;
1 cubit (Hebrew, long) = 533.4 mm;
1 cubit (Egyptian) = 450.1 mm;
1 cubit (Royal Egyptian) = 525.0 mm;
1 cubit (Ezekiel's) = 520.7 mm;
1 cubit (Roman, NT) = 444.5 mm.

Like the Egyptians, the Israelites used two kinds of cubits, namely the smaller cubit of 6 palmbreadths and the larger cubit of 7 palmbreadths. The longer cubit was probably adopted by the Israelites, while all the other measures were derived from Babylon.

Halakhic authorities have tried to estimate the value of the thumbbreadth, by interpreting talmudic and rabbinic laws. Rabbi Avrohom Yeshaya Karelitz estimated 1 ez̤ba as being 24 mm. Rabbi Chaim P. Benish suggested that the etzba was 19–19.2 mm. These values give us the following scales:

Ratio between the units according to the short cubit

קָנֶה	אַמָּה	זרת	טפח	אצבע	Metric	Reported as
qaneh (reed)					2.743 m	2.70– 3.15 m
6	**'ammāh** (cubit)				457.2 mm	450– 458 mm
12	2	**zeret** (span)[a]			228.6 mm	225–229 mm
36	6	3	**ṭefaḥ** (palmbreadth)		76.2 mm	75–76.2 mm
144	24	12	4	**ez̤ba** (thumbbreadth)	19.05 mm	18.75–19.05 mm
Ezekiel 40:5	Genesis 6:15	Exodus 28:16	Exodus 25:25 1 Kings 7:26	Jeremiah 52:21		

[a]Span = the width of a spread out human hand from the tip of the thumb to the tip of the pinky finger

Ratio between the units according to the long cubit

קָנֶה	אַמָּה	זֶרֶת	טֶפַח	אצבע	Metric
qaneh (reed)					3.20 m
6	**'ammāh** (cubit)				533.4 mm
14	2⅓	**zeret** (span)			228.6 mm
42	7	3	**ṭefaḥ** (palmbreadth)		76.2 mm
168	28	12	4	**ez̤ba** (fingerbreadth)	19.05 mm
Ezekiel 40:5	Ezekiel 40:5	Exodus 28:16	Exodus 25:25	Jeremiah 52:21	

אַמָּה	זֶרֶת	טֶפַח	אֶצְבַּע	Metric (Karelitz scale)	Metric (Benish scale)
’ammāh				480–576 mm	456–460.8 mm
2	**zeret**			240–288 mm	228–230.4 mm
6	3	**ṭefaḥ**		80–96 mm	76–76.8 mm
24	12	4	**ez̤ba**	20–24 mm	19–19.2 mm

The large measures mentioned in the Bible are based upon estimates, such as the range of the bowshot [Gen 21:16]. The expression **kivrat ‘erez** (“a short distance”) seems to mean a journey of about two hours [Gen 35:16]. Even greater distances were measured by days’ journey [Gen 30:36]. The Talmud adds a few more units, adopted from Persia (parasang and stadium), Greece (dichas, or double palm) and Rome (mil).

(which is even mentioned as a unit of area[8] and as a unit of capacity[9]) and the **cord/חבל** (defined contradictorily as 50 amahs[10] in the Mishnah, but only as 4 amahs[11] in the Germara).

Rabbi Papa ben Samuel introduced a measure of 3 kapiz or kefiza. In Papunis (a place between Bagdad and Pumbeditha), they referred to it as a **roz-Papa**, probably meaning “Papa’s measure.” [12]

Talmudic and rabbinic additions

דֶּרֶךְ יוֹם			ריס	זרת	חסיט	טֶפַח	Metric
derekh yom (day’s journey)							42,672 m
10	**parasakh**						4267.20 m
40	4	**mil**[a]					1066.80 m
300	30	7½	**ris** (stadium)				142.24 m
80,000	8000	2000	266⅔	**pesi’ah** (pace) or **’ammāh**			533.4 mm
240,000	24,000	6000	800	3	**hasiṭ** (double palm)		177.8 mm
480,000	48,000	12,000	1600	6	2	**ṭefaḥ** (palm)	88.9 mm
Genesis 30:36		Matthew 5:41	2 Maccabees 11:5				

[a]A Sabbath Day’s journey

Some measurements are mentioned in the Bible but do not fall within this system, such as the **gomed** (Judg. 3:16), which was probably shorter than the normal cubit, and the **saad** (2 Sam. 6:13), probably not a specific measure. There is also the **Sabbath day’s journey** (Acts 1:12), equal to about 1–1.2 km, and the foot (Deuteronomy 2:5), estimated at about 308 mm.

There are also two additional units of unknown size, namely the **garmida/גרמידא** Some scholars think this measure was equal to 3 log, and others 9 log.

Other consistent systems presented by scholars are presented below.

[8] Baba Batra, 27a
[9] Erubin, 14b
[10] Erubin, 5:4
[11] Erubin, 58b
[12] [OPPE3, p. 342] and [EPST p. 372].

System based on [MART3]

					קָנֶה	אַמָּה		זֶרֶת	טֶפַח	אֶצְבַּע	Metric
parasakh											4393.200 m
3	**chibrat barah**										166.400 m
22½	7½	**reison**									221.920 m
112½	37½	5	**asba**								44.384 m
187½	62½	8⅓	1⅔	**chebel**							26.630 4 m
1500	500	66⅔	13⅓	8	**qaneh**						3.328 8 m
9000	3000	400	80	48	6	**’ammāh**					554.8 mm
18,000	6000	800	160	96	12	2	**pañham**				277.4 mm
24,000	8000	1066⅔	213⅓	128	16	2⅔	1⅓	**zeret**			208.0 mm
72,000	24,000	3200	640	384	48	8	4	3	**ṭefaḥ**		69.3 mm
288,000	96,000	12,800	2560	1536	192	32	16	12	4	**eẓba**	1.73 mm

System based on [SING]

דֶּרֶךְ יוֹם				אַמָּה	זֶרֶת		טֶפַח	אֶצְבַּע	Metric
derekh yom									44,814.926 m
10	**parasakh**								4481.493 m
40	4	**Sabbaths day’s journey**							1120.373 m
300	30	7½	**ris**						149.383 m
80,000	8000	2000	266⅔	**’ammāh**					560.186 mm
320,000	32,000	8000	533⅓	2	**zeret**				280.093 mm
480,000	48,000	12,000	800	3	1½	**hasiṭ**			186.729 mm
960,000	96,000	24,000	1600	6	3	2	**ṭefaḥ**		93.364 mm
3,840,000	384,000	96,000	6400	24	12	8	4	**eẓba**	23.341 mm

27.2 Units of Area

The biblical texts indicate areas by describing how much land could be sown with a certain volume of seed.

				Metric
beit kor[a]				15,677.39–24,883 m^2
30	**beit seah**[b]			522.58–829.4 m^2
720	24	**beit rova**[c]		21.77–34.56 m^2
75,000	2500	104⅙	**ammah al ammah**	20.903–33.18 dm^2

[a]The amount of land able to be sown with a kor of seed
[b]The amount of land able to be sown with a seah of seed
[c]The amount of land able to be sown with a 1/4 kav of seed

The Israelites also adopted the yoke (צֶמֶד (**tsemed**) in Hebrew) from Mesopotamia, equal to the amount of land that a pair of yoked oxen could plough in a single day. This area has been estimated as being 6480 amah al amah = about 1354.5 m^2, but scholars normally estimate it as 1600–2500 m^2.

For smaller areas

			Metric
geris			2.26 m^2
9	**adashah**		25.13 dm^2
36	4	**searah**[a]	6.28 dm^2

[a]A circle with a diameter of about 20 mm

Other consistent systems presented by scholars:

System based on [MART3]

				Metric
beit kor				2308.523 m^2
30	**beit seah**			76.951 m^2
60	2	**socab**		38.475 m^2
75,000	2500	1250	**ammah al ammah**	3.078 dm^2

27.3 Units of Dry Capacity

When it comes to units of dry capacity, three separate systems have been identified: the *midbarit system* (presumed system, used in the years Moses is written to have spent in the Sinai desert), the *yerushalmit system* (used in Jerusalem) and the *sepphorit system* (used in Tzippori or Sepphoris, in the central Galilee region). The smallest unit in these systems was the egg (Hebrew: **beẓah**). The base unit *se'ah* should have contained 144 eggs in the midbarit system, 172⅘ (= ~173) eggs in the yerushalmit system, and 207 9/25 (= ~207) eggs in the sepphorit system. The size of these measures has been a matter of controversy. Two major schools of thought are presented below, representing Rabbi A. H. Na'eh and Rabbi Avraham Yeshayahu Kareliz (known as the Hazon Ish). All foodstuffs were generally measured by volume, while metals and precious metals were weighed.

כור	האמה		קב		תומן	עוכלא		Rabbi Na'eh		
								midbarit	yerushalmit	sepphorit
kōr[a]								248 L	298.5 L	358.1 L
30	**se'ah**[b]							8.31 L	9.95 L	11.94 L
60	2	**tarkab**						4.15 L	4.98 L	5.97 L
180	6	3	**kab**					1.38 L	1.66 L	1.99 L
720	24	12	4	**rova**				346.2 mL	414.6 mL	497.4 mL
1440	48	24	8	2	**tuman**			173.1 mL	207.3 mL	248.7 mL
3600	120	60	20	5	2½	**'ukla**		69.2 mL	82.9 mL	99.5 mL
4320	144	72	24	6	3	1⅕	**beẓah**	57.7 mL		
	173						**beẓah**		69.1 mL	
	207						**beẓah**			82.9 mL

כור	האמה		קב		תומן	עוכלא		The Hazon Ish		
								midbarit	yerushalmit	sepphorit
kōr[a]								430 L	515.8 L	619.1 L
30	**se'ah**[b]							14.33 L	17.19 L	20.64 L
60	2	**tarkab**						7.16 L	8.60 L	10.32 L
180	6	3	**kab**					2.39 L	2.86 L	3.44 L
720	24	12	4	**rova**				597.0 mL	716.4 mL	859.8 mL
1440	48	24	8	2	**tuman**			298.5 mL	358.2 mL	429.9 mL
3600	120	60	20	5	2½	**'ukla**		119.4 mL	143.3 mL	172.0 mL
4320	144	72	24	6	3	1⅕	**beẓah**	99.5 mL		
	173						**beẓah**		119.4 mL	
	207						**beẓah**			143.3 mL

[a]The largest unit of capacity mentioned in the OT, the kōr, was sometimes called the **hōmer**. Both of these names appear to have been used for dry commodities, as well as for liquids. See also [BROM, p. 1049]
[b][LEWY] estimated the cubic finger to be 9⅓ cm^3, the egg, about 56 cm^3, the midbarit se'ah, 8.10 L, the yerushalmit se'ah, 9.72 L, and the sepphorit se'ah, 11.664 L. According to [SING], there was yet another seah used in Arbela, but of unknown size

Some of the units in the NT are the same as those encountered in the OT, while others are derived from Greco-Roman measures.

Units adopted from Persia and Greece during Talmudic time

גרב		מודיא	קב	קפיזא	תומן	עוכלא	Metric
garab[a]							?
?	**geriwa**[b]						?
?	?	**módius**					6.592 L
?	?	3¾	**kab**, **qab**, or **cab**				2.197 L
?	?	12	3⅕	**kapiza**			686.7 mL
?	?	30	8	2½	**tuman**		274.7 mL
?	?	75	20	6¼	2½	**'ukla**	109.9 mL
	Er. 29b; Pes. 32a; Ned 50b B. K. 96a	Mk. 7:4	Ter. 47b				

[a]A unit of weight for solids that might have been used as a unit of dry capacity as well
[b]The value of it is unknown, but some scholars report the geriwa, based on Er. 14b, as being equal to the seah

1 **xéstēs** (Mk. 7:4) = about 546 mL.

Estimated values for presumed Hebrew/Persian system

כור	לתך		איפה		איפה	עשׂרוֹן	קב	לג		Metric
kōr										180.878 9 L
2	**lethek** or **lethekh**[a]									90.439 5 L
3⅓	1⅔	**nebel**								54.263 7 L
10	5	3	**ephah**[b]							18.087 9 L
20	10	6	2	**sephel**						9.043 9 L
30	15	9	3	1½	**saton**					6.029 3 L
100	50	30	10	5	3⅓	**gomer**				1.808 8 L
180	90	54	18	9	6	1⅘	**kab** or **kav**			1.004 9 L
720	360	216	72	36	24	7⅕	4	**log**		251.22 mL
4320	2160	1296	432	216	144	43⅕	24	6	**beẓah**	41.87 mL
	Hosea 3:2		Ezekiel 45:24	Luke 11:33			II King 6:25	Leviticus 14:10		

[a]Translated in the Septuagint, the Greek Old Testament, into the Greek term *nebel oínou* (= a skin of wine). Some scholars prefer to exclude **lethek** from the metrological system, reflecting its obscure relation to other units. See also [BROM, p. 1049]
[b]The ephah is only mentioned as a unit of dry capacity in the Bible; flour (1 S. 1:24), roasted grain (1 S. 17:17) and barley (Ruth 2:17)

Alternative values for the biblical system (based on [ECON], [KAHN] and [ALBE])

כור	לתך	איפה	איפה	עשׂדוֹו	קב	Metric	Metric	Metric
kōr						380 L	201.215 L	220 L
2	**Lethek**					190 L	100.608 L	110 L
10	5	**ephah**				38 L	20.121 L	22 L
30	15	3	**s'ah**, **se'ah**, or **saton**[a]			12.7 L	6.707 L	7.3 L
100	50	10	3⅓	**omer**, **'issaron**, or **oner**[b]		3.8 L	2.012 L	2.2 L
180	90	18	6	1⅘	**kab**, **qab**, or **kav**	2.1 L	1.118 L	1.2 L
Leviticus 27:16	Hosea 3:2	Exodus 16:36	II Kings 7:1	Exodus 16:36, Leviciticus 5:11 and 5:20, Numbers 28:13, and Ezekiel 45:11	II Kings 6:25			

[a]Considered to be about 12.50 L by [DALM]
[b]The omer, = 1/10 kor, is probably a result of the influence of the decimal systems of Egypt and Assyria

There was also a very small Talmudic unit of capacity, known as a **ke'zayit** (Hebrew: כזית), that has usually been said to equal the size of an average olive. It's generally considered that there was no exact relation between the ke'zayit and the bezah. Mosheh ben Maimon (1135–1204), a Jewish Torah scholar and rabbi, specified the ke'zayit as less than one-third of a bezah. [AU: The second half of the first sentence in this paragraph is coming out all garbled as I look at it, likely because of the insertion of the word in Hebrew script, which reads from right to left instead of left to right. If it looks okay to you, then never mind. I wanted to make a small correction to that sentence, but could not because the formatting is out of whack. However, it was not an especially important correction, and thus I am just going to let it lie.]

