Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Measuring density

Time allowed: 1 hour 40 minutes

Subject code **0625**

Physics

Questions from Paper 3, Paper 4 and Paper 6

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 86

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 86 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 **(a)** The length of a rectangular sheet of plastic is measured using a short ruler, as shown in Fig. 2.1 (not full size).

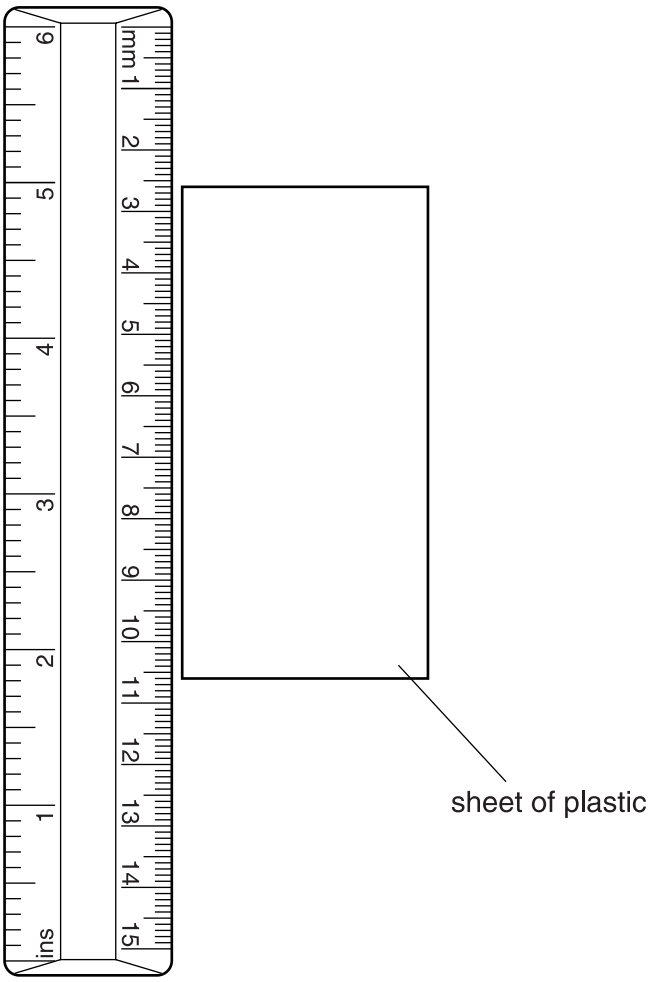


Fig. 2.1 (not full size)

From the ruler in Fig. 2.1, find the length, in cm, of the sheet.

length = ... cm [1]

(b) The sheet of plastic in **(a)** has a thickness of 0.50 cm and a width that is half its length.

Calculate the volume of the sheet of plastic.

volume = ... cm^3 [2]

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(c) The plastic has a density of $1.2\,g/cm^3$.

(i) Calculate the mass of the sheet.

mass = ... g [2]

(ii) Which laboratory instrument could be used to check the mass of the sheet?

.....[1]

[Total: 6]

Density Click for more variations

1 **(a)** 8 or 8.0 (cm) B1

(b) $8 \times 4 \times 0.5$ e.c.f. from (a) C1
16 (cm^3) e.c.f. A1

(c) **(i)** $D = M/V$ in any form OR $V \times D$ OR his volume $\times$ 1.2 C1
19.2 (g) e.c.f. A1

(ii) balance (accept spring balance)
OR scales NOT scale B1

[6]

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2 **(a)** A scientist has a measuring cylinder, a beaker of sea water and an electronic balance.

Describe an experiment to determine the density of the sea water.

Include any equations in your answer.

.....

.....

.....

.....

.....

..... [5]

(b) A plank of wood floats on the sea.

Explain why the wood floats.

.....

..... [1]

[Total: 6]

Density Click for more variations

Reduced to 78% to fit the page (wider than A4).

2(a)	find mass of measuring cylinder / beaker / container empty	**B1**
	add sea water AND read volume	**B1**
	find mass of measuring cylinder / beaker / container with seawater	**B1**
	subtract the 2 mass readings (to give mass of seawater)	**B1**
	(D) = M ÷ V in any form	**B1**
2(b)	wood less dense (than seawater) / ora	**B1**

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3 A student wishes to find the volume of a piece of wood of irregular shape. Her experiment requires the use of a small brass object of mass 200 g.

(a) Calculate the volume of the brass object. The density of brass is 8.4 g/cm^3.

volume = ...[2]

(b) To find the volume of the piece of wood, the student has a measuring cylinder, a supply of water and the brass object in **(a)**. The piece of wood and the brass object are small enough to be placed in the measuring cylinder.

