APPENDIX 1. SI UNITS AND SOME EQUIVALENCES

Wherever possible the units used are those of the International System of Units (SI). Other "conventional" units (such as the liter or calorie) are frequently used, especially in reporting data from earlier work. Recommendations on standardized scientific terminology and units are published periodically by international committees, but adherence to these remains poor in practice. Conversion between units often requires great care.

The base SI units

Quantity	*Unit*	*Symbol*
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

Some SI derived and supplementary units

Quantity	*Unit*	*Symbol*	*Unit expressed in base or other derived units*
Frequency	hertz	Hz	s^{-1}
Force	newton	N	$kg\,m\,s^{-2}$
Pressure, stress	pascal	Pa	$N\,m^{-2}$
Energy, work, quantity of heat	joule	J	N m
Power	watt	W	$J\,s^{-1}$
Electric charge, quantity of electricity	coulomb	C	A s
Electric potential, potential difference, electromotive force	volt	V	$J\,C^{-1}$
Electric capacitance	farad	F	$C\,V^{-1}$
Electric resistance	ohm	ohm (Ω)	$V\,A^{-1}$
Electric conductance	Siemens	S	Ω^{-1}
Magnetic flux	weber	Wb	V s
Magnetic flux density	tesla	T	$Wb\,m^{-2}$
Inductance	henry	H	$Wb\,A^{-1}$
Luminous flux	lumen	lm	cd sr
Illuminance	lux	lx	$lm\,m^{-2}$
Activity (of a radionuclide)	becquerel	Bq	s^{-1}
Absorbed dose, specific energy	gray	Gy	$J\,kg^{-1}$
Dose equivalent	sievert	Sv*	$J\,kg^{-1}$
Plane angle	radian	rad	
Solid angle	steradian	sr	

*Not to be confused with Sverdrup conventionally used in oceanography: see SI Equivalences of Other Units.

SI base units and derived units may be used with multiplying prefixes (with the exception of kg, though prefixes may be applied to gram $= 10^{-3}$ kg; for example, $1\,\text{Mg} = 10^{6}\,\text{g} = 10^{3}\,\text{kg}$)

Prefixes used with SI units

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

SI Equivalences of Other Units

Physical quantity	*Unit*	*Equivalent*	*Reciprocal*
Length	nautical mile (nm)	1.85318 km	km = 0.5396 nm
Mass	tonne (t)	10^{3} kg = 1 Mg	
Time	min	60 s	
	h	3600 s	
	day or d	86 400 s	$s = 1.1574 \times 10^{-5}$ day
	y	3.1558×10^{7} s	$s = 3.1688 \times 10^{-8}$ y
Temperature	°C	°C = K − 273.15	
Velocity	knot ($1\,\text{nm}\,\text{h}^{-1}$)	$0.51477\,\text{m}\,\text{s}^{-1}$	$\text{m}\,\text{s}^{-1} = 1.9426$ knot
		$44.5\,\text{km}\,\text{d}^{-1}$	
		$16\,234\,\text{km}\,\text{y}^{-1}$	
Density	$\text{gm}\,\text{cm}^{-3}$	$\text{tonne}\,\text{m}^{-3} = 10^{3}\,\text{kg}\,\text{m}^{-3}$	
Force	dyn	10^{-5} N	
Pressure	$\text{dyn}\,\text{cm}^{-2}$	$10^{-1}\,\text{N}\,\text{m}^{-2} = 10^{-1}$ Pa	
	bar	$10^{5}\,\text{N}\,\text{m}^{-2} = 10^{5}$ Pa	
	atm (standard atmosphere)	$101\,325\,\text{N}\,\text{m}^{-2}$ = 101.325 kPa	
Energy	erg	10^{-7} J	
	cal (I.T.)	4.1868 J	
	cal (15°C)	4.1855 J	
	cal (thermochemical)	4.184 J	J = 0.239 cal

(*Note*: The last value is the one used for subsequent conversions involving calories.)

Energy flux	langley (ly) min^{-1} = $cal\,cm^{-2}\,min^{-1}$	$697\,W\,m^{-2}$	$W\,m^{-2} = 1.434 \times 10^{-3}$ $ly\,min^{-1}$
	$ly\ h^{-1}$	$11.6\,W\,m^{-2}$	$W\,m^{-2} = 0.0860\,ly\,h^{-1}$
	$ly\ d^{-1}$	$0.484\,W\,m^{-2}$	$W\,m^{-2} = 2.065\,ly\,d^{-1}$
	$kcal\,cm^{-2}\,y^{-1}$	$1.326\,W\,m^{-2}$	$W\,m^{-2} = 0.754\,kly\,y^{-1}$
Volume flux	Sverdrup	$10^6\,m^3\,s^{-1}$ $3.6\,km^3\,h^{-1}$	
Latent heat	$cal\,g^{-1}$	$4184\,J\,kg^{-1}$	$J\,kg^{-1} = 2.39 \times 10^{-4}$ $cal\,g^{-1}$
Irradiance	Einstein $m^{-2}\,s^{-1}$ (mol photons $m^{-2}\,s^{-1}$)		

*Most values are taken from or derived from *The Royal Society Conference of Editors Metrication in Scientific Journals*, 1968, The Royal Society, London

The SI units for pressure is the pascal ($1\,Pa = 1\,N\,m^{-2}$). Although the bar ($1\,bar = 10^5\,Pa$) is also retained for the time being, it does not belong to the SI system. Various texts and scientific papers still refer to gas pressure in units of the torr (symbol: Torr), the bar, the conventional millimetre of mercury (symbol: mmHg), atmospheres (symbol: atm), and pounds per square inch (symbol: psi) – although these units will gradually disappear (see Conversions between Pressure Units).

Irradiance is also measured in $W\,m^{-2}$. Note: $1\,mol\ photons = 6.02 \times 10^{23}$ photons.

The SI unit used for the amount of substance is the mole (symbol: mol), and for volume the SI unit is the cubic metre (symbol: m^3). It is technically correct, therefore, to refer to concentration in units of $mol\,m^{-3}$. However, because of the volumetric change that sea water experiences with depth, marine chemists prefer to express sea water concentrations in molal units, $mol\,kg^{-1}$.

Conversions between Pressure Units

	Pa	kPa	bar	atm	Torr	psi
1 Pa =	1	10^{-3}	10^{-5}	$9.869\ 23 \times 10^{-6}$	$7.500\ 62 \times 10^{-3}$	$1.450\ 38 \times 10^{-4}$
1 kPa =	10^3	1	10^{-2}	$9.869\ 23 \times 10^{-3}$	7.500 62	0.145 038
1 bar =	10^5	10^2	1	0.986 923	750.062	145.038
1 atm =	101 325	101.325	1.013 25	1	760	14.6959
1 Torr =	133.322	0.133 322	$1.333\ 22 \times 10^{-3}$	$1.315\ 79 \times 10^{-3}$	1	$1.933\ 67 \times 10^{-2}$
1 psi	6894.76	6.894 76	$6.894\ 76 \times 10^{-2}$	$6.804\ 60 \times 10^{-2}$	51.715 07	1

psi = pounds force per square inch.
1 mmHg = 1 Torr to better than 2×10^{-7} Torr.