Other consistent systems presented by scholars:

System based on [SING]

כור	לתך	איפה	איפה	קב		לג				Metric
kōr										395.533 2 L
2	**lathek** or **pesiḳta**									197.766 6 L
10	5	**ephah**								36.553 3 L
30	15	3	**se'ah** or **geriwa**							13.184 4 L
180	90	18	6	**cab**						2.197 4 L
360	180	36	12	2	**ḳapiza**					1.098 7 L
720	360	72	24	4	2	**log**				549.3 mL
1440	720	144	48	8	4	2	**tuman**			274.7 mL
3600	1800	360	120	20	10	5	2½	**'ukla**		109.9 mL
4320	2160	432	144	24	12	6	3	1⅕	**beẓah**	91.6 mL

System based on [MART3]

כור	לתך	איפה	איפה	עשׂדוֹו	Metric
kōr					284.587 L
2	**Lethek**				142.293 L
10	5	**ephah**			28.459 L
30	15	3	**se'ah**		9.486 L
100	50	10	3⅓	**omer**	2.846 L

Sepphorit system, based on [LENZ]

כור	איפה	איפה	קב	לג	Metric
kōr					466.64 L
10	**ephah**				46.66 L
30	3	**se'ah**			15.55 L
180	18	6	**can**		2.592 L
720	72	24	4	**log**	648 mL

27.4 Units of Liquid Capacity

As with the dry dimensions, there are different opinions about the size of the units. Often cited values: **log midbarit** = 503.5 mL, **log yerushalmit** = 699.4 mL, and **log sepphorit** = 777.4 mL. An unbroken jar located at Qumran, an archaeological site in the West Bank, which was inscribed "two seah and seven logs" (= 55 logs), has been reported as being 2175.52 cu in (= about 35.65 L). This estimation indicates that one log = about 648 mL.

								Rabbi Na'eh		
								midbarit	yerushalmit	sepphorit
kōr								248.8 L	298.5 L	358.1 L
10	**bath**							24.9 L	29.9 L	35.8 L
60	6	**hin**						4.1 L	5.0 L	6.0 L
100	10	1⅔	**issaron**					2.49 L	2.98 L	3.58 L
720	72	12	7⅕	**log**				345.6 mL	414.5 mL	497.4 mL
2880	288	48	28⅘	4	**revi'it**			86.4 mL	103.7 mL	124.3 mL
25,930	2592	432	259⅕	36	9	**mesurah**		9.6 mL	11.6 mL	13.9 mL
46,080	4608	768	460⅘	64	16	1⁷⁄₉	**kortob**	5.4 mL	6.5 mL	7.8 mL

								The Hazon Ish		
								midbarit	yerushalmit	sepphorit
kōr								429.9 L	515.8 L	619.1 L
10	**bath**							43.0 L	51.6 L	61.9 L
60	6	**hin**						7.2 L	8.6 L	10.3 L
100	10	1⅔	**issaron**					4.30 L	5.16 L	6.19 L
720	72	12	7⅕	**log**				597.0 mL	716.4 mL	859.8 mL
2880	288	48	28⅘	4	**revi'it**			149.3 mL	179.1 mL	215.0 mL
25,930	2592	432	259⅕	36	9	**mesurah**		16.5 mL	20.0 mL	23.8 mL
46,080	4608	768	460⅘	64	16	1⁷⁄₉	**kortob**	9.3 mL	11.2 mL	13.4 mL

The bath occurs in *Leviticus 19:35, I Kings 7:26, 38*, and *I Chronicles 2:10*, the log occurs in *Leviticus 14:10, 12, 15, 21*, and *24*, the issaron occurs in *Exodus 29:4*; *Leviticus 5:1*; *6:20*, *Numbers 28:13*, and *Ezekiel 45:11*, the hin occurs in *Exodus 29:40*, *Leviticus 19:36*, *Numbers 15:4, 5, 6, 9; 28:5, 7, 14, Ezekiel 4:11; 45:24; 45:24; 46:5, 7, 11*, and 14, the bath occurs in *1 Kings 7:26, 38; 2 Chr 2:10; 4:5; Ezekiel 7:22; 45:10, 11, 1614*; and *Isaiah 5:10*, and the kor, or cor, occurs in *Ezekiel 45:14, 1 Kings 4:22* and *5:11*.

Estimated values for presumed Hebrew/Persian system

							Metric
kōr							180.878 9 L
10	**bath**						18.087 9 L
60	6	**hin**					3.014 6 L
720	72	12	**log**				251.22 mL
960	96	16	1⅓	**cadaa**			188.41 mL
2880	288	48	4	3	**rebiite**		62.80 mL
4320	432	72	6	4½	1½	**cos**	41.87 mL

Other consistent systems presented by scholars:

System based on [MART3]

				Metric
bath				28.459 L
6	**hin**			4.743 L
18	3	**Kab**		1.581 L
72	12	4	**log**	395 mL

Systems based on [ECON] and [ALBE]

				Metric	Metric
kōr				380 L	220 L
10	**bath**[a]			38 L	22 L
60	6	**Hin**		6.3 L	3.6 L
720	72	12	**log**	528 mL	306 mL

[a][KAHN] reported 36.44 L or 20.13 L

System based on [SING]

						Metric
meṭarta						39.553 32 L
12	**kuza**					3.296 11 L
72	6	**log**, **kaisa** or **xestes**				549.35 mL
288	24	4	**anṭel**, **naṭla**, **anpaḳ**, **anbag** or **kuza**			137.34 mL
2304	192	32	8	**barzina**		17.17 mL
4608	384	64	16	2	**ḳorṭab**	8.58 mL

Systems based on [LENZ]

					midbarit	yerushalmit	sepphorit
kōr					254.85 L	305.82 L	366.99 L
10	**bath**				25.48 L	30.58 L	36.70 L
60	6	**hin**			4.25 L	5.10 L	6.12 L
180	18	3	**cab**		1.41 L	1.70 L	2.04 L
720	72	12	4	**log**	354 mL	425 mL	510 mL

Other measures used in ancient times:

1 **shåfīthå** or **sapation** (for wine)[13] = 15 xestai = ~4.5 L (in Gaza), = 18 xestai = ~5.4 L (in Azotus),
and = 22 xestai = ~6.6 L (in Ashkelon);
1 **shåfīthå** (for ointment) = 1/2 xestes = ~150 mL.

27.5 Units of Weight

27.5.1 Biblical Scale

Seven coin weights are mentioned in the Bible, namely the talent, the mina, the shekel, the beka, the gerah, the pim, and the kesitah. The relationship between the first five weights can be established on the basis of the Bible and other sources. As in the Ugaritic and Canaanite systems, the talent was divided into 3000 shekels (see also Exodus 38:25–26). It should be noted that the talent in Babylonia was divided into 3600 parts. The Greco-Roman talent ranged from 26.4 kg to 37.8 kg in different periods. To determine the values used for a talent in Palestine, we need to assume a number of excavated shekels, which have inscriptions with the specified unit values. According to such excavations, the value varied between about 8.5 g and 16 g. The beka is mentioned in Genesis 24:22 and Exodus 38:26, and its basic meaning is "a part."

There were four different systems of measurement in use: a heavy royal version, a light royal version, a heavy common version and a light common version. The heavy royal talent often took the form of a lion, while the light royal talent was often represented in the form of a duck.

The Bible mentions at least three kinds of shekels: "a shekel of silver" (Genesis 23:16), "shekel by the sanctuary weight" (Exodus 30:13) and "shekel by the king's weight" (II Samuel 14:26). According to [JOSE, vol. 14, p. 106], the heavy common system was the normal measure of weight. Gradually, the system was reformed, probably under the influence of Egypt, so that a mina was worth only 50 shekels. The shekel then remained the same weight, while the weight of the standard minah was reduced.

Biblical scale based on a mina = 60 shekels (Ezekiel 45:12) and 1 shekel = 24 gerah (from the Mesopotamian system)

כִּכָּר	מָנֶה	שֶׁקֶל	בֶּקַע	גֵּרָה	Metric
talent or **kikkar**					43 kg
60	**mina** or **maneh**				717 g
3600	60	**shekel**			11.95 g
7200	120	2	**beka**, **bekah**, or **beqa**		6.0 g
86,400	1440	24	12	**gerah** or **obol** (carob seed)	498 mg

[13] According to Epiphanius (*c*. 315–403). See [DEAN, p. 51, 55].

Biblical scale based on a mina[a] = 60 shekels (Ezekiel 45:12) and 1 shekel = 20 gerah (Exodus 30:13) (from the Canaanite–Israelite system)

כִּכָּר	מָנֶה	שֶׁקֶל	בֶּקַע	גֵּרָה	Heavy royal Metric	Light royal Metric	Heavy common Metric	Light common Metric
talent or **kikkar**					60.6 kg	38 kg	58.9 kg	34.2 kg
60	**mina** or **maneh**				1.01 kg	633 g	982.4 g	570 g
3600	60	**shekel**			16.8 g	10.6 g	16.4 g	9.5 g
7200	120	2	**beka**, **bekah**, or **beqa**		8.4 g	5.3 g	8.2 g	4.7 g
72,000	1200	20	10	**gerah** or **obol**	842 mg	528 mg	819 mg	475 mg

[a]Reckoned as the "holy" mina

Biblical scale based on a mina[a] = 50 shekels (Ex. 38: 25–26)

כִּכָּר	מָנֶה	שֶׁקֶל	בֶּקַע	גֵּרָה	Light royal Metric	Heavy common Metric
talent or **kikkar**					31.7 kg	49.1 kg
60	**mina** or **maneh**				528 g	819 g
3000	50	**shekel**			10.6 g	16.4 g
6000	100	2	**beka**, **bekah**, or **beqa**		5.3 g	8.2 g
60,000	1000	20	10	**gerah** or **obol**	528 mg	819 mg

[a]Reckoned as the "profane" mina

Other consistent systems presented by scholars:

System based on [MART3]

כִּכָּר	מָנֶה	שֶׁקֶל	גֵּרָה	Metric
kikkar				21.266 550 kg
50	**mina**			425.331 g
3000	60	**shekel**		7.089 g
60,000	1200	20	**gerah**	354 mg

Other measures mentioned in the Bible:

1 **kesitah**, **gesitha**, or **q^{e}śîṭah** (קְשִׂיטָה) = probably about 46 g (mentioned in Jos 24:32); The value of the *kesitah* (Genesis 33:19, Joshua 24:32, and Job 42:11) is still not fully known.

1 **'adarkonim** (1 Chr. 29:7; Ezra 8:27) or **darkomnim** (Ezra 2:69; Neh. 7:70) = the Greek gold coin dareikos (אֲדַרְכֹנִים) = about 8.42 g;

1 **pim** or **pym** (3/2= (פִּים shekel = about 7.8 g (mentioned in I Samuel 13:21); The relative value of the pim can be determined from archaaeological finds.

1 **bq'** or **beqa** (2/1= (בֶּקַע shekel = about 5.8 g (cf. Ex. 38: 26);

1 **peres** =1/2 zuz = probably about 3.6 g (mentioned in Daniel 5:25, 28).

27.5.2 Talmudic Scale

The currency system found in the Talmudic literature is generally considered to be based on the Roman monetary system.

Talmudic system

כִּכָּר					שֶׁקֶל			Metric[a]
talent[b] or **kikkar**								43.02 kg
60	**liṭra**[c] or **mina**[d]							717.00 g
120	2	**tarṭimar**						358.50 g
750	12½	6¼	**unkiyyah** or **uncia**					57.36 g
1500	25	12½	2	**sela**				28.68 g
3000	50	25	4	2	**shekel**			14.34 g
6000	100	50	8	4	2	**zuz**		7.17 g
24,000	400	200	32	16	8	4	**perutah**	1.79 g

[a]The values of the weights often varied in different parts of the country, e.g., the Mishnah states that used the weights in Judea had but half the value they possessed in Galilee
[b]Also said to equal 3000 or 4000 Italian issars, and 12,000 provincial selas (copper coinages that were minted locally in a number of cities, and were considered to be 1/8 of the imperial selas)
[c]Used for fish, figs, vegetables, meat, gold, and silver
[d]Used for figs, meat, spices, and wool

Other consistent systems presented by scholars:

System in use by the end of the Babylonian captivity, which ended in 538, based on [MART3]

כִּכָּר	מָנֶה	שֶׁקֶל	גֵּרָה	Metric
kikkar				42.533 100 kg
50	**mina**			850.662 g
3000	60	**shekel**		14.178 g
60,000	1200	20	**gerah**	709 mg

System based on [SING]

כִּכָּר	מָנֶה				שֶׁקֶל		גֵּרָה	Metric
talent								21.510 kg
37½	**mina**							573.6 g
60	1⅗	**Italian mina**						358.5 g
120	3⅕	2	**tarṭimar**					179.2 g
1500	40	25	12½	**shekel of the Sanctuary**				14.34 g
3000	80	50	25	2	**shekel**			7.17 g
6000	160	100	50	4	2	**zuz**		3.58 g
36,000	960	600	300	24	12	6	**gerah**	0.597 5 g

28 Jewish (*c.* 1050 BCE–*c.* 930 BCE)

See also *Kingdom of Judah* and *Kingdom of Israel*.

This note is about the biblical United Kingdom of Israel and Judah before it was split into the Kingdom of Israel and the Kingdom of Judah in *c*. 930 BCE.

Main source: [ALBE]

28.1 Units of Length

Lower scale for general use

								Metric
royal **kaneh**								3.23 m
1⅙	**kaneh**							2.76 m
6	5⅐	royal **'ammah**						537.6 mm
7	6	1⅙	**'ammah**					460.8 mm
14	12	2⅓	2	**zeret** or **zereth**				230.4 mm
21	18	3½	3	1½	**hasit**			153.6 mm
42	36	7	6	3	2	**tefah, tophah,** or **tofah**		76.8 mm
168	144	28	24	12	8	4	**ezba** or **etzba**	19.2 mm

Upper scale for general use

					Metric
day's journey					43.1 km
10	**parasang**				4.31 km
40	4	**sabbath day's journey**[a]			1.08 km
300	30	7½	**ris**		143 m
13, 333⅓	1333⅓	333⅓	44⁴⁄₉	**royal kaneh**	3.23 m

[a]There are some passages in the New Testament that allude to the Sabbath day's journey, such as in Acts 1:12: "Then they returned to Jerusalem from the Mount called Olivet, which is from Jerusalem a Sabbath day's journey"

28.2 Units of Weight

1 **shekel hamelech** (King's shekel) = 14.55 g.

System according to [ALBE, p. 29]

					Metric
kikar					49.11 kg
60	**mina**				818.5 g
3000	50	**shekel**			16.37 g
6000	100	2	**beka**		8.185 g
60,000	1000	20	10	**gera**	818.5 mg

29 Kingdom of Judah (*c.* 930 BCE–586 BCE)

See also *Kingdom of Israel*.

This state was established in the Southern Levant, and is often referred to as the Southern Kingdom.

Main sources: [AHAR], [AHAR2], and [KLET]

29.1 Units of Weight

The monetary weight system was based on the silver shekel. Monetary transactions were made by weighing pieces of silver using the shekel weights. Many dome-shaped limestones and some rectangular and trapezoidal weights made of bronze have been found in Israel. Many of these have a peculiar shekel-sign on them, followed by an hieratic number, the cursive form of ancient Egyptian writing, representing 1, 2, 5, 10, 15, 20, 30, and 50. Not a single inscribed weight of the heavier *maneh* or *kikar* units has yet been found.

