MEASUREMENTS

SI Metric System

The SI (Système Internationale d'Unités) is founded on seven base units that can be multiplied or divided by each other to yield derived units. Values of the base and derived units can be increased or decreased by using SI prefixes indicating decimal multiplication factors. Units and prefixes are assigned internationally accepted symbols.

Base Units

	Physical Quantity	Symbol
metre	length	m
kilogram	mass	kg
second	time	s
ampere	electric current	A
kelvin	thermodynamic temperature	K
mole	amount of substance	mol
candela	luminous intensity	cd

Derived Units With Special Names and Symbols

	Physical Quantity	Symbol
becquerel	radioactivity	Bq
coulomb	electric charge	C
degree Celsius	temperature	°C
farad	electric capacitance	F
gray	absorbed radiation dose	Gy
henry	inductance	H
hertz	frequency	Hz
joule	energy, work	J
lumen	luminous flux	lm
lux	illumination	lx
newton	force	N
ohm	electric resistance	Ω
pascal	pressure, stress	Pa
radian	plane angle	rad
siemens	electric conductance	S
sievert	radiation dose equivalent	Sv
steradian	solid angle	sr
tesla	magnetic flux density	T
volt	electric potential difference	V
watt	power	W
weber	magnetic flux	Wb

Some Derived Units Without Special Names and Symbols

	Physical Quantity	Symbol
ampere per metre	magnetic field strength	A/m
cubic metre	volume	m^3
henry per metre	permeability	H/m
joule per kelvin	heat capacity, entropy	J/K
kilogram per cubic metre	mass density	kg/m^3
metre per second	linear speed	m/s
metre per second squared	linear acceleration	m/s^2
mole per cubic metre	concentration of substance	mol/m^3
newton metre	moment of force, torque	N·m
radian per second	angular speed	rad/s
square metre	area	m^2
volt per metre	electric field strength	V/m
watt per metre kelvin	thermal conductivity	W/(m·K)
watt per steradian	radiant intensity	W/sr

Prefixes

Multiplication Factor			Name	Symbol
1 000 000 000 000 000 000	or	10^{18}	*exa-*	E
1 000 000 000 000 000	or	10^{15}	*peta-*	P
1 000 000 000 000	or	10^{12}	*tera-*	T
1 000 000 000	or	10^{9}	*giga-*	G
1 000 000	or	10^{6}	*mega-*	M
1 000	or	10^{3}	*kilo-*	k
100	or	10^{2}	*hecto-*	h
10	or	10^{1}	*deca-* or *deka-*	da
0.1	or	10^{-1}	*deci-*	d
0.01	or	10^{-2}	*centi-*	c
0.001	or	10^{-3}	*milli-*	m
0.000 001	or	10^{-6}	*micro-*	μ
0.000 000 001	or	10^{-9}	*nano-*	n
0.000 000 000 001	or	10^{-12}	*pico-*	p
0.000 000 000 000 001	or	10^{-15}	*femto-*	f
0.000 000 000 000 000 001	or	10^{-18}	*atto-*	a

Other Units Used With the SI

Some units technically outside of the SI are nevertheless employed with it due to their practical or special significance or because they are already in wide use. Excepting the electronvolt, litre, tex, and tonne, prefixes are not used with these units. The tonne does not take prefixes indicating a multiplication factor of less than ten.

Name	Symbol	Quantity	SI Equivalent
astronomical unit	–	length	≈ 1.4960×10^{11} m
barn	b	area	= 10^{-28} m^2
day, mean solar	d	time	= 86 400 s
degree	°	plane angle	= (Π/180) rad
electronvolt	eV	energy	≈ $1.60\,22 \times 10^{-19}$ J
hectare	ha	area	= 10 000 m^2
hour, mean solar	h	time	= 3600 s
knot	kn	linear speed	= 1852 m/h
litre	L or l	volume	≈ 1 dm^3 or 1000 cm^3
millibar	mbar	pressure	= 100 Pa
minute, mean solar	min	time	= 60 s
minute	'	plane angle	= (Π/10 800) rad
nautical mile	M	length	= 1852 m
parsec	pc	length	≈ 3.0857×10^{16} m
revolution	r	plane angle	= 2Π rad
second	"	plane angle	= (Π/648 000) rad
tex	tex	linear density	= 1 mg/m
tonne	t	mass	= 1000 kg
unified atomic mass unit	u	mass	≈ 1.6605×10^{-27} kg
year	a	time	≈ 3.1536×10^7s (calendar)
			= 3.155693×10^7s (solar)
			= 3.155815×10^7s (sidereal)

Conversion of Common SI Units

Conversions for some common SI units or those used with the SI to Imperial or US Customary units are given below.

