Skills

1 Units

In Physics, measurable quantities usually have a number and a unit. The unit gives an indication of the size of that quantity and also information about what the quantity physically represents. This is best understood with examples.

A quantity such as 15 metres is clearly a length; one cannot measure a mass or a time in metres. 15 metres is a shorter length than 15 miles, but a longer length than 15 inches. Without the inclusion of a unit, a length of 15 is meaningless.

To facilitate global collaboration in science, seven units have been selected as the standard that all scientists should use. These are called SI base units (which comes from the French name: Système International d'unités). At GCSE Physics level, you are expected to know and be able to use the first six of these units.

Quantity	Unit name	Unit symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Amount of substance	mole	mol
Luminous intensity	candela	cd

SI derived units are units given in terms of the SI base units. A speed, for example, is always a length divided by a time. In SI derived units, a speed should be given in metres per second (m/s). A volume always includes the product of three lengths so, in SI derived units, a volume should be given in cubic metres (m^3).

You can work out what the appropriate unit for any quantity is by considering the quantities that are combined in any equation for that quantity.

Units may also include a prefix. These are included between the number and the unit and tell you by how much the number should be multiplied.

Prefix	Multiply By
mega (M)	1 000 000
kilo (k)	1 000
centi (c)	0.01
milli (m)	0.001
micro (μ)	0.000 001
nano (n)	0.000 000 001

1.1 Complete the table below with the correct SI base units.

Quantity	Equation	Unit in terms of SI base units
Area	$A = L^2$	(a)
Acceleration	$a = (v - u)/t$	(b)
Momentum	$p = mv$	(c)
Kinetic energy	$E = \frac{1}{2}mv^2$	(d)
Gravitational potential energy	$E = mgh$	(e)
Electric charge	$Q = It$	(f)

1.2 Write the following quantities with the appropriate unit and prefix

0.000 001 20 m	(a)	5 200 000 mg	(b)
6 500 μs	(c)	0.000 000 920 km	(d)
3 400 000 nA	(e)	0.000 027 0 kA	(f)
5 500 000 000 nm	(g)	6 500 000 cm^2	(h)
0.000 044 0 km/s	(i)	83 000 mm^3	(j)

1.3 Convert these measurements to metres (m):

(a) 240 cm (b) 1 500 cm (c) 95 cm (d) 7.0×10^3 cm

1.4 Convert these mass measurements into kilograms (kg):
(a) 2 500 g (b) 350 g (c) 1 020 g (d) 3.80×10^4 g

1.5 Convert these mass measurements into grams (g):
(a) 6.70 kg (b) 3 400 mg (c) 0.050 kg (d) 150 mg

1.6 Convert the following volumes into cubic metres (m^3) [1 cm^3 = 1 ml]:
(a) 2 500 cm^3 (b) 68 cm^3 (c) 3 700 litres

1.7 Convert the following volumes to litres (L):
(a) 2 500 cm^3 (b) 2.0 m^3 (c) 560 cm^3

1.8 How many cubic centimetres (cm^3) are there in these volumes?
(a) 1.60 litres (b) 3.25 m^3 (c) 0.0625 m^3 (d) 0.080 litres

1.9 Convert these areas into square metres (m^2):
(a) 4 250 cm^2 (b) 5.3×10^4 cm^2 (c) 2.50 km^2 (d) 15.0 cm^2

1.10 Calculate the number of square centimetres (cm^2) in:
(a) 1.44 m^2 (b) 0.0275 m^2 (c) 3.50×10^{-2} m^2 (d) 1.50×10^{-4} m^2

Additional Units Questions

1.11 Change these times into seconds (s):
(a) 3.0 mins (b) 2 hrs 30 mins (c) 3.6 mins (d) 4 mins 30 secs

1.12 How many seconds are there in a minute, an hour, a day and a year?

1.13 Write the following fundamental constants and data without unit prefixes.
(a) speed of light = 300 Mm/s (b) g = 9 810 mN/kg
(c) Earth's radius = 6 370 km (d) red wavelength = 680 nm

1.14 The light-year (ly) is a unit often mistaken as a unit of time. It is defined as the distance travelled by light in a vacuum in one Julian year (365.25 days). Use the data in Q1.13 and the equation speed = distance/time ($v = s/t$). What SI measurement is 1.0 ly equivalent to?