Upper scale, based on the Egyptian and Assyrian systems

							כשק	Metric[a]	Metric[b]	Metric[c]
50								454.55 g	**50 qdt = 455.5 g**	~452.0 g
1⅔	**30**							274.33 g	**30 qdt = 273.3 g**	~271.2 g
2½	1½	**20**						184.769 g	**20 qdt = 182.2 g**	~180.8 g
3⅓	2	1⅓	**15**					129.45 g	**15 qdt = 136.6 g**	~135.6 g
5	3	2	1½	**10**				90.627 g	**10 qdt = 91.1 g**	~90.4 g
10	6	4	3	2	**5**			45.239 g	5 qdt = 45.5 g	**~45.2 g**
20	12	8	6	4	2	**2**		22.617 g	2 qdt = 18.2 g	**~22.6 g**
40	24	16	12	8	4	2	**shekel**	11.332 g	1 qdt = 9.11 g	**~11.3 g**

[a]The average masses of the corpus of shekel weights, based on [KLET]
[b]The estimated average masses of the shekel weights, based on an average qdt of 9.11 g. A shekel weighing 9.113 g and with an 1 qdt inscription is housed in the Bible museum at Terre Sainte in Paris. [LEMA]
[c]The estimated average masses of the shekel weights, based on an average shekel of 11.3 g

Some scholars have assumed that the *shekel* and the Egyptian *qdt* were equal before 700 BCE. This relationship is shown by the grey boxes to the left in the table above. This theory also assumes that, likely as a result of the rise of influence of the Assyrian empire, the shekel became heavier around 700 BCE, increasing from about 9.1 g to about 11.3 g.

Regular lower scale

כשק													Metric
shekel													~11.3 g
–	**nesef**												~9.4 g
–	–	**pym**											~7.5 g
2	–	–	**beqa**[c]										~5.6 g
–	2	–	–	**10 gerah**									~4.7 g
–	–	2	–	–	**8 gerah**								~3.8 g
–	–	–	–	–	–	**7 gerah**							~3.3 g
4	–	–	2	–	–	–	**6 gerah**						~2.8 g
–	4	–	–	2	–	–	1⅕	**5 gerah**					~2.3 g
–	–	4	–	–	2	1¾	1½	1¼	**4 gerah**				~1.9 g
8	–	–	4	–	–	2⅓	2	1⅔	1⅓	**3 gerah**			~1.4g
12	10	8	6	5	4	3½	3	2½	2	1½	**2 gerah**		~0.9 g
24	20	16	12	10	8	7	6	5	4	3	2	**gerah**[a]	~0.5 g

[a]In the Bible (Exodus 30:13), a *shekel* is mentioned containing 20 gerahs

30 Kingdom of Lydia (*c*. 1200 BCE–546 BCE)

See also *Achaemenid Empire* and *Ancient Rome*.

This kingdom covered, at its greatest extent, all of western Anatolia.

30.1 Units of Weight

						Metric
talent						28.8 kg
60	**mine**					480.6 g
1800	30	**stater**				16.02 g
2700	45	1½	**stater** (silver)			10.68 g
3600	60	2	1⅓	**stater** (gold)		8.01 g
648,000	10,800	360	240	180	**gran** (barley-corn)	44.5 mg

31 Kingdom of Macedonia (*c.* 800 BCE–146 BCE)

See also *Ptolemaic Kingdom* and *Ancient Rome*.

This kingdom was established by Karanus during the early 800s BCE, and became, during the reign of Alexander the Great (356–323 BCE), the most powerful empire in the world, including the former Persia and Egypt within its territories, which stretched to the east as far as the Indus River. In 146 BCE, Macedonia was conquered by the Roman Republic.

31.1 Currency

1 Greek drachma = 6 oboloi = 48 chalkoi

31.2 Units of Length

Македонскиот кубит	педа	вршок	Metric
Macedonian kubit			355.6 mm
2	**peda**[a]		177.8 mm
8	4	**vershok**	44.4 mm

[a]The distance between the tip of the little finger and the tip of the thumb

32 Kingdom of Magadha (*c.*600 BCE–321 BCE)

This state included most of Bihar and Bengal.

Main source: [MARS2]

32.1 Currency

1 panas

32.2 Units of Weight

Scale based on [MARS2]

						Metric
droṇa						18.58 kg
4	**a'ṭaka**					4.64 kg
16	4	**prastha**				1.16 kg
512	128	32	**pala**			36.288 g
32,768	8192	2048	64	**māsha**		567.00 mg
163,840	40,960	10,240	320	5	**rāti**	113.40 mg

33 Maurya Empire (321 BCE–185 BCE)

During the reign of Chandragupta Maurya (*c.* 340–293 BCE), there was a well-defined system for weights and measures, as reported by Chānakya or Kauṭilya (*c.* 370–283 BCE), an adviser to the Emperor, in the Arthaśāstra.

Main sources: [GUPT] and [KAUT]

33.1 Currency

1 panas

33.2 Units of length

For an overview of the ancient hasta systems, see also *Nepal*.

Upper scale as

योजन										Metric
yojana										~15,200 m
4	**krosha** or **gorața**									~3800 m
400	100	**paridesha**								~38 m
800	200	2	**rajju**							~19 m
8000	2000	20	10	**daṇḍa**[a] or **dhanuṣ**						~1.9 m
32,000	8000	80	40	4	**aratni**					~470 mm
64,000	16,000	160	80	8	2	**vitasti**[b]				~240 mm
96,000	24,000	240	120	12	3	1½	**dhanumuṣṭi**			~160 mm
192,000	48,000	480	240	24	6	3	2	**dhanugraha**[c]		~80 mm
768,000	192,000	1920	960	96	24	12	8	4	**aṅgula**	~20 mm

[a]The height of a bow
[b]The distance between the tip of the thumb and the tip of the last finger when the palm is outstretched
[c]A bow grip

Lower scale, based on [GUPT]

						Metric
aṅgula						~20 mm
8	**yavamadhya**					~2.500 mm
64	8	**yūkā**[a]				~312.500 mg
512	64	8	**likṣā**[b]			~ 39.062 mg
4096	512	64	8	**rathacakravipruṣ**[c]		~4.883 mg
32,768	4096	512	64	8	**paramāṇu**[d]	~0.610 mg

[a]Also called a **yookamadhya**
[b]The size of the egg of a lice. It was also called a **vālāgras**
[c]Also called a **rajahkan** or **ratharenu**. A grain of dust which arose from the wheels of chariots
[d]Only visible to the great Sage

34 Maya Civilization (c. 1800 BCE–c. 900 CE)

The settlements in Zaklohpakab, in present-day Mexico, have been estimated to have been built as early as 1800 BCE. The peak of significant and artistic development, as well as large-scale constructions, occurred during the classic period, *c*. 250–900 CE. The empire consisted of numerous independent city-states, such as Calakmul, Comalcalco, Copán, Dos Pilas, Jaina, Mani, Mayapán, Naranjo, Palenque, Tikal, Tolum, Topoxte, Uaxactun, Uxmal, and Xultún.

Main sources: [ANDR], [BRIN], [CALD], [CAST], [DECI], [HOCQ], [HOFL], [MACR], [OBRI], [PRAD], [RACA], and [WATA]

34.1 Currency

1 peso = 8 reales

34.2 Units of Quantity

1 **bak** = 400;
1 **zontle** (for avocados, corn cobs and wood) = 400;
1 **huacal** (for tuna) = 300;
1 **chiquihuite** (for guava) = 250;
1 **huacal** (for avocado and guava) = 200;
1 **huacal** (for squash and annona) = 100;
1 **huacal** (for pineapple and papaya) = 25;
1 **jicara** (for plums) = 20;
1 **kal** = 20.

34.3 Units of Length

The Mayan measurement system varied from one city to another. Measurements taken of wall thicknesses and the like show that measures used for a specific building were internally consistent, and usually also consistent within the community, but differed in minor ways from the measures used in neighbouring communities. Despite this, some generalizations can be made.

The Maya appear to have used two different systems of length measures, but both with the zapal, = the distance between the extremities of the extended arms, as the base unit.

First scale, based on [PRAD] and [OBRI]

				Metric
zapal or **zap**				~1.46 m
16	**kab**[a]			~91 mm
40	2½	**UP**		~36.5 mm
144	9	$3\frac{3}{5}$	**xóot**	~10.1 mm

[a]‘Hand’ in Yucatec

Second scale, based on [PRAD] and [OBRI]

				Metric
zapal or **zap**				~1.46 m
9	**oc**[a], **chekoc**[b] or **chekeb-oc**[b]			~162 mm
40	$4\frac{4}{9}$	**UP**		~36.5 mm
144	16	$3\frac{3}{5}$	**xóot**	~10.1 mm

[a]‘Foot’ in Yucatec
[b]‘Footstep’ in Yucatec

Some scholars have tried to approximate a general scale.

System, based on [CALD] and [RACA]

							Metric
bakaan							~8,736 m
20	**kalkaan**						~436.8 m
400	20	**kaan**					~21.84 m
4800	240	12	**zap**, **zapal**, or **zapiche**				~1.82 m
9600	480	24	2	**betán** or **pātan**			~0.910 m
192,000	9600	480	40	20	**azab**		~45.5 mm
3,840,000	192,000	9600	800	400	20	**chan**	~2.275 mm

34.4 Units of Area

According to [BRIN], there were three types of kaan used as a customary land measure:

1 **hun kaan tah can zapalche** = 4 zap = about 48 square fathoms = 160.5 m^2;
1 **kaan** = 3 zap = about 36 square fathoms = 120.4 m^2;
1 **hun kaan tah ox zapalche** = 2 zap = about 24 square fathoms = 80.3 m^2.

Land area for plowing or cultivation

		Metric
vinic or **uinic**[a]		9540 m^2
20	**kaan** or **estadal**	477 m^2

[a] A land area, growing enough maize to support a family

Land area in general

					Metric
zontle					~40,000 m^2
2	**pantle**				~20,000 m^2
2⅔	1⅓	**milpa**[a]			~15,000 m^2
4	2	1½	**apantle**		~10,000 m^2
100	50	37½	25	**mecate** or **top**	~400 m^2

[a] Usually a corn field

34.5 Units of Dry Capacity

					Metric
iquipil					1750 L
3½	**colote**				500 L
87½	25	**chochocol**			20 L
116⅔	33⅓	1⅓	**quilli**		15 L
1166⅔	333⅓	13⅓	10	**jicara**[a]	1.5 L

[a]Usually used for beans

34.6 Units of Weight

Various reported measures:

1 **cuch** = the load which a man, or beast, can carry on his shoulders (estimated as ~43.4 kg);
1 **chiquihuite** (for corn cobs) = ~40 kg;
1 **huacal** (for tuna) = ~40 kg;
1 **huacal** (for avocado) = ~30 kg;
1 **tambache** or **cacaxtle** = ~25 kg;
1 **huacal** (for green chile) = ~23 kg;
1 **chiquihuite** (for fruits) = ~15 kg;
1 **petaca** (for chickpea straw) = ~11.5 kg;
1 **jicaco** = ~25 g.

35 Minoan Civilization (*c.* 2700 BCE–*c.* 1400 BCE)

The Minoan civilization was a Bronze Age civilization that arose on the island of Crete. The Empire attained its greatest power in about 1600 BCE, when they contolled the entire Aegean and traded extensively with Egypt. The Minoans developed an advanced writing system, a uniform system for weights and measures, and a calendrical system based on precise astronomical observations.

Excavations on Crete have revealed some 3000 clay tablets with syllabic scripts or ideograms, known as Linear A and Linear B to indicate their chronological order. Some "Linear A" writings on stones and terra-cotta vessels, dating back to 1750 BCE, have been interpreted as documenting a complex system of weights and measures. The majority of the Linear B tablets are dated between 1400 and 1150 BCE.

The largest unit of weight was divided into thirtieths, which were themselves subdivided into fourths. The solid measure contained tenths, each tenth being divided into sixths, and each sixth into fourths. Liquid measures were divided into thirds, which were then divided again into further thirds, then into sixths, and subsequently fourths. The Minoan system later became widespread in the Aegean, in Akrotiri, and on mainland Greece.

Main sources: [FOST2], [GRAH5], [PETR6], and [PETR7]

35.1 Units of Length

The Minoans used a foot of about 11$\frac{15}{16}$ inches = 303.2 mm, according to [GRAH5, p. 224].

35.2 Units of Weight

Some of the weights found in Minoan settlements are inscribed with signs representing their value. The weights correspond exactly to the Linear A and Linear B tablets on which special ideograms were used to represent the weight of the goods. One category of weights varied from 60 to 64 g, and another category from 480 to 510 g.

Mochlos system

							Metric
+							~1.46 kg
2	IIIIIIIIIIII						~0.73 kg
4	2	**?**					~0.36 kg
24	12	6					~60.9 g
36	18	9	1½	·			~40.6 g
48	24	12	2	1⅓	▲		~30.4 g
72	36	18	3	2	1½	. . . +	~20.3 g

Knossos system

								Metric
?								~1.49 kg
4	**?**							~372.6 g
6	1½	**?**						~248.4 g
16	4	2⅔	**?**					~93.1 g
24	6	4	1½	°				~62.1 g
36	9	6	2¼	1½	**?**			~41.4 g
72	18	12	4½	3	2	·		~20.7 g
96	24	16	6	4	2⅔	1⅓		~15.5 g

Palekastro system

					Metric
?					64.05 g
2	**?**				32.02 g
4	2	**?**			16.01 g
8	4	2	**?**		8.00 g
24	12	6	3	**?**	2.67 g

Presumed Minoan system

									Metric
talent									29.0 kg
30	**heavy mina**								967.0 g
60	2	**mina**							483.5 g
120	4	2	**half mina**						241.7 g
240	8	4	2	**?**					120.9 g
480	16	8	4	2	**?**				60.4 g
960	32	16	8	4	2	**?**			30.2 g
1920	64	32	16	8	4	2	**?**		15.1 g
3840	128	64	32	16	8	4	2	**?**	7.5 g

36 Mitanni (*c.* 1500 BCE–*c.* 1300 BCE)

This state was situated in northern Syria and southeast Anatolia, wkich was a great power beginning in about 1500 BCE.

Main source: [DASS]

36.1 Units of Area

For land areas, strips rather than squares

			Metric
ikû			~4000 m^2
4	**kumānu**		~1000 m^2
10	2½	**purīdu**	~400 m^2

36.2 Units of Weight

Presumed scale for silver

				Metric
mina				470 g
2	**?**			235 g
60	30	**shekel**		7.83 g
320	160	5⅓	**?**	1.47 g

37 Mycenaean Greece (*c.* 1600 BCE–*c.* 1050 BCE)

Mycenaean culture was a Bronze Age culture in Greece, named after the supremely important archaeological location of Mycenae. The culture was later spread over the Aegean islands.

The systems of weights and measures were influenced by the systems used by the Minoan civilization. Some units of the systems were represented in the script by special signs. In some cases, it is possible to guess what these words were, but we have no way of verifying these guesses, thus I use quotes around the names I have chosen to use in the text below.

Main source: [CHAD]

37.1 Units of Area

The Mycenaens measured land by the quantity of seed required for sowing.