(i) The piece of wood does not sink in water.

Suggest why.

.....[1]

(ii) Describe what the student does to find the volume of the piece of wood, stating the measurements that she makes and any calculations required.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 7]

Density Click for more variations

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3	**(a)**	d = m / V in any form OR (V =) m / d OR 200 / 8.4	C1
		$24\,cm^3$	A1
	(b) **(i)**	density less (than water) OR upthrust ≥ weight	B1
	(ii)	determine any volume of any liquid (V_1)	B1
		states viable method to submerge wood	B1
		reads volume (V_2) from previous line and determines volume of (wood + brass) ($V_2 - V_1$)	B1
		subtract volume of brass from above (to give volume of wood)	B1

[Total: 7]

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4 Fig. 1.1 shows three metal blocks. Each block has the same mass.

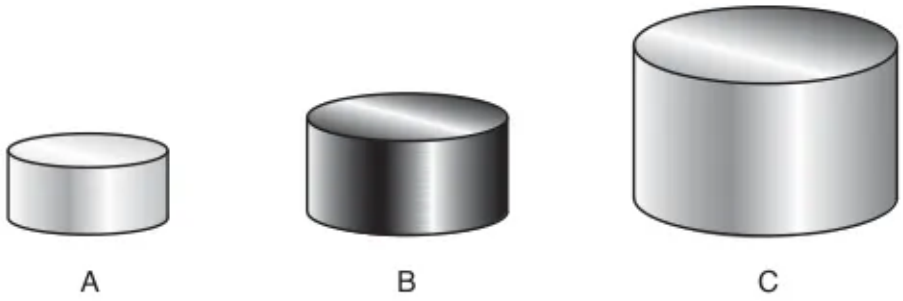


Fig. 1.1

The volumes of the blocks are different.

Each block is made of a different metal. The table gives the density of each metal.

name of metal	density (g/cm^3)
aluminium	2.83
iron	6.95
lead	11.3

(a) Use the data from the table to identify the metal used to make each block.

A .....

B .....

C ..... [1]

(b) Another metal block is made of brass. Its mass is 200 g.

The density of brass is 8.4 g/cm^3.

Calculate the volume of the brass block.

volume = ... cm^3 [3]

STEM

(c) Describe a method for determining the volume of a small, dense, irregularly-shaped object.

You may draw a labelled diagram.

.....

.....

.....

.....

.....

..... [4]

[Total: 8]

Density Click for more variations

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4(a)	(A =) lead, (B=) iron, (C=) aluminium	**B1**
4(b)	density = mass ÷ volume in any form (V =) M/d	**C1**
	200 ÷ 8.4	**C1**
	24 (cm^3)	**A1**
4(c)	add water to measuring cylinder/note the volume of water added	**B1**
	lower/immerse metal object into water	**B1**
	note new volume of water owtte	**B1**
	subtract new volume from initial volume/determine difference in volumes	**B1**

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5 **(a)** Fig. 3.1 shows a metal block and its dimensions.

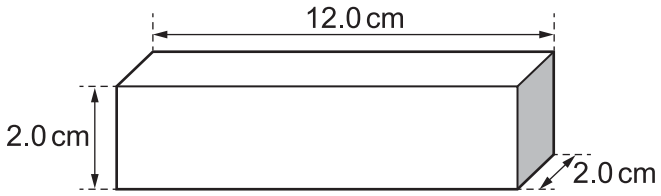


Fig. 3.1 (not to scale)

Calculate the volume of the metal block.

volume of the block = ... cm^3 [2]

(b) A different metal block has a mass of 86 g and a volume of 8.0 cm^3.

(i) Calculate the density ρ of the metal using the equation

$$\rho = \frac{m}{V}.$$

density of metal = ... g/cm^3 [2]

(ii) The metal block is placed in some liquid. The metal block floats on the liquid.

Suggest a value for the density of the liquid.

..... g/cm^3 [1]

(c) A student has a measuring cylinder, a beaker of liquid and a balance.

Describe how the student can use this equipment to determine the density of the liquid.

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

Density Click for more variations

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5(a)	(volume =) 48 (cm^3)	**A2**
	(volume =) l × b × h	**(C1)**
5(b)(i)	11 (g / cm^3)	**A2**
	(density =) 86 ÷ 8.0	**(C1)**
5(b)(ii)	any value greater than **(b)(i)** (g / cm^3)	**B1**
5(c)	any **three** from: measure mass of (empty) measuring cylinder on balance add liquid to measuring cylinder **AND** read volume measure mass of measuring cylinder **AND** liquid on balance find difference in the 2 mass readings	**B3**

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6 A student wants to find the volume of a piece of metal. The student can use any of the items of equipment shown in Fig. 2.1.

