STANDARDS AND UNITS

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SI Units

The International System of Units, the SI, is the internationally agreed basis for expressing measurements at all levels of precision and in all areas of Science, Technology, and human endeavour.

There are two classes of units in the SI,

- **Base units**
- **Derived units**

Base units of the SI

The seven base units of the SI provide the reference used to define all the measurement units of the International System.

Length ⟶ metre, ' m'

The metre is the length of the path travelled by light in vacuum during a time interval of 1/299 792 458 of a second.

Mass ⟶ kilogram, 'kg'

The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram.

time, duration ⟶ second,' s'

The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.

electric current ⟶ ampere, 'A'

The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length.

thermodynamic temperature ⟶ kelvin, 'K'

The kelvin, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water.

amount of substance ⟶ mole, 'mol'

The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12.

When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.

luminous intensity ⟶ candela, 'cd'

The 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 watt per steradian.

Derived Units

Derived units are defined as products of powers of the base units and are used to measure derived quantities

Some examples of derived quantities and units

Derived quantity, symbol	Derived quantity, symbol
area, A	square metre, m^2
volume, V	cubic metre, m^3
speed, velocity, v	metre per second, m/s
acceleration, a	metre per second squared, m/s^2
mass density, ρ	kilogram per cubic metre, kg/m^3
current density, j	ampere per square metre, A/m^2
magnetic fieldstrength, H	ampere per metre, A/m
concentration, c	mole per cubic metre, mol/m^3
luminance, L_v	candela per square metre, cd/m^2

Dimensionless quantities

Dimensionless quantities, also called **quantities of dimension one**, are usually defined as the ratio of two quantities of the same kind (for example, refractive index, is the ratio of two speeds).

Thus the unit of a dimensionless quantity is the ratio of two identical SI units, and is therefore always equal to one. However in expressing the values of dimensionless quantities the unit one, 1, is not written.

Decimal multiples and sub-multiples of SI units

A set of multiple and sub-multiple **prefixes** have been adopted for use with the SI units. They may be used with any of the base units and with any of the derived units with special names.

SI prefixes

Factor	Name	Symbol	Factor	Name	Symbol
10^{1}	deca	da	10^{-1}	deci	d
10^{2}	hecto	h	10^{-2}	centi	c
10^{3}	kilo	k	10^{-3}	milli	m
10^{6}	mega	M	10^{-6}	micro	μ
10^{9}	giga	G	10^{-9}	nano	n
10^{12}	tera	T	10^{-12}	pico	p
10^{15}	peta	P	10^{-15}	femto	f
10^{18}	exa	E	10^{-18}	atto	a
10^{21}	zetta	Z	10^{-21}	zepto	z
10^{24}	yotta	Y	10^{-24}	yocto	y

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