The actual size of a plot varied between the king's estate at 30 full units (= about 2880 L of wheat) and one unit (= about 1.6 L of wheat). We also know of two types of land from the Sphagiānes district. One type of land became known as *ko-to-na ki-ti-me-na*, what may be called "privately owned," and one type was known as *ko-to-na ke-ke-me-na*, what may be refered to as "public."

37.2 Units of Dry Capacity

The major unit had no special sign, but the commodity sign (for wheat) was often used instead.

For wheat and other cereals

				Metric
				~64.8–93.1 L
10				~6.5–9.3 L
60	6			~1.1–1.5 L
240	24	4		~0.3–0.4 L

37.3 Units of Liquid Capacity

The major unit had no special sign, but the commodity sign (for wine) was often used instead.

				Metric
				~19.5–27.9 L
3				~6.5–9.3 L
18	6			~1.1–1.5 L
72	24	4		~0.3–0.4 L

37.4 Units of Weight

					Metric
 or "talanton"					~30 kg
30	 or "dimnaion"				~1 kg
120	4	 or "quarter"			~250 g
1440	48	12			~21 g
8640	288	72	6		~3.5 g

38 Neo-Babylonian Empire or Chaldean Culture (*c.* 626 BCE–539 BCE)

See also *Babylonian culture*.

During the end of the Neo-Babylonian era, the Empire included Assyria, Aramea, Cilicia, Israel, Judah, Phoenicia, Syria, and parts of Asia Minor, Egypt, and Arabia. In 539 BCE, Babylonia was absorbed into the Achaemenid Empire.

Main sources: [CARD], [GEOR2], and [POWE]

38.1 Units of Length

Early Neo-Babylonian system

				Metric
nindanu				~7 m
2	**qanû**			~3.5 m
14	7	**ammatu**		~50 cm
336	168	24	**ubānu**	~2.1 cm

Late Neo-Babylonian/Persian system, upper scale

						Metric
stathmos or **mansion**						~25.6 km
$3\frac{19}{27}$	**schoëme**					~6.9 km
4	$1\frac{2}{25}$	**parasang**				~6 4 km
$14\frac{22}{27}$	4	$3\frac{19}{27}$	**mille**			~1.73 km
$111\frac{1}{9}$	30	$27\frac{7}{9}$	$7\frac{1}{2}$	**ghalva**		~230.4 m
1000	270	250	$67\frac{1}{2}$	9	**chebel**	~25.6 m

Late Neo-Babylonian/Persian system, lower scale

							Metric
chebel							~25.6 m
$6\frac{2}{3}$	**qasab**						~3.84 m
$13\frac{1}{3}$	2	pace					~1.92 m
40	6	3	cubit				~640 mm
80	12	6	2	**zereth**			~320 mm
160	24	12	4	2	palm		~160 mm
1280	192	96	32	16	8	finger	~20 mm

38.2 Units of Area

Neo-Babylonian system, seed measures

					Metric
kurru					~13,500 m^2
5	**pānu**				~2700 m^2
30	6	**sutu**			~450 m^2
180	36	6	**qu**		~75 m^2
1800	360	60	10	**akalu**	~7.5 m^2

Linear-based surface measures, based on the zereth

				Metric
kurru				14 745.6 m^2
10	**gan**			1 474.56 m^2
100	10	**dizaine**		147.456 m^2
1000	100	10	**gar** (= 144 zereth^2)	14.746 m^2

38.3 Units of Dry Capacity

Early Neo-Babylonian system

					Metric
kurru					~336 L
5	**pānu**				~36 L
30	6	**sūtu**			~6 L
336	36	6	**qû**		~1 L
3360	360	60	10	**akalu**[a]	~0.1 L

[a]According to [POWE], the akalu was based on an approximation of the amount of flour used for one flatcake

38.4 Units of Capacity (Measured by Weight)

								Metric
gariba								260.8 kg
2⅔	large **amphora**							97.8 kg
4	1½	large **artaba**						65.2 kg
5⅓	2	1⅓	small **artaba**					48.9 kg
8	3	2	1½	**amphora**				32.6 kg
16	6	4	3	2	**woëbe** or **modius**			16.3 kg
64	24	16	12	8	4	**makuk**		4.08 kg
256	96	64	48	32	16	4	**cado**	1.02 kg

38.5 Units of Weight

Upper scale:

1 **biltu** = 32.6 kg;
1 **mina** = 1/50, 1/60 or 1/100 biltu;
1 **drachma** = 1/5000, 1/6000 or 1/10,000 biltu.

Lower scale based on the mina = about 500 g

													Metric
šiqlu													8.333 g
1⅓	**šalāš rebâtu**												6.25 g
1½	1⅛	**šitta qātātu**											5.555 g
2	1½	1⅓	**zūzu**										4.167 g
3	2¼	2	1½	**šalšu**									2.778 g
4	3	2⅔	2	1⅓	**rebūtu**								2.083 g
5	3¾	3⅓	2½	2	1¼	**ḫummušu**							1.667 g
6	4½	4	3	2⅖	1½	1⅕	**suddû**						1.389 g
8	6	5⅓	4	3⅕	2	1⅗	1⅓	**bitqu**					1.042 g
12	9	8	6	4⅘	3	2⅖	2	1½	**māḫat**				694 mg
24	18	16	12	9⅗	6	4⅘	4	3	2	**girû**[a]			347 mg
40	30	26⅔	20	16	10	8	6⅔	5	3⅓	1⅔	**ḫallūru**		208 mg
180	135	120	90	72	45	36	30	22½	15	7½	4½	**uṭṭatu**[b]	46 mg

[a]A seed from the carob tree (*Ceratonia siliqua*)
[b]A barleycorn. Also called še. Sometimes reported as 46.7 mg

39 Odrysian Kingdom (*c*. 460 BCE–46 CE)

This kingdom was a union of Thracian tribes. It came to extend over most of present-day Bulgaria, parts of Northern Greece and European Turkey, as well as parts of Northern Dobruja. The area became a Roman province in 46 CE.

Main source: [ARCH]

40 Parthian Empire (*c*. 247 BCE–224 CE)

The area of the Parthanians was a satrapy of the Persian Empire from 550 BCE, when it was subdued by Cyrus the Great. In 311 BCE, Parthia became part of the Selucid Empire. Around 247 BCE, Andragoras, the governor of the Seleucid province of Parthia, proclaimed the area as independent from the Seleucid Empire. After a battle in 224 CE, the area became part of the Sassanid Empire.

40.1 Currency

247 BCE–224 CE: 1 drachma

41 Persian Empire

See *Achaemenid Empire*.

42 Philistine States (*c*. 1550 BCE–*c*. 1200 BCE)

The Philistines appeared in the southern coastal area of Canaan at the beginning of the Iron Age, most probably from the Aegean region. They ruled the five city-states of Ashdod, Ashkelon, Ekron, Gath, and Gaza.

Main sources: [BEND3] and [SCOT6]

42.1 Units of Weight

Some weights found in present-day Israel, *pym* or *pîm* and *nṣp*, are considered by some scholars to be part of a system of weights used by the Philistines.

43 Phoenician (in present Lebanon) (*c.* 1200 BCE–*c.* 539 BCE)

This ancient sea-trading Semitic Canaanite civilization established cities and colonies throughout the Mediterranean, e.g., in modern Algeria, Cyprus, Italy, Libya, Mauritania, Morocco, Portugal, the Somali peninsula, Spain, Tunisia, and Turkey.

The system of weights and measures in use in Phoenicia was nearly the same as that used by the Hebrew-speaking people in Sinai and Canaan. Each of their cities, such as Byblos, Sidon and Tyre, was a city-state which was a politically independent unit. This means that there were very likely a lot of different systems of weights and measures in use simultaneously. As the Phoenicians were important sailors and traders for the time, they also exerted a powerful influence on Eastern Mediterranean weights and measures.

Main sources: [IRWI] and [MART3]

43.1 Units of Length

								Metric
stathme								21.48 km
2	**gav**							10.74 km
4	2	**parasang**						5.37 km
120	60	30	**asparsa**					179 m
1000	500	250	8⅓	**chebel**				21.48 m
40,000	20,000	10,000	333⅓	40	**royal meh**			537 mm
43,200	21,600	10,800	360	43⅕	1 2/25	**aratni** or **aratsni**		49.7 mm
172,800	86,400	43,200	1440	172⅘	4 8/25	4	**vitasti**[a]	12.4 mm

[a]The distance between the tip of the thumb and the tip of the last finger when the palm is outstretched

Hebrew system, based on [MART3]

			אַמָּה		אֶצְבַּע	Metric
parasang						6657.600 m
4	**chibrat barah**					1664.400 m
30	7½	**reison**				221.920 m
12,675	3168¾	422½	**ammah**			525.2 mm
101,400	25,350	3380	8	**tofah**		65.7 mm
405,600	101,400	13,520	32	4	**etzba**	16.4 mm

43.2 Units of Dry Capacity

Hebrew scale, based on [MART3]

				Metric
kor				175.333 L
2	**ardob**			87.667 L
10	5	**efa**		17.533 L
100	50	10	**gomor**	1.753 L

43.3 Units of Liquid Capacity

Attic scale

כור		Metric
cor		477 L
10	**Attic metretae**	47.7 L

Persian/Hebrew system, based on [MART3]

			לג	Metric
ardob				52.600 L
3	**bath**			17.533 L
40	13⅓	**capita**		1.315 L
216	72	5⅖	**log**	243 mL

43.4 Units of Weight

The ancient Phoenician weights were also used as commercial weights in Egypt in the time of the Pharaohs, e.g., the **kikkar** (= about 29.36 kg) and the **mina** (= about 587.2 g).

Hebrew system, based on [MART3]

ככר	מנה	שקל	גרה	Metric
kikkar				21.266 550 kg
60	**maneh**			354.442 g
3000	50	**shekel**		7.089 g
60,000	2000	20	**gerah**	354 g

Persian/Hebrew system after Phoenicia was captured by Cyrus the Great in 539 BCE, based on [MART3]

ככר	מנה	שקל		גרה	Metric
kikkar					42.533 100 kg
60	**maneh**				708.885 g
3000	50	**shekel**			14.178 g
6000	100	2	**derhem**		7.089 g
60,000	1000	20	10	**gerah**	709 mg

Some reported coin weights:
1 **stater** = 435 g;
1 **sela** = 220 g.

43.5 Kingdom of Pontus (291 BCE–65)

See also *Roman Empire* and *Bosporan Kingdom*.

This kingdom was conquered by Pompey in 65 CE, and became part of the Roman Empire 2 years later.

44 Ptolemaic Kingdom (305 BCE–30 BCE)

See also *Ancient Egypt*, *Ancient Greece*, *Kingdom of Macedonia*, and *Ancient Rome*.

Egypt was conquered by Persia (in 525 BCE) and Alexander the Great (in 332 BCE). In 323 BCE, Ptolemy I Soter, a Macedonian general under Alexander the Great, became ruler of Egypt. The Ptolemies ruled until the suicide of Cleopatra (in 30 BCE), when Egypt became the private domain of the Roman emperor.

Main sources: [JOMA], [LEHM], and [MART3]

44.1 Currency

1 talentum = 60 mine =50 sicli = 100 drachme = 600 oboli = 2400 assaria = 4800 leptons

44.2 Units of Length

Phileterian system, based on [MART3]

											Metric
milliare											1623.600 m
7½	**stadium**										216.480 m
45	6	**plethrum**									36.080 m
75	10	1⅔	**hamma**								21.648 m
450	60	10	6	**acena**							3.608 m
750	100	16⅔	10	1⅔	**orgyia**						2.16 m
2250	300	50	30	5	3	**cubitus**					720 mm
3000	400	66⅔	40	6⅔	4	1⅓	small **cubitus**				541.2 mm
4500	600	100	60	10	6	2	1½	**pes**			360.8 mm
18,000	2400	400	240	40	24	8	6	4	**palmus**		90.2 mm
72,000	9600	1600	960	160	96	32	24	16	4	**digitus**	22.5 mm

Upper Phileterian system, based on [JOMA], and Phoenician-Egyptian value for stadium, from [LEHM]

										Metric
schænus or **parasanges**										6276 m
4	**milliare**									1569 m
15	3 ¾	**diaulum**								418.4 m
30	7½	2	**stadium**							209.2 m
90	22½	6	3	**jugerum**						69.7 m
180	45	12	6	2	**plethrum**					34.9 m
300	75	20	10	3⅓	1⅔	**amma**				20.9 m
1800	450	120	60	20	10	6	**acena**			3.49 m
2000	500	133⅓	66⅔	22⅖	11⅑	6⅔	1⅑	**calamus**		3.14 m
3000	750	200	100	33⅓	16⅔	10	1⅔	1½	**ulna**	2.09 m

Lower Phileterian system, based on [JOMA], and Phoenician-Egyptian value for stadium, from [LEHM]

										Metric
ulna										2.09 m
1⅓	**xylum**									1.57 m
2⅖	1⅘	**passus**								872 mm
4	3	1⅔	**cubitus**							523 mm
4⅘	3⅗	2	1⅕	**pygon**						436 mm
6	4½	2½	1½	1¼	**pes**					349 mm
8	6	3⅓	2	1⅔	1⅓	**spithame**				261.5 mm
12	9	5	3	2½	2	1½	**dichas**			174.3 mm
24	18	10	6	5	4	3	2	**palmus**		87.2 mm
96	72	40	24	20	16	12	8	4	**digitus**	21.8 mm

Alexandria system

				Metric
Mekyas cubit[a]				540 mm
1½	**t'ser**			360 mm
6	4	**choryos**		90 mm
24	16	4	**theb**	22.5 mm

[a]Used for measuring the depth of the Nile

44.3 Units of Area

Phileterian system, based on [JOMA]

					Metric
bethcoron or **bethcor**					9720.35 m^2
2	**bethléthech**				4860.17 m^2
30	15	**bethséa**[a]			324.01 m^2
180	90	6	**bethcabum**		54.00 m^2
720	360	24	4	**bethroba**	13.50 m^2

[a]At the time of the introduction of phileterian measures in Egypt during the reign of the Ptolemies, the bethséa was raised from about 324.0 m^2 to about 689.1 m^2

Phileterian system, based on [MART3]

			Metric
socarium			468.64 m^2
100	**orgya quadrata**		4.686 4 m^2
3600	36	**pes quadratus**	13.02 dm^2

Egyptian scale

								Metric
kha-ta or **jata**								275,650 m^2
10	**khat** or **jat**							27,565 m^2
100	10	**setjat**, **aroura**, or **arura**						2756.5 m^2
~200	~20	~2	**remen**					1367.65 m^2
~400	~40	~4	2	**heseb** or **hebes**				683.82 m^2
~800	~80	~8	4	2	**sa**			341.91 m^2
~1000	~100	~10	~5	~2½	~1¼	**kha**		275.65 m^2
~10,000	~1000	~100	~50	~25	~12½	10	**ta** or **mej**	27.565 m^2

44.4 Units of Volume

Some reported measures:

1 **naubion** (for earth) = 2 × 2 × 2 cubits = 1.158 m^3;
1 **pes cubicus** = 47.0 dm^3.

