

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

Distance = Speed \times Time = $30 \times 20 = 600 \text{ m}$
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 $4 + 9 = 13 \text{ m/s}$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{650}{13} = 50 \text{ s}$$

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

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.

$$\text{Area} = 4^2 = 16 \text{ cm}^2$$

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}: \quad 10 = \frac{\text{Weight}}{16}$$

$$\text{Weight} = 10 \times 16 = 160 \text{ N}$$

The weight of the cube is 160 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: $\text{Density} = \frac{\text{Mass}}{\text{Volume}}: \quad 10 = \frac{\text{Mass}}{3 \times 4 \times 5}$
 $\text{Mass} = 10 \times 60 = 600 \text{ g}$

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: Population density = $\frac{66700000}{240000} = 278250 \text{ people/km}^2$.

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.

$$\text{Metal A: Density} = \frac{\text{Mass}}{\text{Volume}} \quad 19.3 = \frac{150}{\text{Volume}}$$
$$\text{Volume of metal A} = \frac{150}{19.3}$$

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

$$\text{Metal B: Density} = \frac{\text{Mass}}{\text{Volume}} \quad 8.9 = \frac{150}{\text{Volume}}$$
$$\text{Volume of metal B} = \frac{150}{8.9}$$

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