

Measurements and units review questions

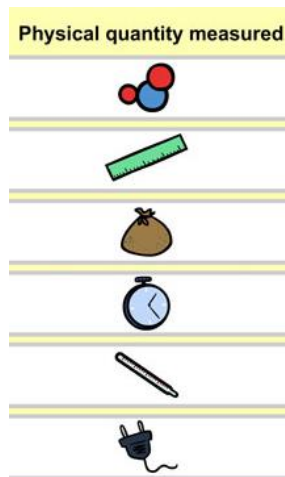
1) SI base units

The pictures on the right represent the main six base units from which the System International of units is built. Create a table for these six units as below:

Quantity	Symbol	Units
Amount of substance	n	mol

The first row is done for you as it is more Chemistry than Physics.

Quantity	Symbol	Units
Amount of substance	n	mol
Distance (length)	d	metre
Mass	m	kilogram
Time	t	second
Temperature	T	Kelvin
Current	I	Ampere



2) Derived units and prefixes

(a) What is this distance: km ? **kilometre = 1000 metres**

(b) What are these times:

ns, μ s, ms?

ns: nanosecond = 10^{-9} seconds

μ s: microsecond = 10^{-6} seconds

ms: millisecond = 10^{-3} seconds (0.001 s)

(c) What is the unit for volume? **Metres cubed, m^3 .**

(d) Define density and state its units. **Density is the mass of an object/substance divided by the volume it occupies. Density = Mass / Volume. Units are kg/m^3 (or g/cm^3).**

(e) If $2m^3$ of aluminium has a mass of 5400kg what is the density of aluminium?

Density = $5400/2 = 1700 kg/m^3$

(f) A cm^3 is the same volume as a ml (milli-litre)

a. How many cm^3 are there in a m^3 ?

There are 100 cm in a meter but we are in 3 dimensions here so there are $100 \times 100 \times 100 = 1000,000$ or one million or $10^6 cm^3$ in a m^3 .

b. How many litres are there in a m^3 ?

A ml is a milli-litre so a litre is a thousand ml.

There are therefore a thousand times less litres in a m^3 compared to ml.

$1000,000 / 1000 = 1000$ litres are there in a m^3 .

3) Smaller and bigger

Write down two mathematical equivalents of the following unit prefixes. (for example for nano [a billionth] you would write $1/1,000,000,000$ and 10^{-9})

a) kilo (k) b) milli (m) c) Mega (M) d) centi (c)

kilo: 1000 or 10^3

milli: $1/1000$ or 10^{-3} or 0.001

Mega: 1000000 or 10^6

Centi: $1/100$ or 10^{-2} or 0.01

4) Measuring density

a) Explain how a measuring cylinder can be used to accurately measure the volume of a liquid.

Add the liquid to the measuring cylinder and then with your eyes level with the meniscus read off the scale



b) Explain how a mass balance can be used to accurately measure the mass of a liquid.

If the density of the liquid is known then the volume = mass / density. In the case of water the density is 1g/cm³ so each gram of water has a volume of 1cm³.

c) Explain whether a solid of volume 12cm³ that has a mass of 14g floats in pure water.

Density = 14/12 = 1.17 g/cm³ which is more dense than water so it will sink.

d) Opposite is a photograph of a displacement can. Explain how this can be used to measure the volume of a solid object.

The can is filled and then left for water to drain to level of side-arm.

The solid object is then added and the volume of water displaced can be caught and measured.

Volume displaced = Volume of solid.

5) Mass and weight

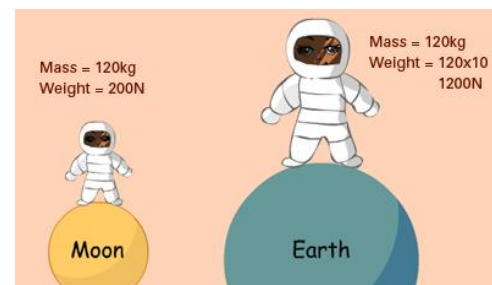
a) A planet's density varies. Are planets denser in the central core or at the outer layers?

The central core is denser.

b) A large, dense planet will have the greatest gravity.

i) Uranus has a similar gravitational field strength to Earth and Venus but is much larger. Compare the density of the Earth and Venus to the density of Uranus

If Uranus is much bigger but has similar gravitational field strength then it must be less dense.



ii) Mars and Mercury have similar gravitational field strengths (4 N/kg).

a) How much would a person of mass 80kg weigh on Mars or Venus.

80kg x 4 N/kg = 320 Newtons

b) Mercury is denser than Mars, which planet is smaller?

Mercury is smaller

c) Look at the picture opposite. What is the gravitational field strength on the moon?

200N / 120 kg = 1.7 N/kg

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