44.5 Units of Dry Capacity

Phileterian system, based on [JOMA]

									Metric
cor									330 L
2	**lethek**								165 L
3⅓	1⅔	**nebel**							99 L
10	5	3	**ephah**						33 L
20	10	6	2	**sephel**					16.5 L
30	15	9	3	1½	**saton**				11 L
100	50	30	10	5	3⅓	**gomer**			3.3 L
180	90	54	18	9	6	1⅘	**cab**		1.83 L
720	360	216	72	36	24	7⅕	4	**log**	458.3 mL

Phileterian system, based on [MART3]

				Metric
corus or **cor**				352.258 L
10	**medimnus** or **artabe**			35.226 L
20	2	**modius** or **sefel**		17.613 L
100	10	5	**chænix** or **gomor**	3.523 L

44.6 Units of Liquid Capacity

Phileterian system, based on [JOMA]

							Metric
Cor							350 L
10	**bath**						35 L
60	6	**hin**					5.83 L
720	72	12	**log**				486.1 mL
960	96	16	1⅓	**cadaa**			364.6 mL
2880	288	48	4	3	**rebiite**		121.5 mL
4320	432	72	6	4½	1½	**cos**	81.0 mL

Phileterian system, based on [MART3]

			Metric
metreta or **artabe**			46.968 L
3	**tertius** or **sat**		11.742 L
72	24	**sextarius** or **log**	489 mL

Alexandria system

				Metric
artaba				46.7 L
4	**sat**			11.675 L
8	2	**hin**		5.838 L
96	24	12	**log**	486.5 mL

44.7 Units of Weight

Phileterian system, based on [JOMA]

						Metric
talent						21.25 kg
60	**mine**					354.166 g
1200	20	**once**				17.708 g
1500	25	1 ¼	**tetradrachme**			14.166 g
6000	100	5	4	**drachme**		3.541 7 g
30,000	500	25	20	5	**obole** or **gerah**	708.3 mg

Phileterian system, based on [MART3]

						Metric
talentum or **talent**						41.997 084 kg
60	**mina** or **minah**					699.951 g
100	1⅔	**libra** or **litra**				419.971 g
1200	20	12	**uncia** or **once**			34.998 g
3000	50	30	2½	**siclus** or **siclos**		13.999 g
6000	100	60	5	2	**drachma** or **drachme**	7.000 g

Alexandria system, used for copper and brass

					Metric
Talent					46.7 kg
60	**minah** or **mina**				778.3 g
3000	50	**shekel** or **tetradrachm**			15.57 g
6000	100	2	**didrachm**		7.78 g
12,000	200	4	2	**drachm**	3.89 g

45 Ancient Rome (c. 753 BCE–476 CE)

See also *Byzantine Empire, Kingdom of Lydia, Kingdom of Macedonia*, and *Ptolemaic Kingdom*.

The Roman Kingdom lasted, according to legend, from 753 BCE until 509 BCE, when the Roman Republic was established. The post-Republic phase, known as the Western Roman Empire, began with Gaius Julius Caesar Augustus, who ruled alone from 27 BCE until his death in 14 CE.

Main sources: [DILK], [FOLK2], [GRAE], [HECH], [HULT], [LEMP], [MART3], [PETU], [RAPE], [SAIG], and [SMIT8]

45.1 Currency

c.133 BCE: 1 gold aureus = 25 silver denarii = 400 copper asses = 1600 copper quadrantes

–*c*.133 BCE: 1 gold aureus = 25 silver denarii = 250 copper asses

Silver coins before *c*.133 BCE

denarius					
2	quinarius				
4	2	sestertius			
16	8	4	libella		
32	16	8	2	sembella	
64	32	16	4	2	teruncius

Copper coins before *c*.133 BCE

sestertius						
2	dupondius					
4	2	as				
8	4	2	semissis			
12	6	3	1½	triens		
16	8	4	2	1½	quadrans	
24	12	6	3	2	1½	sextula

After *c*.133 BCE

aureus									
25	denarius								
50	2	quinarius or victoriatus							
100	4	2	sestertius						
200	8	4	2	dupondius					
400	16	8	4	2	as				
800	32	16	8	4	2	semissis			
1200	48	24	12	6	3	1½	triens		
1800	64	32	16	8	4	2	1½	quadrans	
2700	96	48	24	12	6	3	2	1½	sextula

45.2 Units of Length

The Romans used the Roman foot (**pes**) as the standard unit of length. The pes was about 296 mm in the early empire and about 292 mm in the later empire. It was sometimes called the **pes monetalis**, from the official measure that was kept in the temple of June Moneta at Rome. Various divisions and multiples of the pes were named after standards derived from the human frame.

Upper scale in the Roman Republic (*c*. 300 BCE)

									digitus	Metric
schoenus[a]									320,000	5,927.04 m
2⅔	**Gallic leuga** or **leuka**								120,000	2222.64 m
4	1½	**mille passum** or **milliārium**							80,000	1481.76 m
32	12	8	**stadium**						10,000	185.22 m
166⅔	62½	41⅔	5 5/24	**actus**					1920	35.562 m
2000	750	500	62½	12	**acnua**, **dekempeda**, or **pertica**				160	2.963 m
3333⅓	1250	833⅓	104⅙	20	1⅔	**ulna extenda**			96	1.778 m
4000	1500	1000	125	24	2	1⅕	**passus**		80	1.482 m
8000	3000	2000	250	48	4	2⅖	2	**gradus**	40	740.80 mm

[a]The schoenus was an itinerant distance, which varied with the terrain. The Romans adopted it from the Greeks, who had adopted it from the Egyptians (See also [SWAR])

Middle scale in the Roman Republic (*c*. 300 BCE)

						digitus	Metric
gradus or **pes sestertius**						40	740.80 mm
1⅔	**cubĭtus** or **ulna**					24	444.48 mm
2	1⅕	**palmĭpes**				20	370.40 mm
2²⁄₉	1⅓	1⅑	**pugnus**			18	333.36 mm
2½	1½	1¼	1⅛	**pes**[a]		16	296.32 mm
3⅓	2	1⅔	1½	1⅓	**dodrans** or **palmus major**	12	222.24 mm

[a]Sometimes reported as equalling 4/7 Sumerian Nippur cubit = 296.352 mm. I have chosen, as many scholars do, a somewhat smaller value. [ADAM4] estimated the pes as being 294.7 mm and [LILJ] estimated it as only 245.7 mm

Lower scale in the Roman Republic (*c*. 300 BCE)

							Metric
dodrans or **palmus major**							222.24 mm
1¹⁄₁₁	**palma porrecta**						203.72 mm
1½	1⅜	**pes dimidius**					148.16 mm
3	2¾	2	**palmus**				74.08 mm
6	5½	4	2	**duorum digitorum**			37.04 mm
9	8¼	6	3	1½	**uncial** or **polex**		24.69 mm
12	11	8	4	2	1⅓	**digĭtus**[a]	18.52 mm

[a][ADAM4] reported the digitus as being equal to 4 granum. The **granum** was said to be the length of a barley grain [LILJ] estimated one granum as being 3.71 mm

Upper scale in the Roman Empire, based on [MART3]

									Metric
mille passum									1477.500 m
8	**stadium**								184.687 5 m
41⅔	5⁵⁄₂₄	**actus**							35.460 0 m
500	62½	12	**decempeda**						2.955 0 m
1000	125	24	2	**passus**					1.477 5 m
2000	250	48	4	2	**gradus**				738.75 mm
3333⅓	416⅔	80	6⅔	3⅓	1⅔	**cubitus**			443.25 mm
4000	500	96	8	4	2	1⅕	**palmipes**		369.35 mm
5000	625	120	10	5	2½	1½	1¼	**pes**	295.50 mm

The term **as** and the words which denote its divisions were applied to measures of length, land area, capacity and weight, as well as to any object which could be regarded as consisting of 12 equal parts. When the division of the pes into unciae was adopted, the different divisions from one uncial up to twelve unciae were designated by the nomenclature given for the divisions of the as.

Subdivisions of the pes

													Metric
pes													295.500 mm
1 1/11	**deunx**												270.875 mm
1⅕	1 1/10	**dextans**											246.250 mm
1⅓	1 2/9	1 1/9	**dodrans**										221.625 mm
1⅗	1 7/15	1⅓	1⅕	**bes**									184.687 mm
1 5/7	1 4/7	1 9/21	1 2/7	1 1/14	**septunx**								172.375 mm
2	1⅚	1⅔	1½	1¼	1⅙	**semis**							147.750 mm
2⅖	2⅕	2	1⅘	1½	1⅖	1⅕	**quincunx**						123.125 mm
3	2¾	2½	2¼	2	1¾	1½	1¼	**triens**					98.500 mm
4	3⅔	3⅓	3	2⅔	2⅓	2	1⅔	1⅓	**quadrans**				73.875 mm
6	5½	5	4½	4	3½	3	2½	2	1½	**sextans**			49.250 mm
8	7⅓	6⅔	6	5⅓	4⅔	4	3⅓	2⅔	2	1⅓	**sesunx**		36.937 mm
12	11	10	9	8	7	6	5	4	3	2	1½	**pollex**	24.625 mm

Upper scale in system introduced during the reign of Julian the Apostate (after 355 CE)

					Metric
milion					1575 m
7½	**stadion**				210 m
50	6⅔	**pledron**			31.5 m
500	66⅔	10	**akena**		3.15 m
750	100	15	1½	**orgyia**	2.10 m

Lower scale in system introduced during the reign of Julian the Apostate (after 355 CE)

							Metric
orgyia							2.10 m
2	**bema**						1.05 m
4	2	**pechys**					525 mm
6	3	1½	**poys**				350 mm
8	4	2	1⅓	**spithame**			262.5 mm
24	12	6	4	3	**palaiste**		87.5 mm
96	48	24	16	12	4	**daktylos**	2.19 mm

Other measures used for distances:

1 **iter pedestre** (a day's travel) = 28,725 m.
1 **ulna**, varied in signification when used to indicate a length. Sometimes it represented the distance from the shoulder to the wrist, sometimes from the shoulder to the extremity of the middle finger, and sometimes the distance between the tips of the middle fingers, when the arms are outstretched out in the same plane with the body.

45.3 Units of Area

We know a lot about Roman land surveying, partly because of the *Corpus Agrimensorum Romanorum*, a collection of manuals of various dates preserved in the manuscript *Codex Guelfferbytanus 36.23 Augusteus 2*.

The land was divided by parallel lines, called *limites*, from east to west and from south to north. These limites were usually subsidiary tracks, or sometimes even roads, between the demarcated areas of land (each such area was called a centuria). Limites in one direction were called *kardines* and those at right angles *decumani*, hence the two main roads were called *kardo maximus* and *decumanus maximus*. The standard centuria was a square with a side of 200 iugera.

During the Roman Empire, there wwere *agrimensores* (= "land measurers") that divided *ager publicus* (= "state land attatched to a colony"), as well as drawing charts of the land, plotting the courses of roads, registering population and estimating travelling times. When it came to measuring plots, the size of the plots varied between 2 iugera and 100 iugera, according to the rank of the owner.

Upper scale (*c*. 300 BCE–*c*. 400 CE)

						pes quadratus	Metric	Metric[a]
saltus[b]						23,040,000	2,023,040 m^2	2,195,612 m^2
4	**centuria**[c]					5,760,000	505,760 m^2	548,903 m^2
400	100	**heredium**				57,600	5057.6 m^2	5489.0 m^2
800	200	2	**iugerum**[d]			28,800	2528.8 m^2	2744.5 m^2
1024	256	$2\frac{14}{25}$	$1\frac{7}{25}$	**arvum** or **arura**		22,500	1975.6 m^2	2144.1 m^2
1600	400	4	2	$1\frac{9}{16}$	**actus quadratus**[e]	14,400	1264.4 m^2	1372.3 m^2

[a]Values based on the hypothesis that Roman surveyors used a perch equal to 10 pous of Kyrenaika = 3.087 m. This makes the saltus = 1 milliarium quadratus
[b]Woodland pasture, equal to 2 × 2 centuriae
[c]2400 × 2400 pedes
[d]240 × 120 pedes
[e]Cattle drive, equal to 120 × 120 pedes. In the province of Baetcae, roughly the area of present-day western Andalusia, they called the unit an **acnua** or **agnuam** (See [MALT] and [COLU])

Lower scale (*c*. 300 BCE–*c*. 400 CE)

								pes quadratus	Metric	Metric
actus quadratus								14,400	1264.4 m^2	1372.3 m^2
1 11/25	**versus**							10,000	878.0 m^2	953.0 m^2
3	2 1/12	**sextans**						4800	421.5 m^2	457.4 m^2
4	2 7/9	1⅓	**clima**					3600	316.1 m^2	343.1 m^2
6	4⅙	2	1½	**uncia**				2400	210.7 m^2	228.7 m^2
30	20⅚	10	7½	5	**actus minimus**, **actus simplex**, or **uncia**			480	42.15 m^2	45.74 m^2
144	100	48	36	24	4⅘	**scripulum**[a]		100	8.78 m^2	9.53 m^2
288	200	96	72	48	9⅗	2	**dimidium scrupulum**	50	4.39 m^2	4.76 m^2

[a]Also called **decempeda quadrata**

In applying the divisions of the as to measures of surface, the iugerum was regarded as the as.

												pes quadratus
iugerum												28,800
1 1/11	**deunx**											26,400
1⅕	1 1/10	**dextans**										24,000
1⅓	1 2/9	1⅑	**dodrans**									21,600
1⅗	1 7/15	1⅓	1⅕	**Bes**								18,000
1 5/7	1 4/7	1 9/21	1 2/7	1 1/14	**septunx**							16,800
2	1⅚	1⅔	1½	1¼	1⅙	**semis**						14,400
2⅖	2⅕	2	1⅘	1½	1⅖	1⅕	**quincunx**					12,000
3	2¾	2½	2¼	2	1¾	1½	1¼	**triens**				9600
4	3⅔	3⅓	3	2⅔	2⅓	2	1⅔	1⅓	**quadrans**			7200
6	5½	5	4½	4	3½	3	2½	2	1½	**sextans**		4800
8	7⅓	6⅔	6	5⅓	4⅔	4	3⅓	2⅔	2	1⅓	**clima**	3600

Other reported measures:

1 **quinaria** (used to measure the cross-sectional area of pipes in the Roman water distribution systems) = 4.15 cm^2.

45.4 Units of Volume

1 naubion (for earth) = 3 × 3 × 3 cubits = 3.9 m^3.

