

Density, Mass and Volume

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (2 marks)

A bar of soap has a volume of 80 cm^3

The mass of the bar of soap is 92 g.

Work out the density of the soap.

Density = mass $\div$ volume

$$92 \div 80 = 1.15$$

Answer: 1.15 g/cm^3

Tip: Divide the mass by the volume, not the other way round. $80 \div 92 = 0.869 \dots$ is a common wrong answer.

Marks: 1 mark for $92 \div 80$. 1 mark for 1.15

2 (3 marks)

A bar of chocolate is a cuboid 15 cm long, 6 cm wide and 1.2 cm thick.

The density of the chocolate is 1.3 g/cm^3

Work out the mass of the bar of chocolate.

Volume of the cuboid: $15 \times 6 \times 1.2 = 108 \text{ cm}^3$

Mass = density $\times$ volume

$$1.3 \times 108 = 140.4$$

Answer: 140.4 g

Tip: To find a mass, **multiply** density by volume. Dividing $108 \div 1.3$ is a common mistake.

Marks: 1 mark for 108. 1 mark for 1.3×108 . 1 mark for 140.4

3 (3 marks)

A jar contains 0.5 kg of honey.

The density of honey is 1.42 g/cm^3

Work out the volume of honey in the jar.

Give your answer correct to 3 significant figures.

The density uses grams, so change kg to g:

$$0.5 \text{ kg} = 0.5 \times 1000 = 500 \text{ g}$$

Volume = mass $\div$ density

$$500 \div 1.42 = 352.11\dots$$

To 3 significant figures: 352

Answer: 352 cm^3

Tip: Use $1 \text{ kg} = 1000 \text{ g}$ (not 100 g). Mixing kg and g/cm^3 in the same calculation gives a wrong answer.

Marks: 1 mark for 500. 1 mark for $500 \div 1.42$. 1 mark for 352.

4 (3 marks)

A solid block of aluminium is in the shape of a cuboid.

The base of the block is 4 cm by 6 cm.

The block has a mass of 648 g.

The density of aluminium is 2.7 g/cm^3

Work out the height of the block.

Volume = mass $\div$ density

$$648 \div 2.7 = 240 \text{ cm}^3$$

Volume of a cuboid = area of base $\times$ height

$$\text{Area of the base: } 4 \times 6 = 24 \text{ cm}^2$$

$$\text{Height: } 240 \div 24 = 10$$

Answer: 10 cm

Tip: First use the density to find the volume. Then work backwards from volume = length $\times$ width $\times$ height.

Marks: 1 mark for $648 \div 2.7$. 1 mark for dividing the volume by 24. 1 mark for 10.

5 (4 marks)

Ines is a jeweller.

She has 1 kg of silver.

The density of silver is 10.5 g/cm^3

Ines makes silver pendants.

Each pendant uses 2.4 cm^3 of silver.

Work out the greatest number of pendants Ines can make.

Change the silver to grams: $1 \text{ kg} = 1000 \text{ g}$

Mass of one pendant = density $\times$ volume

$$10.5 \times 2.4 = 25.2 \text{ g}$$

$$\text{Number of pendants: } 1000 \div 25.2 = 39.68 \dots$$

She cannot make part of a pendant, so round down to 39.

(40 pendants would need $40 \times 25.2 = 1008 \text{ g}$, which is more than 1000 g.)

Answer: 39

Tip: Round **down**: 39.68 means she has enough silver for 39 whole pendants, not 40.

Marks: 1 mark for 10.5×2.4 (or $1000 \div 10.5$). 1 mark for using 1000 g. 1 mark for $1000 \div 25.2$ (or $95.2 \dots \div 2.4$). 1 mark for 39.

6 (3 marks)

A candle is a solid cylinder with radius 3.5 cm and height 12 cm.
The candle is made from wax.
The density of the wax is 0.9 g/cm^3

Work out the mass of the candle.
Give your answer correct to 3 significant figures.

Volume of a cylinder = $\pi r^2 h$

$$\pi \times 3.5^2 \times 12 = 461.81 \dots \text{ cm}^3$$

Mass = density $\times$ volume

$$0.9 \times 461.81 \dots = 415.63 \dots$$

To 3 significant figures: 416

Answer: 416 g

Tip: You need the cylinder's **volume** ($\pi r^2 h$), not the area of the circle. Use the radius 3.5 cm, not the diameter, and keep the full volume in your calculator.

Marks: 1 mark for the volume. 1 mark for $0.9 \times$ volume. 1 mark for 416.

7 (4 marks)

Leo mixes 1.2 kg of white paint with 0.35 kg of blue paint.
The density of the white paint is 1.5 g/cm^3
The density of the blue paint is 1.4 g/cm^3

Work out the density of the paint Leo makes.
Give your answer correct to 2 decimal places.

Change the masses to grams: 1200 g of white paint and 350 g of blue paint.

Find the volume of each paint (volume = mass $\div$ density):

$$\text{White: } 1200 \div 1.5 = 800 \text{ cm}^3$$

$$\text{Blue: } 350 \div 1.4 = 250 \text{ cm}^3$$

$$\text{Total mass: } 1200 + 350 = 1550 \text{ g}$$

$$\text{Total volume: } 800 + 250 = 1050 \text{ cm}^3$$

$$\text{Density} = 1550 \div 1050 = 1.476 \dots$$

To 2 decimal places: 1.48

Answer: 1.48 g/cm³

Tip: Do not just average the two densities. Find the total mass and the total volume, then divide.

Marks: 1 mark for one correct volume. 1 mark for the total volume 1050. 1 mark for $1550 \div 1050$. 1 mark for 1.48

8 (4 marks)

A measuring jug contains 350 cm³ of water.

30 identical steel ball bearings are put into the jug.

The ball bearings sink to the bottom and are completely covered by the water.

The water level rises to 370 cm³

Each ball bearing has a mass of 5.2 g.

Work out the density of the steel.

You must show all your working.

Total mass of the ball bearings: $30 \times 5.2 = 156$ g

The ball bearings push the water up by their own volume.

Volume of the ball bearings: $370 - 350 = 20$ cm³

Density = mass $\div$ volume

$156 \div 20 = 7.8$

Answer: 7.8 g/cm³

Tip: The volume of the steel is the **rise** in the water level (20 cm³), not 370 cm³. Use the mass of all 30 ball bearings with this volume.

Marks: 1 mark for 156. 1 mark for $370 - 350 = 20$. 1 mark for $156 \div 20$. 1 mark for 7.8
