Tables of SI Units and Prefixes

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This is a **unit-at-a-glance** list. You can also download a PDF version of this document for off-line use.

Table I. Basic Units

defined by *Conférence Générale des Poids et Mesures* (CGPM) in the latest SI-brochure of 1998.

Quantity	Unit	Symbol	Definition
Length	**meter**	**m**	1983, 17th CGPM: The path travelled by light in vacuum during a time interval of 1/299792458 seconds. This fixes the speed of light to **exactly** 299792458 m/s.
Mass	**kilogram**	**kg**	1901, 3rd CGPM: Mass of the platinum-iridium prototype at BIPM in Sevres.
Time	**second**	**s**	1968, 13th CGPM: One second equals 9192631770 periods of the radiation due to the transition between the two hyperfine levels of the ground state of Cesium 133.
Electric current	**ampere**	**A**	1948, 9th CGPM: Given two parallel, rectilinear conductors of negligible circular cross-section positioned 1 m apart in vacuum, one ampere is the electric current which, passing through both of them, makes them attract each other by the force of 2.10^{-7} newtons per every meter of length. This fixes the permeability of vacuum to **exactly** $2\pi*10^{-7}$ H/m.
Temperature	**kelvin**	**K**	1968, 13th CGPM: One degree K equals 1/273.16 of the thermodynamic temperature of the triple point of water.
Quantity of substance	**mole**	**mol**	1971, 14th CGPM: The **amount of a substance** composed of as many specified elementary units (molecules, atoms) as there are atoms in 0.012 kg of Carbon 12.
Luminosity	**candle**	**cd**	1979, 16th CGPM: The candle (or candela) is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540.10^{12} hertz and that has a radiant intensity in that direction of 1/683 W/sr.

Table II. Derived units with assigned names

defined by BIPM in the latest SI-brochure (1998) and its supplement (2000).

Quantity	Unit	Symbol	Equals	Definition / Note
Space and time:				
Plane angle	**radian**	**rad**		The plane angle which, when centered in a circle, cuts off an arc whose length is equal to the circle radius.
Solid angle	**steradian**	**sr**		The solid angle which, when centered in a sphere, cuts off a cap whose surface equals that of a square having the radius as side.
Frequency	**hertz**	**Hz**	$1\ s^{-1}$	[number of events or cycles]/[time].
Mechanics:				
Force	**newton**	**N**	$1\ kg.m.s^{-2}$	[mass].[acceleration].
Pressure	**pascal**	**Pa**	$1\ N.m^{-2}$	[force]/[area]. Also: stress.
Energy	**joule**	**J**	1 N.m	[force].[length]. Also: Work, Heat
Power	**watt**	**W**	$1\ J.s^{-1}$	[energy]/[time]. Also: Radiant flux
Thermodynamics:				
Temperature	**celsius**	**°C**	1 K	$T\ [^oC] = T\ [K] - 273.15$ (the offset is exact!).
Electromagnetism:				
Charge	**coulomb**	**C**	1 A.s	[current].[time].
Potential	**volt**	**V**	$1\ W.A^{-1}$	[power]/[current]. Only differences are measurable!
Resistance	**ohm**	**Ω**	$1\ V.A^{-1}$	[Δpotential]/[current].
Conductance	**siemens**	**S**	$1\ A.V^{-1}$	[current]/[Δpotential].
Capacitance	**farad**	**F**	$1\ C.V^{-1}$	[charge]/[Δpotential].
Inductance	**henry**	**H**	$1\ V.s.A^{-1}$	[Δpotential]/[rate of change of current].
Magnetic flux	**weber**	**Wb**	$1\ J.A^{-1}$	[energy]/[current].
Magnetic flux density	**tesla**	**T**	$1\ Wb.m^{-2}$	[magnetic flux]/[area]. Also **magnetic induction**.
Optics:				
Luminous flux	**lumen**	**lm**	1 cd.sr	[luminosity].[solid angle].
Illuminance	**lux**	**lx**	$1\ lm.m^{-2}$	[luminous flux]/[area].
Convergence	**dioptry**	**dioptry**	$1\ m^{-1}$	Inverse of focal length.