45.5 Units of Dry Capacity

During the fifth century BCE, based on [HERO]

		Metric
medimnos		51.84 L
48	**khonix**	1.08 L

Upper scale for cereals

							Ligula	Metric
medimnus							4608	52.052 L
2	**quadrantal**[a]						2304	26.026 L
6	3	**modius** or **modiolis**					768	8.675 L
12	6	2	**semimodius** or **semodius**				384	4.338 L
96	48	16	8	**sextarius**			48	542.2 mL
144	72	24	12	1½	**cheonix**		32	361.6 mL
192	96	32	16	2	1⅓	**hemina**	24	271.1 mL

[a] $= 1 \times 1 \times 1$ ped

Lower scale for cereals

							Metric
hemina or **cotyla**							271.1 mL
2	**quartarius** or **quadrans**						135.5 mL
3	1½	**sextans**					90.4 mL
4	2	1⅓	**acetabulum**				67.8 mL
6	3	2	1½	**cyathus**			45.2 mL
12	6	4	3	2	**uncia**		22.6 mL
24	12	8	6	4	2	**ligula** or **lingua**	11.3 mL

45.6 Units of Liquid Capacity

During the fifth century BCE, based on [HERO]

		Metric
amphora		19.44 L
72	**katule**	270 mL

During the Roman Empire

								Metric
amphora quadrantal								25.488 L
2	**urna**							12.744 L
3	4	**congius**						3.186 L
48	24	6	**sextarius**					531 mL
96	48	12	2	**hemina**				265.50 mL
384	192	48	8	4	**acetabulum**			66.375 mL
576	288	72	12	6	1½	**cyathus**		44.250 mL
2304	1152	288	48	24	6	4	**cochlear**	11.062 mL

The Romans used a large container, an amphora, as a measure for liquids. Its volume was based on the weight of 80 librae of wine, giving it a theoretical capacity of about 26 L, but the local volumes contained in actual amphoras often varied significantly. From the reign of Nero (54–68), measures tended toward greater standardization because of growing international trade. Below, the amphora is set as one cubic ped.

Upper scale

								Ligula	Metric
culleus or **culeus**								46,080	520.53 L
20	**amphora quadrantal**							2304	26.026 L
40	2	**urna**						1152	13.013 L
80	4	2	**bicongius**					576	6.507 L
160	8	4	2	**congius**				288	3.253 L
480	24	12	6	3	**sextarius castrensis**			96	1.626 L
960	48	24	12	6	2	**sextarius urbius**		48	542.22 mL
1920	96	48	24	12	4	2	**hemina** or **cotyla**	24	271.11 mL

Lower scale

								Metric
hemina or **cotyla**[a]								271.11 mL
1½	**triens**							180.74 mL
2	1⅓	**quartarius** or **quadrans**						135.54 mL
3	2	1½	**sextans**					90.40 mL
4	2⅔	2	1⅓	**acetabulum**				67.78 mL
6	4	3	2	1½	**cyathus**			45.18 mL
12	8	6	4	3	2	**uncia**		22.60 mL
24	16	12	8	6	4	2	**ligula** or **lingua**[b]	11.30 mL

[a]Nicolas Chorier (1612–92) observed that the Greek historian Thucydides (c.460–c.395 BCE) mentioned that the cotyla was used both for liquids and for dry commodities, such as bread

[b]1 **cochlear**, **cochleare**, or **cochlearium** often denoted a spoon, and sometimes a measure equal to the ligula

In applying the divisions of the as to measures of liquids, the sextarius was regarded as the as and the cyathus as the twelfth part.

													Metric
sextarius													542.22 mL
1 1/11	**deunx**												497.03 mL
1⅕	1⅒	**dextans**											451.85 mL
1⅓	1 2/9	1⅑	**dodrans**										406.66 mL
1⅗	1 7/15	1⅓	1⅕	**bes**									338.89 mL
1 5/7	1 4/7	1 9/21	1 2/7	1 1/14	**septunx**								316.30 mL
2	1⅚	1⅔	1½	1¼	1⅙	**semis**							271.11 mL
2⅖	2⅕	2	1⅘	1½	1⅖	1⅕	**quincunx**						225.93 mL
3	2¾	2½	2¼	2	1¾	1½	1¼	**triens**					180.74 mL
4	3⅔	3⅓	3	2⅔	2⅓	2	1⅔	1⅓	**quadrans**				135.55 mL
6	5½	5	4½	4	3½	3	2½	2	1½	**sextans**			90.37 mL
8	7⅓	6⅔	6	5⅓	4⅔	4	3⅓	2⅔	2	1⅓	**sesunx**		67.78 mL
12	11	10	9	8	7	6	5	4	3	2	1½	**cyathus**	45.18 mL

During the Roman Republic

				Metric
quadrantal				25.488 L
8	**congius**			3.186 L
48	6	**sextarius**		531 mL
96	12	2	**hemina**	265.5 mL

45.7 Units of Weight

The Romans used a weight system with the libra (literally "balance") as its basic measurement. The libra was also referred to as an as, based on the custom of weighing bars of copper (asses) on balance scales. These bars were one pes (the Roman foot) long and divided into 12 unciae. The following nomenclature was adopted to distinguish various multiples of the libra.

Multiples of the libra

							Metric
centussis							32.745 kg
5	**vicessis**						6.549 kg
10	2	**decussis**					3.274 kg
$12\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{1}{4}$	**octussis**				2.620 kg
$33\frac{1}{3}$	$6\frac{2}{3}$	$3\frac{1}{3}$	$2\frac{2}{3}$	**tripondius**			982.35 g
50	10	5	4	$1\frac{1}{2}$	**dupondius**		654.90 g
100	20	10	8	3	2	**libra**	327.45 g

Divisions of the libra, based on [HULT]

													Metric
libra or **as**													327.456 g
$1\frac{1}{11}$	**deunx**												300.168 g
$1\frac{1}{5}$	$1\frac{1}{10}$	**dextans**											272.880 g
$1\frac{1}{3}$	$1\frac{2}{9}$	$1\frac{1}{9}$	**dodrans**										245.592 g
$1\frac{3}{5}$	$1\frac{7}{15}$	$1\frac{1}{3}$	$1\frac{1}{5}$	**bes**[a]									218.304 g
$1\frac{5}{7}$	$1\frac{4}{7}$	$1\frac{9}{21}$	$1\frac{2}{7}$	$1\frac{1}{14}$	**septunx**								191.016 g
2	$1\frac{5}{6}$	$1\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{6}$	**semis**[b]							163.728 g
$2\frac{2}{5}$	$2\frac{1}{5}$	2	$1\frac{4}{5}$	$1\frac{1}{2}$	$1\frac{2}{5}$	$1\frac{1}{5}$	**quincunx**						136.440 g
3	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{4}$	2	$1\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{4}$	**triens**					109.152 g
4	$3\frac{2}{3}$	$3\frac{1}{3}$	3	$2\frac{2}{3}$	$2\frac{1}{3}$	2	$1\frac{2}{3}$	$1\frac{1}{3}$	**quadrans**[c]				81.864 g
6	$5\frac{1}{2}$	5	$4\frac{1}{2}$	4	$3\frac{1}{2}$	3	$2\frac{1}{2}$	2	$1\frac{1}{2}$	**sextans**			54.576 g
8	$7\frac{1}{3}$	$6\frac{2}{3}$	6	$5\frac{1}{3}$	$4\frac{2}{3}$	4	$3\frac{1}{3}$	$2\frac{2}{3}$	2	$1\frac{1}{3}$	**sesunx**		40.932 g
12	11	10	9	8	7	6	5	4	3	2	$1\frac{1}{2}$	**uncia**	27.288 g

[a]Also called a **bessis**
[b]Also called a **semissis**
[c]Also called a **teruncius**

Divisions of the uncia, based on [HULT]

									Metric
uncia									27.288 g
2	**semuncia**								13.644 g
3	1½	**binae sextulae** or **duella**							9.096 g
4	2	1⅓	**sicilicus**						6.822 g
6	3	2	1½	**sextula**					4.548 g
12	6	4	3	2	**semisextula** or **dimidia sextula**				2.274 g
24	12	8	6	4	2	**scrupulum**			1.137 g
48	24	16	12	8	4	2	**obolus**		568.5 mg
144	72	48	36	24	12	6	3	**siliqua**[a]	189.5 mg

[a]In principle, it was equal to the average weight of a seed of the carob tree

Upper scale, based on [PINK]

													Metric
as													327.45 g
1⅟₁₁	**deunx**												300.16 g
1⅕	1⅒	**dextans**											272.88 g
1⅓	1²⁄₉	1⅑	**dodrans**										245.59 g
1½	1⅜	1 ¼	1⅛	**bes**									218.30 g
1⁵⁄₇	1⁴⁄₇	1³⁄₇	1²⁄₇	1⅐	**septunx**								191.02 g
2	1⅚	1⅔	1½	1⅓	1⅙	**semis**							163.73 g
2⅖	2⅕	2	1⅘	1⅗	1⅖	1⅕	**quincunx**						136.44 g
3	2¾	2½	2¼	2	1¾	1½	1¼	**triens**					109.15 g
4	3⅔	3⅓	3	2⅔	2⅓	2	1⅔	1⅓	**quadrans**				81.86 g
6	5½	5	4½	4	3½	3	2½	2	1½	**sextans**			54.58 g
8	7⅓	6⅔	6	5⅓	4⅔	4	3⅓	2⅔	2	1⅓	**sescuncia**		40.93 g
12	11	10	9	8	7	6	5	4	3	2	1½	**uncia**	27.29 g

Lower scale, based on [PINK]

						Metric
uncia						27.29 g
2	**semuncia**					13.64 g
4	2	**sicilicus**				6.82 g
6	3	1½	**sextula**			4.55 g
12	6	3	2	**dimidia sextula**		2.27 g
24	12	6	4	2	**scripulum**[a]	1.14 g

[a]1 scripulum = 24 wheat grains. 1 wheat grain = about 47.4 mg

In Athens *c*. 590 BCE

						Metric
drachme						4.358 4 g
2	**triobol**					2.179 2 g
4	2	**trihemiobol**				1.089 6 g
6	3	1½	**obol**			726.4 mg
8	4	2	1⅓	**triemorium**		544.8 mg
24	12	6	4	3	**tetartemorion**	181.6 mg

At Aegina *c*. 560 BCE

				Metric
stater				12.408 g
2	**drachme**			6.204 g
4	2	**triobol**		3.103 g
12	6	3	**obol**	1.034 g

At Mytilene, Lesbos, *c*. 550 BCE

										Metric
stater										11.208 g
2	**drachme**									5.604 g
3	1½	**tetrobol**								3.736 g
4	2	1⅓	**triobol**							2.802 g
6	3	2	1½	**diobol**						1.868 g
8	4	2⅔	2	1⅓	**trihemiobol**					1.401 g
12	6	4	3	2	1½	**obol**				934.0 mg
16	8	5⅓	4	2⅔	2	1⅓	**tritemorion**			700.5 mg
24	12	8	6	4	3	2	1½	**hemiobol**		467.0 mg
48	24	16	12	8	6	4	3	2	**tetartemorion**	233.5 mg

At Teos, Ionia, *c*. 540 BCE

								Metric
stater								12.328 8 g
2	**drachme**							6.164 4 g
3	1½	**tetrobol**						4.109 6 g
4	2	1⅓	**triobol**					3.082 2 g
6	3	2	1½	**diobol**				2.054 8 g
8	4	2⅔	2	1⅓	**trihemiobol**			1.541 1 g
12	6	4	3	2	1½	**obol**		1.027 4 g
24	12	8	6	4	3	2	**hemiobol**	513.7 mg

At Miletus *c*. 525 BCE

								Metric
stater								11.955 2 g
2	**oktobol**							5.977 6 g
3	1½	**drachme**						4.483 2 g
4	2	1½	**tetrobol**					2.988 8 g
8	4	3	2	**diobol**				1.494 4 g
16	8	6	4	2	**obol**			747.2 mg
32	16	12	8	4	2	**hemiobol**		373.6 mg
64	32	24	16	8	4	2	**tetartemorion**	186.8 mg

In Athens, after the introduction of the Solonian standard during the fifth century BCE, based on [HERO]

		Metric[a]	Metric[b]
talanton or **talent**		36.39 kg	25.92 kg
60	**mna**, **mana** or **mina**	606.5 g	432 g

[a]For commodities
[b]For metal

Upper scale for general merchantile use *c*. 268 BCE

							Metric
Talentum							26.2 kg
80	**libra**						327.48 g
320	4	**quadrans**					81.87 g
960	12	3	**ounce**				27.29 g
1920	72	6	2	**semuncia**			13.65 g
2880	108	9	3	1½	**duella**		9.10 g
3840	144	12	4	2	1⅓	**sicilicus**	6.82 g

Lower scale for general merchantile use *c*. 268 BCE

						Metric
sicilicus						6.82 g
1½	**sextula**, **nomisma**, or **solidus**[a]					4.55 g
2	1⅓	**drachma**[b]				3.41 g
6	4	3	**scrupulus**			1.137 g
12	8	6	2	**obolus**[b]		568.5 mg
36	24	18	6	3	**siliqua**	189.5 mg

[a]1 **solidus** (gold coin unit under Constantine the Great) = 1/72 libra, was also reported as 4.548 g.
[b]The drachma and the obolus, adopted from ancient Greece, were reckoned as 1/8 uncia and 1/48 uncia, respectively.

The monetary units often had the same names as many of the units of weights, but should be distinguished from each other. The mass of the monetary pound, the as, fell steadily, as shown below.

Era	Libra	Metric
280–242 BC	1	327.48 g
280–276 BC	1	322 g
275–270 BC	1	331 g
269–266 BC	1	265 g
265–242 BC	1	270 g
241–235 BC	1	272 g
230–226 BC	1	266 g
225–217 BC	1	268 g
217–214 BC	1/2	163.5 g
214–211 BC	1/4	81.75 g
211–141 BC	1/6	54.6 g
141–91 BC	1/12	27.3 g
91 BC	1/24	13.7 g

Monetary weights after 335 CE

						Pf
as						47
2	**semis**					23½
3	1½	**triens**				15⅔
4	2	1⅓	**quadrans**			11¾
6	3	2	1½	**sextans**		
12	6	4	3	2	**uncia**	

Medical weight system (*Pondera medica*) *c.* 268 BCE

									Metric
mina									436.64 g
1⅓	**libra**								327.48 g
16	12	**uncia**							27.29 g
128	96	8	**drachma**						3.41 g
384	288	24	3	**scripulus**					1.14 g
768	576	48	6	2	**obolus**				568.5 mg
1536	1152	96	12	4	2	**semiobolus**			284.2 mg
2304	1728	144	18	6	3	1½	**siliqua**		189.5 mg
9216	6912	576	72	23	12	6	4	**granum**	47.4 mg

Veterinarian weight system (*Pondera hippoiatrica*)

						Metric
mina						409.31 g
1¼	**libra**					327.45 g
15	12	**uncia**				27.29 g
112½	90	7½	**drachme**			3.64 g
337½	270	22½	3	**scripulum**		1.21 g
675	540	65	6	2	**obolus**	606.4 mg

46 Sumerian Culture (*c.* 5300 BCE–1940 BCE)

The southern-most part of Mesopotamia became the centre of early city-state formation from at least 8000 BCE. Hunting and fishing was still important, but agriculture and herding had become the principal modes of subsistence. Permanent self-sufficient settlements were gradually established. Some settlements became rather large, as Jericho (during seventh millennium BC) with at least 2000 inhabitants, and Çatal Hüyük (during sixth millennium BCE) with more than 5000 inhabitants. This chapter covers the period from *c.* 5300 to 1940 BCE. For later measurement systems, used in the area during the old Babylonian period, see *Babylonian systems*.