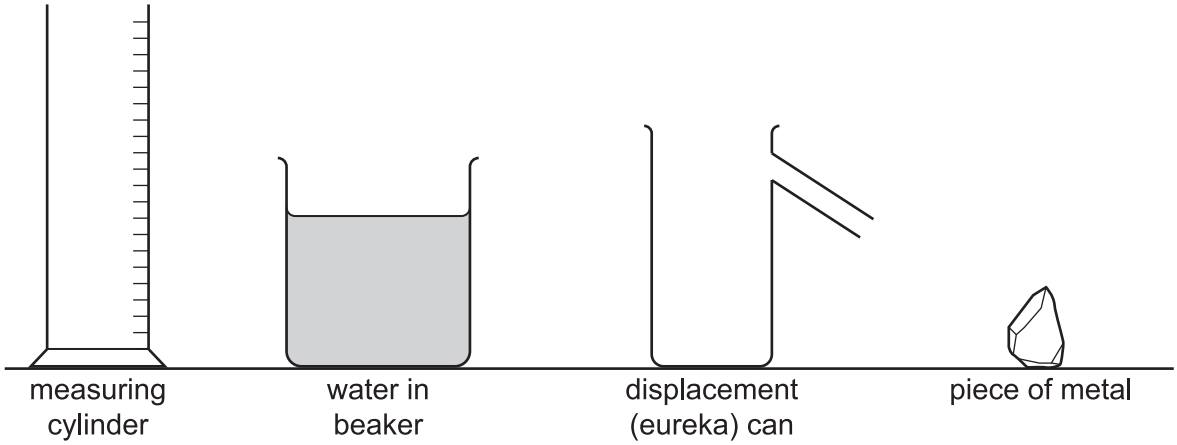


Fig. 2.1

(a) Describe how the student can find the volume of the piece of metal by using equipment from Fig. 2.1.

.....

.....

.....

.....

.....

..... [4]

(b) The volume of a different piece of metal is 30 cm^3. The mass of this piece of metal is 192 g.

Calculate the density of the metal. Include the unit.

density of the metal = ...

unit .....

[4]

[Total: 8]

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Density Click for more variations

6(a)	any **three** from: • measuring cylinder (part) filled with water • volume of water measured or recorded/noted/read • metal submerged / placed in water owtte • new volume read / noted / measured / recorded	**B3**
	volume of metal = difference in volumes	**B1**
6(b)	(ρ =) 6	**A3**
	(ρ =) 192 ÷ 30	(C2)
	(density =) mass ÷ volume **OR** (ρ =) m / V in any form	(C1)
	g / cm^3	**B1**

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7 The IGCSE students are carrying out measurements in order to determine the density of water using two methods.

(a) Method 1

Fig. 1.1 shows an empty measuring cylinder on a balance and Fig. 1.2 shows the measuring cylinder containing water.

