Compound measures

Starter

1. **(Review of last lesson)**
How long is a train which passes signal in 20 seconds at a speed of 108 km/h?

Working: 108 km/h $\equiv 108000$ m/h $\equiv \dfrac{108000}{60}$ m/min $\equiv \dfrac{108000}{60 \times 60} = 30$ m/s

Distance $=$ Speed $\times$ Time $= 30 \times 20 = 600$ m
The train is 600 m long.

2. **(Review of previous material)** Two people run towards each other at 4 m/s and 9 m/s respectively. Initially they are 650 m apart. How long will it be before they meet?

Working: The relative speed of the two people is $4 + 9 = 13$ m/s
$\text{Time} = \dfrac{\text{Distance}}{\text{Speed}} = \dfrac{650}{13} = 50$ s
It will be 50 seconds before the people meet.

E.g. 1 The volume of a solid object is 5 cm^3 and its mass is 50 g. Calculate the density of the material, giving the correct units for your answer..

Working: $\text{Density} = \dfrac{\text{Mass}}{\text{Volume}} = \dfrac{50}{5} = 10$ g/cm^3

E.g. 2 A cube of side 4 cm applies a pressure of 10 Nm^{-2} to the table it is resting on. Calculate the weight of the cube

Working: The weight of the cube is the "force" in the formula.
Since the pressure units are 10 Nm^{-2} the area needs to be m^2.
Area $= 0.04^2 = 0.0016$ cm^2
$\text{Pressure} = \dfrac{\text{Force}}{\text{Area}}$: $\quad 10 = \dfrac{\text{Weight}}{0.0016}$
$\text{Weight} = 10 \times 0.0016 = 0.016$ N
The weight of the cube is 0.016 N.

E.g. 3 A solid cuboid of dimensions 3 cm by 4 cm by 5 cm is made of metal of density 10 g/cm^3. Calculate the mass of the cuboid, giving your answer in kg.

Working: $\text{Density} = \dfrac{\text{Mass}}{\text{Volume}}$: $\quad 10 = \dfrac{\text{Mass}}{3 \times 4 \times 5}$
$\text{Mass} = 10 \times 6o = 600$ g
The mass of the cuboid is 0.6 kg

E.g. 4 A certain plastic has a density of 3 g/cm^3. Convert the density into kg/m^3.

Working: Convert from g/cm^3 to g/m^3 and then kg/m^3.
There will be more grams in a 1 m^3 than 1 cm^3 so multiply.

$$3 \text{ g/cm}^3 \equiv 3 \times 100 \times 100 \times 100 \text{ g/m}^3$$
$$\equiv \frac{3 \times 100 \times 100 \times 100}{1000} \text{ kg/m}^3$$
$$= 3000 \text{ kg/m}^3$$

E.g. 5 The population of the UK is about 66.7 million and land area is about 240000 km^2. Work out the population density, stating your units clearly and giving your answer to the nearest integer.

Working: $\text{Population density} = \frac{66700000}{240000} = 278$ people/km^2.

E.g. 6* Zahra mixes 150 g of metal A and 150 g of metal B to make 300 g of an alloy. Metal A has a density of 19.3 g/cm^3 and metal B has a density of 8.9 g/cm^3. Work out the density of the alloy to 3 s.f., stating the units clearly.

Working: The density of the alloy is not just the average of the densities of the metals.
The volume of the alloy must be calculated.

Metal A: $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$ $\qquad 19.3 = \frac{150}{\text{Volume}}$

$$\text{Volume of metal } A = \frac{150}{19.3}$$

N.B. Do not round half-way through the calculation.

Metal B: $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$ $\qquad 8.9 = \frac{150}{\text{Volume}}$

$$\text{Volume of metal } B = \frac{150}{8.9}$$

N.B. Do not round half-way through the calculation.

$$\text{Volume of alloy} = \frac{150}{19.3} + \frac{150}{8.9}$$
$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{150 + 150}{\frac{150}{19.3} + \frac{150}{8.9}} = 12.2$$

The density of the alloy is 12.2 g/cm^3.

Video: Density
Video: Pressure
Video: Converting between metric units of area
Video: Converting between metric units of volume

Solutions to Starter and E.g.s

Exercise

9-1 class textbook:	p313 M10.4 Qu 1-15
A*-G class textbook:	p276 M10.4 Qu 1-14
9-1 homework book:	p105 M10.4 Qu 1-12
A*-G homework book:	p77 M10.4 Qu 1-10