Radioactivity and radiation:				
Activity	**becquerel**	**Bq**	1 s^{-1}	[number of decay events]/[time].
Absorbed dose	**gray**	**Gy**	1 $J.kg^{-1}$	[energy]/[mass].
Dose equivalent	**sievert**	**Sv**	1 $J.kg^{-1}$	[energy]/[mass]. Absorbed dose re-normalized by biological effects.
Chemistry:				
Katalytic activity	**katal**	**kat**	1 $mol.s^{-1}$	[quantity of substance]/[time].

Table III a. SI Units prefixes

with examples of correct usage.

Prefix	Symbol	Factor	Examples of usage	Origin
Yotta	**Y**	10^{24}	0.2 YW, 1.23Y [W]	Greek 'octo' (eight, 1000^8)
Zetta	**Z**	10^{21}	3.33 Zs, 3.33Z [s]	French 'sept' (seven, 1000^7)
Exa	**E**	10^{18}	1.23 Ekg, 1.23E [kg]	Greek 'six' (1000^6)
Peta	**P**	10^{15}	7.5 Ps, 7.5P [s]	Greek 'five' (1000^5)
Tera	**T**	10^{12}	0.5 Tm, 0.5T [m]	Greek 'teras' = monster
Giga	**G**	10^9	1.2 GΩ, 1.2G [Ω]	Greek 'gigas' = giant
Mega	**M**	10^6	7 MW, 7M [W]	Greek 'megas' = large
Kilo	**K**, **k**	10^3	33 km, 33K [m]	Greek 'kilioi' = thousand
hecto	**h**	100	**Deprecated by SI**	Greek 'hekaton' = hundred
deca	**da**	10	**Deprecated by SI**	Greek 'deka' = ten
deci	**d**	0.1	**Deprecated by SI**	Latin 'decima pars' = one tenth
centi	**c**	0.01	**Deprecated by SI**	Latin 'centesima pars' = one hundredth
milli	**m**, **k**	10^{-3}	22 mm , 1.2m [m]	Latin 'millesima pars' = one thousandth
micro	**μ**, **u**	10^{-6}	2.7 uJ , 2.7μ [J]	Greek 'mikros' = small
nano	**n**	10^{-9}	2.2 nF, 2.2n [F]	Latin 'nanus' = dwarf
pico	**p**	10^{-12}	1.5 pA, 1.5p [A]	Spanish 'pico' = minimal measure
femto	**f**	10^{-15}	4.8 fs, 4.8f [s]	Danish and Norvegian 'femten' = fifteen (10^{-15})
atto	**a**	10^{-18}	1.2 ag, 1.2a [g]	Danish and Norvegian 'atten' = eighteen (10^{-18})
zepto	**z**	10^{-21}	0.2 zm, 1.2z [m]	French 'sept' (seven, 1000^{-7})

yocto	**y**	10^{-24}	1 ys, 1y [s]	Greek 'octo' (eight, 1000^{-8})

Table III b. Binary prefixes for Bytes

which are not a part of SI but which are in common use in informatics [see the note].

Prefix	Symbol	Factor	Value	Examples
Kilo	**KB**	2^{10}	1024	12345 KB = 12 641 280 bytes
Mega	**MB**	2^{20}	1 048 576	420 MB fits in my PC's dynamic RAM
Giga	**GB**	2^{30}	1 073 741 824	16 GB flash-memory pen drive costs $20
Tera	**TB**	2^{40}	1 099 511 627 776	3.9 TB hard disks are a reality
Peta	**PB**	2^{50}	1 125 899 906 842 624	13.5 PB is the CIA total memory capacity
Exa	**EB**	2^{60}	1 152 921 504 606 846 976	1 EB is still a bit out of reach (AD 2010)
Zetta	**ZB**	2^{70}	1 180 591 620 717 411 303 424	How many ZB to hard-copy a human being ???
Yotta	**YB**	2^{80}	1 208 925 819 614 629 174 706 176	1 YYB is still nothing compared with the Universe

Table IV. Accepted non-SI units

compiled according to the US Federal Register (ref.4).