A large number of settlements in Khuzestan, based around Susa, already formed a interconnected system during early fifth millennium BCE, where some settlements seems to have had a central function. Differentiated levels of administrative control was developed in Susiana area during early third millennium BCE, and probably even a system for the distribution of standardized grain rations to institution workers at the end of this era. At least two different metrological sequences has been identified for this era, one that was used for units of dry capacity (1, 6, 60, 180, and 1800), and one for areas (1, 6, 18, 180, and 720). The main currency during early third millennium was grain, measured in the dry capacity system. As silver became more widely used, the old capacity measures were replaced by a system of standard weights, built upon the full sexagesimal place-value system.

For most of the third millennium BCE, Mesopotamia was divided into city-states of varying size and importance. Each city-state seem to have had its own system of weights and measures. During Akkad-Ur III, these multiple standards were reduced to a few agreed upon common groupings, e.g. the sexagesimal sequence (1, 10, 60, 600, 3600, and 36,000) that was mainly used for counting cattle, fish, slaves, vessels and tools made of wood or stone, and the bisexagesimal sequences (1, 10, 60, 120, 1200, and 7200), that was mainly used to count cereal and bread. Length measures were now defined to relate systematically to area, volume, capacity, and perhaps to weight.

The Sumerian system for weights and measures, was later adopted and modified by other Mesopotamian people such as the Akkadians and the Babylonians.

Main sources: [ADAM2], [ALBE], [ARBO], [BERR], [FRIB], [HØYR], [KARW], [MORL], [NISS2], [OPPE4], [POTT2], [POWE2], [ROBS], [STEI4], [WEIG], [WRIG], and [WRIG2]

47 Ubaid Period (*c.* 5300–*c.* 4100 BCE)

For this period, I have not found any reliable sources.

48 Uruk Period (*c.* 4100–*c.* 2900 BCE)

This period could be divided into several parts, as archaeologists have discovered multiple cities of Uruk, e.g. Uruk XVI-X (*c*.4100–*c*.3800 BCE), Uruk VI (*c*. 3800–3400 BCE), Uruk V (*c*. 3400–3300 BCE), Uruk IV (*c*. 3300–3100 BCE), and Jemdet Nasr (*c*. 3100–2900 BCE). During Jemdet Nasr, a high level of administrative control was reached in Uruk that now became a larger settlement than anything known before in the Near East. Large public buildings were performed and trading relations with Bahrain were established.

Out of the need for keeping accounts of personal wealth, various counting tokens were used in late Uruk settlements for both mathematical and metrological functions. During this period, the measures of capacity still consisted of casual daily life containers, such as pottery jars, that had no standardized volume. Nor was there any standardized unit for length, area and weight. The units and the relationship between them changed frequently by location and over time, and the idea of an abstract number did not yet exist. However, they used various sequences for counting. To date, research has been able to identify twelve different sequences (see [POTT2]):

A. Sexagesimal sequence S, used for counting cattle, fish, slaves, vessels and tools made of wood or stone;
B. Sexagesimal sequence S' used for counting dead animals and certain types of beer;
C. Bisexagesimal sequence B, used for counting cereals, bread, fish, and milk products;
D. Bisexagesimal sequence B* used for counting rations;
E. GAN_2 sequence G used for counting field measurement;
F. ŠE sequence Š used for counting barley by volume;
G. ŠE sequence Š' used for counting malt by volume;
H. ŠE sequence Š'' used for counting wheat by volume;
I. ŠE sequence Š* used for counting barley groats;
J. EN sequence E used for counting weights;
K. U_4 sequence U used for counting calendric;
L. DUG_b sequence Db used for counting milk by volume;
M. DUG_c sequence Db used for counting beer by volume.

48.1 Units of Capacity

From the early third millennium BCE

					Metric
guru					~864,000 L
3600	**gur**				~240 L
14,400	4	**bariga**			~60 L
86,400	24	6	**ban**		~10 L
864,000	240	60	10	**síla**	~1 L

From the late third millennium BCE

					Metric
guru					~1,080,000 L
3600	**gur**				~300 L
18,000	5	**bariga**			~60 L
108,000	30	6	**ban**		~10 L
1,080,000	300	60	10	**síla**	~1 L

49 Early Dynastic Period (*c.* 2900–*c.* 2334 BCE)

This period is usually divided into three parts, Early Dynastic I (*c*. 2900–*c*. 2750 BCE), Early Dynastic II (*c*. 2750–*c*. 2600 BCE), and Early Dynastic III (*c*. 2600–*c*. 2334 BCE).

The various measurement systems used during the Uruk period were reformed and simplified over the following centuries. Some of the notational ambiguity from the Uruk period remained in Early Dynastic metrology, as did the bundling of number and unit into a single sign.

49.1 Units of Length

1 **nı́g̃-du** = unit of unknown size.

Upper scale about 2600 BCE

				Metric
kasbu				~22.4 km
30	**us**			~746 m
1800	60	**gar**		~12.4 m
21,600	720	12	**ĝiri$_3$**	~1.04 mm

Lower scale about 2600 BCE

						Metric
ĝiri$_3$						~1.04 m
2	**kuš$_3$**[a]					~518 mm
10	5	handbreadth				~104 mm
30	15	3	digit			~34 mm
60	30	6	2	**šu-si**		~17 mm
600	300	60	20	10	**sossus**	~1.7 mm

[a]A copper-aloy bar, of 1.103 5 m, from *c*. 2650 BCE was found in 1916 by the German Assyriologist Eckhard Unger during excavation at Nippur. It is divided into sections measuring 256 mm, 67 mm, 209.5 mm, 241.5 mm, 67.5 mm, 53 mm, and 209 mm. These sections seem to represent 15, 4, 12, 14, 4, 3, and 12 fingers. Three sections marked off by deeper indentations may represent a cubit of 30 fingers = about 518.5 mm

Upper scale about 2400 BCE

						Metric
da-na[a]						~10,500 m
6	**sar**					~1800 m
36	6	**ner**				~300 m
360	60	10	**uš**			~30 m
3600	600	100	10	**rohr**		~3 m
21,600	3600	600	60	6	**kuš$_3$**	~500 mm

[a][KAHN] reported about 10,690 m

Lower scale about 2400 BCE

				Metric
kuš$_3$				~500 mm
1⅞	**šu-du$_3$-a**[a]			~267 mm
30	16	**šu-si**		~16.7 mm
180	96	6	**še**	~2.8 mm

[a]The Sumerian ruler Gudea of Lagash (*c*. 2575 BCE) defined the foot as being about 264.6 mm

According to [ROTT4] ideally equal to about 265.4 mm

In Ebla about 2300 BCE

					Metric
nidan					~6 m
2	**gi**				~3 m
6	3	**ĝiri$_3$**			~1 m
12	6	2	**kuš$_3$**		~500 mm
360	180	60	30	**šu-si**	~17 mm

49.2 Units of Area

About 2650 BCE

					Metric
gan					~8100 m^2
18	**iku**				~450 m^2
1800	100	**sar**			~45 m^2
108,000	6000	60	**gin**		~75 dm^2
324,000	18,000	180	3	**še**	~25 dm^2

About 2500 BCE

				Metric
gan				~27,200 m^2
1800	**sar**			~15.1 m^2
108,000	60	**gin**		~0.252 m^2
19,440,000	10,800	180	**še**	~14 cm^2

In Ebla about 2300 BCE

					Metric
bur					~64,800 m^2
3	**eshe**				~21,600 m^2
18	6	**iku**			~3600 m^2
1800	600	100	**sar**		~36 m^2
108,000	36,000	6000	60	shekel	~0.6 m^2

49.3 Units of Capacity

1 **níḡ-dù-a** (for fruit) = unknown size.

About 2650 BCE

		Metric
homer		388.8 L
720	**log**	540 mL

About 2500 BCE

			Metric
gur			288.9 L
60	**gin**		4.815 L
300	5	**síla**[a]	963 mL

[a]A silver vase from Lagash, dating to 2475 BCE, measures 4.15 L and is proposed to equal 5 sílas, making 1 síla = *c*. 830 mL

In Lagash about 2400 BCE

							Metric
granary							~1,152,000 L
2400	(great) **gur**						~480 L
4800	2	**lidga** or **gursag-gal**					~240 L
19,200	8	4	**barig**				~60 L
115,200	48	24	6	**ban**			~10 L
691,200	288	144	36	6	**síla**		~1.5 L
41,472,000	17,280	8640	2160	360	60	**gin**	~25 mL

In Ebla about 2300 BCE

					Metric
gubar					~20 L
2	**barizu**				~10 L
5	2 ½	**gin**$_2$			~4 L
20	10	4	**síla**		~1 L
120	60	24	6	**anzam**	~0.17 L

49.4 Units of Weight

In Sumerian cuneiform texts, amounts of metals, like gold, silver, and copper were measured by weight. The corresponding weight numbers were expressed in what is called System M. Amounts of other substances and commodities were measured in talents and minas.

About 2500 BCE and about 2350 BCE (Sumerian/Akkadian names)

				Metric	Metric
gú(n)/ ***biltu*** (talent)				28.836 kg	28.62 kg
60	**ma.na/** ***manû*** (mina)			480.6 g	477.0 g
3600	60	**gín/** ***šiqlu*** (shekel)		8.01 g	7.95 g
648,000	10,800	180	**še/*uṭṭatu*** (barley corn)	44.5 mg	44.2 mg

[FRIB, p. 132] summarize the mass of 58 weight stones in a table, that shows what the corresponding weight of 1 talent, 1 mina and 1 shekel would be in each case:

	Weight stones								
	1 talent	1 mina	1/2 mina	1/3 mina	10 shekels	5 shekels	4 shekels	3 shekels	2 shekels
Actual weight	27.5 kg	478.2 g	245 g	139.9 g	81.6–80 g	41.7 g	34.3 g	24.4–24.0 g	17.3–16.3 g
Gives 1 talent =	>27.5 kg	28.7 kg	28.4 kg	25.2 kg	29.4–28.8 kg	30.0 kg	30.9 kg	29.3–28.8 kg	31.1–29.3 kg
Gives 1 mina =	>458.3 g	478.2 g	490 g	420 g	489.6 g	500.5 g	514.5 g	488	519 g
Gives 1 shekel =	>7.64 g	7.97 g	8.17 g	7.0 g	8.0–8.16 g	8.34 g	8.57 g	8.0–8.13 g	8.15–8.65 g

[POWE3, p. 108] summarize the mass of those 58 stones in 13 tables, that shows the sites where they were found and the mean mina norm. Those tables gives use the following values:

		Mean **mina** norm
South Babylonia	Ur	502 g
	Uruk	494 g
	Lagash/Girsu	498 g
	Adab	489 g
Middle and North Babylonia	Nippur	525 g
	Kish	506 g
	Sippar	504 g
	Eshnunna	509 g
	Ischali	506 g
	Khafajah	512 g
Iran	Susa	508 g
	Persepolis/Darius	499 g
Uncertain site		502 g

Scale based on [KARW]

				Metric
manû				~23.3 g
2	**šiqlu**			~11.7 g
6	3	small **manû**		~3.9 g
12	6	2	**ur-šiqlu**	~1.9 g

50 Akkadian Empire or Sargonic Empire (Named After Sargon of Akkad ; *c.* 2334–*c.* 2218 BCE)

Not until the formation of the Akkadian Empire, during the reign of Sargon of Akkad (*c.* 2270–2215 BCE), a common standard for weights and measures was issued in Mesopotamia. His grandson Narām-Sîn, that reigned *c.* 2254–2218 BCE, improved this standard. The systems were now unified by a single official standard, a theoretical cube of water called the Royal Gur-cube. The cube was about 6 m × 6 m × 0.5 m. From this cube all other units could be derived.

50.1 Units of Length

Basic length units (Sumerian/Akkadian names)

								Metric
eše$_2$/*aslu*								~60 m
10	**nindan/*nindanu***							~6 m
20	2	**gi/*qanû***						~3 m
60	6	3	**ĝiri$_3$/*šēpu***					~0.994 m
120	12	6	2	**kuš$_3$/*ammatu***				~0.497 m
180	18	9	3	1½	**šu-du$_3$-a/*šīzu***			~0.331 m
3600	360	180	60	30	20	**šu-si/*ubānu***		~0.016 6 m
21,600	2160	1080	360	180	120	6	**se/*uṭṭatu***	~0.002 8 m

For distances (Sumerian/Akkadian names)

				Metric
da-na/*bêru*				~10,800 m
30	**uš/*uš***			~360 m
180	6	**eše$_2$/*aslu***		~60 m
1800	60	10	**nidan/ *nindanu***	~6 m

50.2 Units of Area

System based on GAN$_2$ sequence G (Sumerian/Akkadian names)

						Metric
bùr/*būru*[a]						~64,800 m^2
18	**iku/*ikû***[a]					~3600 m^2
36	2	**upu/*ubû***[a]				~1800 m^2
72	4	2	**uzalak/?**			~900 m^2
1800	100	50	25	**sar/*mūšaru***[b]		~36 m^2
64,800	3600	1800	900	36	**gin$_2$/*šiqlu***	~1 m^2

[a]Mainly used for field areas
[b]Mainly used for the area of houses

50.3 Units of Capacity

Capacity was measured by the Š E system Š for dry commodities and the Š E system Š* for liquids.

(Sumerian/Akkadian names)

					Metric
gin$_2$/ *kurru*					~300 L
5	**sila$_3$/ *parsiktu***				~60 L
30	6	**ban$_2$/*sutū***			~10 L
300	60	10	**sila$_3$/*qû***		~1 L
18,000	3600	60	60	**gin$_2$/ *šiqlu***	~16.67 mL

50.4 Units of Weight

System based on the EN system E (Sumerian/Akkadian names)

						Metric
gún$_2$/*biltu*						~30.2 kg
60	**ma.na/ *manû***					~503 g
3600	60	**gín/*šiqlu***				~8.4 g
10,800	180	3	**ma.na-tur/ *manû ṣaḫru***			~2.8 g
216,000	3600	60	20	**gin$_2$/*šiqlu***		~140 mg
648,000	10,800	180	60	3	**še/*uṭṭatu*** (grain)	~46.6 mg

51 Neo-Sumerian Empire or the Ur III Empire (*c.* 2047–*c.* 1940 BCE)

51.1 Units of Length

								Metric
league								~10.8 km
30	cable							~360 m
360	12	chain						~30 m
1800	60	5	rod					~6 m
3600	120	10	2	reed				~3 m
7200	240	20	4	2	half-reed			~1.5 m
21,600	720	60	12	6	3	cubit		~0.5 m
648,000	21,600	1800	360	180	90	30	finger	~17 mm

51.2 Units of Land Area

									Metric
šargal									~23.328 ha
6	**šar'u**								~3.888 ha
60	10	**šar**							~388.8 ha
360	60	6	**bur'u**						~64.8 ha
3600	600	60	10	**bur**					~6.48 ha
10,800	1800	180	30	3	**eše**				~2.16 ha
64,800	10,800	1080	180	18	6	**iku**			~3600 m^2
129,600	21,600	2160	360	36	12	2	**ubu**		~1800 m^2
6,480,000	1,080,000	108,000	18,000	1800	600	100	50	**sar** (1 rod^2)	~36 m^2

51.3 Units of Volume

						Metric
bur'u						~3,240,000 m^3
10	**bur**					~324,000 m^3
30	3	**eše**				~108,000 m^3
180	18	6	**iku**			~1800 m^3
360	36	12	2	**ubu**		~900 m^3
18,000	1800	600	100	50	**sar** (1 rod^2 1 cubit)	~18 m^3

51.4 Units of Dry Capacity

				Metric
gur				~306 L
5	**barig**			~61.2 L
30	6	**bán**		~10.2 L
300	60	10	**síla**	~1.02 L

51.5 Units of Weight

About 1950 BCE

				Metric
talent				~30.27 kg
60	mina			~504.5 g
3600	60	shekel		~8.41 g
648,000	10,800	180	grain	~46.7 mg

52 Syrian Culture (*c.* 1550 BCE–*c.* 1200 BCE)

During the Late Bronze Age, a weight system, as detailed in the table below, was probably in use.