SI Unit	Conversion
length	
micrometre	= 0.000 039 37 inches
millimetre	= 0.039 37 inches
centimetre	= 0.3937 inches
metre	= 39.37 inches or ≈ 1.094 yards
kilometre	≈ 0.621 miles
area	
square millimetre	≈ 0.001 55 square inches
square centimetre	≈ 0.155 square inches
square metre	≈ 1.196 square yards or 10.76 square feet
hectare	≈ 2.471 acres
square kilometre	≈ 0.386 square miles
volume or capacity	
cubic millimetre	≈ 0.000 061 cubic inches
cubic centimetre or millilitre	≈ 0.0610 cubic inches, 0.0352 Imp. fl.ounces, or 0.0338 US fl. ounces
cubic decimetre or litre	≈ 61.0 cubic inches, 0.880 Imp. quarts, 1.057 US liquid quarts, or 0.908 US dry quarts
cubic metre	≈ 1.308 cubic yards
mass	
gram	≈ 0.0353 ou. avoirdupois or 0.0322 ou. troy
kilogram	≈ 2.205 pounds avoirdupois
tonne	≈ 2205 pounds avoirdupois
temperature	
degree Celsius	(°C × 1.8) + 32 = degrees Fahrenheit

Foot-Pound-Second and Troy Systems

The Imperial and US Customary systems are the last foot-pound-second systems still used nationally in everyday trade and commerce, while the troy system of weights continues to find use in the precious metals market, chiefly in North America. All have been supplanted by the SI in scientific and technical work and in nearly all international trade.

Imperial and US Customary System Units

Units of the Imperial and US Customary systems are equal except for some units of volume and capacity.

Unit	Relation	Conversion
length		
inch	–	= 25.4 mm
foot	12 inches	= 0.3048 m
yard	3 feet, 36 inches	= 0.9144 m
rod	$5\frac{1}{2}$ yards, $16\frac{1}{2}$ feet	= 5.0292 m
furlong	220 yards, $\frac{1}{8}$ mile	≈ 0.201 km
mile (statute)	1760 yards, 5280 feet	≈ 1.609 km
area		
square inch	–	= 645.16 mm^2
square foot	144 sq. inches	= 929.0304 cm^2
square yard	9 sq. feet	≈ 0.836 m^2
acre	4840 sq. yards	≈ 0.405 ha
volume or capacity		
cubic inch	–	≈ 16.387 cm^3
cubic foot	1728 cubic inches	≈ 28.316 dm^3
cubic yard	27 cubic feet	≈ 0.765 m^3
(Imperial)		
fluid ounce	–	≈ 28.413 cm^3
pint	20 Imp fl. ou.	≈ 0.568 dm^3
quart	2 Imp. pints	≈ 1.136 dm^3
gallon	4 Imp. quarts	≈ 4.546 dm^3
peck	8 Imp. quarts	≈ 9.092 dm^3
bushel	4 Imp. pecks	≈ 36.369 dm^3
barrel	36 Imp. gallons	≈ 163.7 dm^3
(US, liquid)		
fluid ounce	–	≈ 29.573 cm^3
pint	16 US fl. ou.	≈ 0.473 dm^3
quart	2 US fl. pints	≈ 0.946 dm^3
gallon	4 US fl. quarts	≈ 3.785 dm^3
barrel, wine	$31\frac{1}{2}$ US gallons	≈ 119.2 dm^3
barrel, oil	42 US gallons	≈ 0.159 m^3
(US, dry)		
pint	–	≈ 0.551 dm^3
quart	2 US dry pints	≈ 1.101 dm^3
peck	8 US dry quarts	≈ 8.810 dm^3
bushel	4 pecks	≈ 35.239 dm^3
weight or mass		
ounce	–	≈ 28.349 g
pound	16 ounces	≈ 0.454 kg
(avoirdupois)		
stone (UK)	14 pounds	≈ 6.350 kg
hundred-weight(UK)	112 pounds	≈ 50.80 kg
(long) ton (UK)	2240 pounds	≈ 1.016×10^3kg
(short) ton (US)	2000 pounds	≈ 0.907×10^3kg
(troy)		
ounce	–	≈ 31.103 g
pound	12 ou. troy	≈ 373.242 g
temperature		
degree Fahrenheit	(°F – 32) ÷1.8 = degrees Celsius	

Some Volumetric Measurement Comparisons

Imperial Units	In US Units	In SI Units
1 UK fluid ounce	≈ 0.961 US fluid ounce	≈ 28.413 cm^3
1 UK pint	≈ 1.201 US liquid pint	≈ 0.568 dm^3
1 UK pint	≈ 1.032 US dry pint	≈ 0.568 dm^3
1 UK gallon	≈ 1.201 US gallon	≈ 4.546 dm^3

US Units	In Imperial Units	In SI Units
1 US fluid ounce	≈ 1.041 UK fluid ounce	≈ 29.573 cm^3
1 US liquid pint	≈ 0.833 UK pint	≈ 0.473 dm^3
1 US gallon	≈ 0.833 UK gallon	≈ 3.785 dm^3
1 US dry pint	≈ 0.969 UK pint	≈ 0.551 dm^3