Unit	of	Symbol	Equals	Definition / Note
Degree of arc	plane angle	**°**	(π/180) rad	
Minute of arc	plane angle	**'**	(1/60) °	
Second of arc	plane angle	**"**	(1/60)'	
Minute	time	**min**	60 s	
Hour	time	**h**	60 min	
Day	time	**d**	24 h	Notice that the duration of a day is not linked to Earth motion!
Liter	volume	**L**, **l**	0.001 m^3	Often used sub-units are **deciliter** (**dl**) and **centiliter**.(**cl**).
Gram	mass	**g**	0.001 kg	A tolerated **anomaly**: the *basic unit* of mass (**kg**) has a *prefix*.
Ton	mass	**t**	1000 kg	More precise term: **metric ton**.
Bit	information	**bit**	-	The smallest, dimensionless quantum of information
Baud rate	info flux	**Baud**	1 $bit.s^{-1}$	[amount of information]/[time]
Neper	ratio	**Np**	log(A/B)	Measure of a ratio A/B. The logarithms are in base 10.
Bel	ratio	**B**	0.5 Np	Mostly used as **decibel** (**dB**): 1 dB = (1/20) Np.

Table V. Accepted non-SI units with experimental values.

For the most recent values of these constantly improving units, see Constants of Physics.

Unit	of	Symbol	Equals	Note
Electronvolt	energy	**eV**	$1.60217733(49).10^{-19}$ J	Energy to move an electron across a potential difference of 1 V.
Astronomical unit	length	**au**, **AU**, **ua**	$1.49597870(30).10^{+11}$ m	Mean Earth-to-Sun distance. Also denoted as **ua**.
Atomic mass unit	mass	**u**	$1.6605402(10).10^{-27}$ kg	1/12 of the rest mass of an unbound ^{12}C atom in ground state.

Table VI. Units deprecated by the SI

which are still in current use in most countries.

Unit	of	Symbol	Equals	Note
Nautical mile	length	**mile**	1852 m	
Knot	velocity	**knot**	1 mile.h^{-1}	A nautical unit.
Are	area	**are**	100 m^2	
Hectar	area	**ha**	100 are	10000 m^2
Bar	pressure	**bar**	100000 Pa	Almost 1 atm = 101325 Pa (an obsolete unit)
Calory	energy	**cal**	4.1868 J	Note: the conversion factor is fixed by convention.
Ångström	length	**Å**	10^{-10} m	Used in atomic and molecular physics.
Barn	area	**b**	10^{-28} m^2	Used in particle physics (collision cross-sections).
Radioactivity and radiation:				
Curie	Radioactivity	**b**	$3.7*10^{+10}$ Bq	Note: the conversion factor is fixed by convention.
Röntgen	Radiation dose	**R**	0.000258 Ci.kg^{-1}	Note: the conversion factor is fixed by convention.
Rad	Radiation dose	**rad**	0.01 Gy	
Rem	Equivalent dose	**rem**	0.01 Sv	

Spelling differences

The symbols of various units are international. This, however, is not true about the names of the units. Thus, for example, the US **meter** corresponds to the French **metre**, Italian **metro**, Czech **metr**, etc. In particular, UK English uses the French spelling. Consequently, the US terms **meter**, **gram** and **liter** become, respectively, **metre**, **gramm** and **litre** in the British Commonwealth. Throughout this document, I have used the US spelling.

Note on binary prefixes

These prefixes are so far NOT defined by the SI system, but they are widely used when specifying amounts of information or that of an information storage capacity. This stems from the ubiquitous use of the binary system in electronics information-

handling devices. The prefixes themselves are a combination of binary and decimal concepts (2 as the base, elevated to a decimal exponent) stemming from the approximate equality of 10^3 (1000) and 2^10 (1024). They are used exclusively in combination with the letter "B" standing for "Bytes". Sometimes, a distinction is made between capital "B" (when the prefix is binary) and small "b" (when the prefix is decadic). In such contexts, therefore, 1 KB equals 1.024 Kb. However, be careful because this convention is not universally accepted and can not be counted upon.

References

- *The International System of Units (SI)*, Bureau International des Poids et Measures (**BIPM**), **7th** Edition, 1998.
  Better known as the **SI brochure**, this document is publicly available from the BIPM site.
- Taylor B.N, *The International System of Units (SI)*,
  NIST Special Publication **330**, 2001 Edition (supersedes the 1991 Edition).
- *Metric System of Measurement: Interpretation of the International System of Units for the United States*,
  Federal Register **63**, No.144, July 28, 1998.
- For more, see References on Systems of Units of Measurements

Web links

- BIPM. The home page of the SI System of Units.
- NIST Units of Measurements page.
- Tables of SI Units and Prefixes. URL of this document.
- Si dimensions of over 200 physical quantities.
- NIST Links to official on-line publications about the SI system.
- Unit Converters list.
- For more links, see References on Systems of Units of Measurements

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