Main source: [PARI]

					Metric
talent					~28.2 kg
60	**mina**				~470 g
2400	40	**Hittite unit**			~11.75 g
3000	50	1¼	**Ugaritian/ Syrian unit**		~9.4 g
3600	60	1½	1⅕	**unit of Karemiš**	~7.83 g

53 Tamilakam (*c.* 350 BCE–*c.* 1300 CE)

The largest kingdoms that ruled Tamilakam during the Śaṅgam period were the Chola Empire (*c.* 300 BCE–1279 CE), the Pandya dynasty (c. 300 BCE–1345 CE) and the Chera Kingdom (*c.* 500 BCE–1102 CE). The land area included most of what is now known as southern India.

Some standarization of weights and measures is indicated in ancient sources. Trade exchanges took place with Burma, Ceylon, Java, Persia, Sumatra and the Maldive Islands.

Main sources: [IORG], [JAYA], [JERV], [MADU], [RAMA], [SUBR], and [WILS]

53.1 Currency

Roman coins were used beginning in the second century BCE.

There were gold, silver and copper coins in use during the Chola dynasty.

1 pon, hun, or varāhan = 10 paṇam or kāṇams (gold coins)

1 veṇ pon (silver coin)

1 kāśu (copper coin)

After Kulottunga Chola III (reign 1178–1218), the copper coin was called a kau.

53.2 Units of Quantity

They had several names for huge numbers, such as āmbal, paḻḻam, tāmarai and vellam.

Fractions used:

3/4 = mukkāl;
1/2 = arai;
1/4 = kāl;
1/5 = nālumā;
3/16 = mōnṟu vēsam ;
3/20 = mōnṟumā;
1/8 = araikkāl;
1/10 = irumā;
1/16 = mākāṉi;
1/20 = orumā;
3/64 = mukkāl vēsam;
3/80 = mukkāṉ;
1/32 = araivēsam;
1/40 = araimā;
1/64 = kāl vēsam;
1/80 = kāṇi;

3/320 = araikkāṉi munthiri;
1/160 = araikkāṉi;
1/320 = munthiri;
1/102,400 = kēzh munthiri;
1/2,150,400 = immi;
1/23,654,400 = mummi;
1/165,580,800 = aṉu;
1/1,490,227,200 = kuṉam;
1/7,451,136,000 = pantham;
1/44,706,816,000 = pāgam;
1/312,947,712,000 = vintham;
1/5,320,111,104,000 = nāgavintham;
1/74,481,555,456,000 = sinthai;
1/1,489,631,109,120,000 = kathirmunai;
1/59,585,244,364,800,000 = kuralvaḻaippidi;
1/3,575,114,661,888,000,000 = veḻḻam;
1/357,511,466,188,800,000,000 = nuṉṉmaṉḻ;
1/2,323,824,530,227,200,000,000 = thaertthugal.

53.3 Units of Length

Some traditional measures:

1 **kaḍam** = a long distance, usually reported as being about 16 km;
1 **nalikai** = the distance which could be walked in a *nalikai* (24 min) = about 1600 m;
1 **kūppiḍu** = the distance at which it is possible to hear someone shout;
1 **aḻ** = the height of a full-grown man;
1 **muzham** = the span from the elbow to the tip of the middle finger;
1 **saṇ** = the span from the tip of the thumb to the tip of the little finger;
1 **oṭtaisaṇ** = the span from the tip of the thumb to the forefinger when extended;
1 **anguttam** = the length of a thumb;
1 **kasaḳiram** = the breadth of a hair.

During the Sangam era, based on [SUBR]

							Metric
mulam[a]							~560 mm
28	**peru viral**[b]						~20 mm
224	8	**nel**[c]					~2.5 mm
1792	64	8	**eḻ**[d]				~312.5 μm
14,336	512	64	8	**immi**[e]			~39.1 μm
114,688	4096	512	64	8	**tērttu**[f]		~4.9 μm
917,504	32,768	4096	512	64	8	**aṇu**[g]	~0.6 μm

[a]A cubit
[b]An average thumb
[c]A paddy grain
[d]A sesame grain
[e]A very small grain
[f]A hair's breadth
[g]Literally, an atom

Upper scale during the Chola dynasty

								Metric
kādham								1,166.67 m
625	**pāgam**							1.866 67 m
1250	2	**kajam**						933.333 mm
2500	4	2	**mulam** or **muzham**					466.667 mm
5000	8	4	2	**saṇ** or **sāṇ**				233.333 mm
60,000	96	48	24	12	**viral**			19.444 mm
480,000	768	384	192	96	8	**nel** or **torai**[a]		2.430 5 mm
3,840,000	6144	3072	1536	768	64	8	**eḻ**	303.819 μm

[a]The length of a rice grain

Middle scale during the Chola dynasty

						Metric
eḻ						303.819 µm
8	**siṟu-kadugu**					37.977 µm
64	8	**nuṇmaṇal**				4.747 µm
512	64	8	**mayirmuni**			593.396 nm
4096	512	64	8	**thusumbu**		74.175 nm
32,768	4096	512	64	8	**kathirtthugaḻ**	9.272 nm

Lower scale during the Chola dynasty

				Metric
kathirtthugaḻ				9.272 nm
8	**aṇu**			1.159 nm
80	10	**nuṇṇaṇu**		115.9 pm
800	100	10	**koaṇ**	11.59 pm

53.4 Units of Area

The title *Ulakalanthan* was given to those who helped to measure the land areas during the Chola dynasty. They used a measuring stick called an *Ulagalanthakol*. The main units were the kuli and the veḻi.

During the Sangam era

											Metric
veḻi											26,756 m^2
6¼	**pāḍagam**										4281 m^2
16	$2\frac{14}{25}$	**makāṇi**									1672.2 m^2
20	3⅕	1¼	**mā**								1337.8 m^2
26⅔	$4\frac{4}{15}$	1⅔	1⅓	**mukkāṇi**							1003.35 m^2
40	6⅖	2½	2	1½	**araikmā**						668.9 m^2
80	12⅘	5	4	3	2	**kāṇi**					334.4 m^2
160	25⅗	10	8	6	4	2	**araikkāṇi**				167.2 m^2
320	51⅕	20	16	12	8	4	2	**muntiri**			83.6 m^2
1280	204⅘	80	64	48	32	16	8	4	**muntirigai**		20.903 m^2
2000	320	125	100	75	50	25	12½	6¼	$1\frac{9}{16}$	**kuli** or **kuzhi**	13.378 m^2

Other reported measures:

1 **paṭṭi** = an area of land, sufficient for a sheep-fold = about 8000 m^2;

1 **kundu** = about 101.2 m^2;

1 **parakesari-kāl** = ?;

1 **parakesari-nāli** = ?;

1 **parakesari-ulakku** = ?.

53.5 Units of Volume

Some reported measures:

1 **ambaṇam** = a large container for grains from the fields;

1 **kuli** = 10 f. × 10 f. × 2½ ft = 7.08 m^3.

53.6 Units of Dry Capacity

There were often local variations of the grain measures, but the *marakkāl*, *nāli*, *uri* and *ālākku* were usually reported as subdivisions of the *kalam*.

Upper scale for grain, horse-gram, rice and other dry commodities during the Chola dynasty

				குருணி							Metric
gurisei											14,690.8 L
100	**kalam**										146.908 L
300	3	**tūni** or **kadi**									48.969 L
600	6	2	**paḍākku**[a]								24.485 L
1200	12	4	2	**kuruni**[b]							12.242 L
9600	96	32	16	8	**nāli**[c]						1.530 L
19,200	192	64	32	16	2	**uri**					765.1 mL
38,400	384	128	64	32	4	2	**uḻakku**				382.6 mL
76,800	768	256	128	64	8	4	2	**ālākku**			191.3 mL
192,000	1920	640	320	160	20	10	5	2½	**pidi**		76.5 mL
384,000	3840	1280	640	320	40	20	10	5	2	**sevidu**[d]	38.3 mL

[a]Usually for horse-gram
[b]Also sometimes reported as **marakkāl**, **murcal**, or **ambanam**. In Thanjavūr, as reported by [RAMA], 1 kalam = 15 kuruṇis = 90 nāḻis. [RAMA] also reported 1 kuruni = 8 nalis and 1 marakkāl = 7 nāḻis + 1 uri. A special standard measure, used by the Sri Varadarajaswami Temple at Kanchi, was called the **Arianavallān- kāl**. See [RAMA]
[c]A special standard measure, used by the Sri Varadarajaswami Temple at Kanchipuram, was called the **Arianavallān-nāḻi**. See [RAMA]
[d]Often reported as 360 grains

Lower scale for grain, horse-gram, rice and other dry commodities during the Chola dynasty

sittigai				
7	**uminel**			
49	7	**aṇu**		
539	77	11	**mummi**	
4851	693	99	9	**kuṇam**

Other reported measures:
1 **iḍaṅgali** = unknown magnitude.

53.7 Units of Liquid Capacity

		அடம்									Metric
ķottai											257.88 L
5¼	**thōṇi**										49.12 L
8⅖	1⅗	**ádam**									30.70 L
10½	2	1¼	**paḍākku**								24.56 L
21	4	2½	2	**marakkál**							12.28 L
168	32	20	16	8	**paḍi**[a]						1.535 L
336	64	40	32	16	2	**uri**					767.5 mL
672	128	80	64	32	4	2	**uḻakku**				383.7 mL
1344	256	160	128	64	8	4	2	**ālākku**			191.9 mL
2688	512	320	256	128	16	8	4	2	**mahani**		95.9 mL
6720	1280	800	640	320	40	20	10	5	2½	**sevidu**	38.7 mL

[a]Later also refered to as an **aria-paḍi**

53.8 Units of Weight

During the Chola dynasty, based on [JAYA]

					Metric
kalañju[a]					4.406 g
10	**mañjadi**[b]				440.6 mg
20	2	**kuruni**			220.3 mg
100	10	5	**mā**		44.1 mg
400	40	20	4	**kāni**	11.0 mg

[a]A molucca bean. According to [JAYA, p. 47] = 68–72 grains
[b]The fruit of a tree called a *tilakam*

Based on [SUBR]

palam or **toḍi**	
4	**kaṭaka** or **kasu**

Gold weights

				பலம்	க.:.சு	வராகனெடை	கழஞ்சு	பணவெடை or மாஞ்சாடி	குன்றிமணி	நல் எடை	Metric
kā											853.3 kg
3⅛	**maṇangu**										273.1 kg
4⅙	1⅓	**thulām**									20.48 kg
25	8	6	**vesai**								3.41 kg
1000	320	240	40	**palam**							85.33 g
4000	1280	960	160	4	**kaqhsu**						21.33 g
10,000	3200	2400	400	10	2½	**varāganedai**					8.53 g
16,000	5120	3840	640	16	4	1⅗	**kazhanchu**				5.33 g
80,000	25,600	19,200	3200	80	20	8	5	**paṉavedai** or **manchādi**			1.07 g
160,000	51,200	38,400	6400	160	40	16	10	2	**kunṟimaṉi**		533 mg
640,000	204,800	153,600	25,600	640	160	64	40	8	4	**nel edai**	133 mg

Other reported measures:
1 **parakesari-khal** = unknown magnitude.

53.9 Units of Time

Ancient system—upper scale

ஊழி	வட்டம்	ஆண்டு	பெரும்பொழுது	திங்கள்	அழுவம்	கிழமை	நாள்
ọozhi							
64	**vattam**						
4096	64	**ạaṇḍu**					
24,576	384	6	**perum-pozhuthu**				
49,152	768	12	2	**thingaḻ**			
–	–	–	413/105	413/210	**azhuvam**		
–	–	–	–	59/14	2⅐	**kizhamai**	
–	–	–	–	29½	15	7	**nāḻ**
Epoch	Cycle	Year	Season	Lunar month	Fortnight	Week	Day

Ancient system—middle scale

நாள்	சிறுபொழுது		கணம்	துளி	அணு	சாணிகம்	உயிர்
nāḽ							
6	**siŗupozhuthu**[a]						
60	10	**nāzhigai**					
360	60	6	**kaṇam**				
3600	600	60	10	**thuḽi**			
21,600	3600	360	60	6	**aṇu**		
43,200	7200	720	120	12	2	**saṇigam**	
86,400	14,400	1440	240	24	4	2	**uyir**
Day	4 h	24 min	4 min	24 s	4 s	2 s	1 s

[a]Also, sometimes 1/5 nāḽ = 4⅘ h

Ancient system—lower scale

உயிர்	வினாடி	குறு	சிற்றுழி	மாத்திரை	கைநொடி	கண்ணிமை
uyir						
5/4	**Vinādi**					
–	–	**kuru**				
–	–	–	**siŗŗuzhi**			
–	–	–	–	**māthirai**		
–	–	–	–	2	**kainodi**	
–	–	–	–	4	2	**kaṇimai**
1 s	4/5 s	1/2 s	2/5 s	1/4 s	1/8 s	1/16 s

During the Chola dynasty, based on [JAYA]

Year								
2	**ayanam**							
12	6	Month						
24	12	2	**pakkam**					
51³⁄₇	27³⁄₇	4⁴⁄₇	2¹⁄₇	Week				
360	192	32	15	7	Day			
2880	1536	256	120	56	8	**samam**		
8640	4320	720	360	168	24	3	Hour	
21,600	11,520	1920	900	420	60	7½	2½	**nalikai**

54 Kingdom of Urartu (*c.* 860 BCE–585 BCE)

The former Nairi states and tribes in the area were unified under the reign of Aramu in 860 BCE. It was conquered by the Armenian dynasty before 585 BCE.

Main sources: [PAYN] and [PIOT]

54.1 Units of Length

1 **gez** = ~660 mm.

54.2 Units of Capacity

				Metric
aqarqi[a] or **aharku**				253.2 L ± 5.5 L
9	**terui**[b] or **turuza**			28.1 ± 0.6 L
18	2	**arusi**[c] or **aruza**		14.1 L ± 0.3 L
216	24	12	**terubi**[d] or **turubi**	1.17 L ± 0.03 L

[a]Marked by dots outside of an angled line
[b]Marked by dots within an angled line
[c]Marked by dots below an angled line
[d]Marked by dots or beaker sign plus dots. Probably identical to the Sumerian LIŠ

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