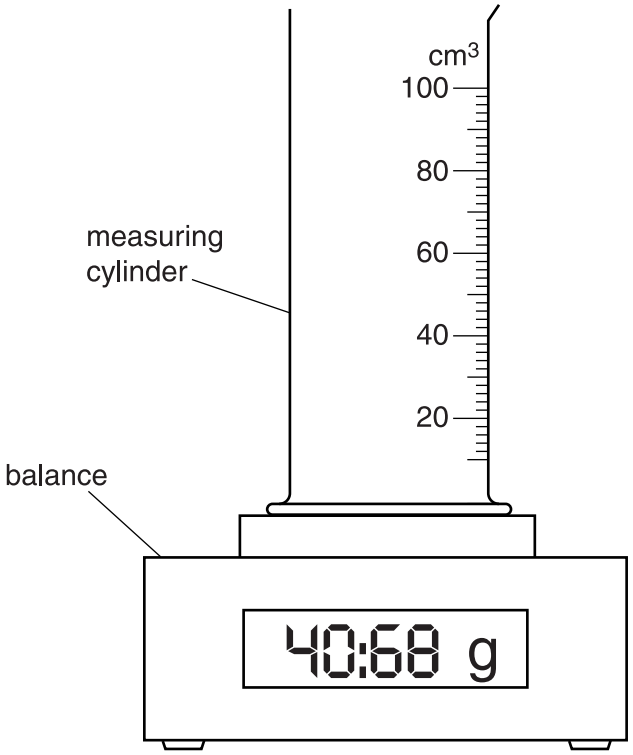


Fig. 1.1

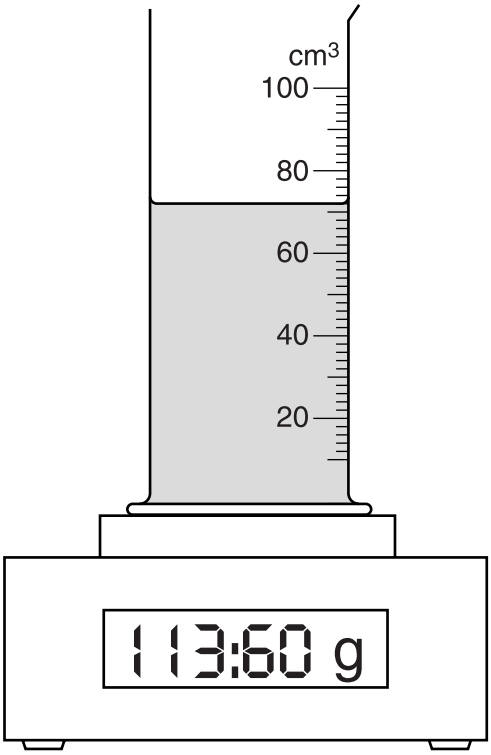


Fig. 1.2

(i) Read and record the mass m_1 of the empty measuring cylinder.

m_1 = ... g

(ii) Read and record the mass m_2 of the measuring cylinder and water.

m_2 = ... g

(iii) Read and record the volume V_1 of water, as shown in Fig. 1.2.

V_1 = ... cm^3

(iv) Calculate a value ρ_1 for the density of water using your readings from **(a)(i)**, **(ii)** and **(iii)** and the equation $\rho_1 = \frac{m_2 - m_1}{V_1}$. Give an appropriate unit.

ρ_1 = ...
[3]

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(b) Method 2

In this method, a test-tube is floated in the water left in the measuring cylinder from Method 1 and the change in water level is measured.

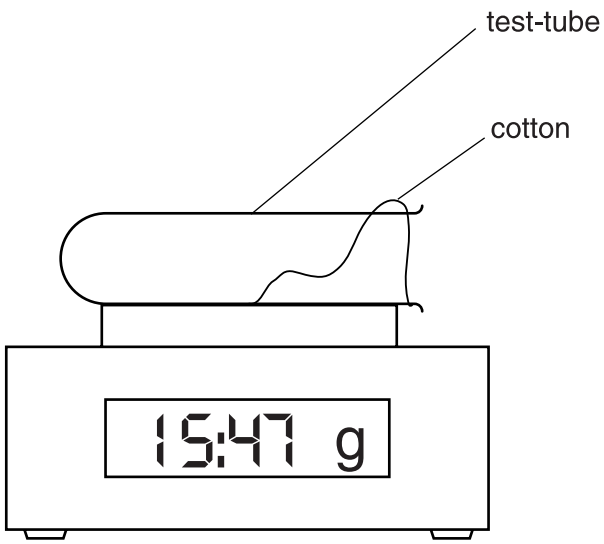


Fig. 1.3

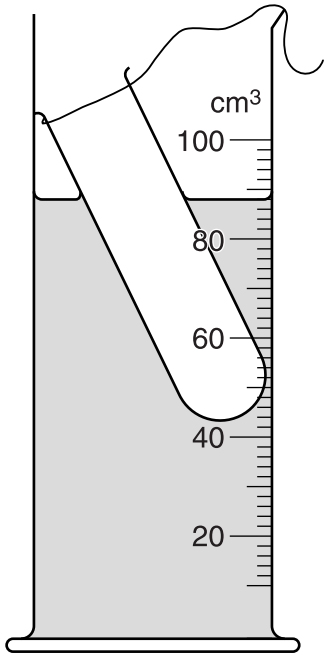


Fig. 1.4

(i) Read and record the mass m_3 of the test-tube, as shown in Fig. 1.3.

m_3 = ...

(ii) The test-tube is carefully lowered, by means of a piece of cotton, into the measuring cylinder until it floats as shown in Fig. 1.4. Read and record the new water level V_2 in the measuring cylinder.

V_2 = ...

(iii) Using your results from **(a)(iii)** and **(b)(ii)**, calculate V_3, the change in the water level, where $V_3 = (V_2 - V_1)$.

V_3 = ...

(iv) Calculate and record a value ρ_2 for the density of water using the equation $\rho_2 = \frac{m_3}{V_3}$.

ρ_2 = ...
[3]

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(c) Calculate an average value ρ_{AV} for the density of water using your results from **(a)(iv)** and **(b)(iv)**.

ρ_{AV} = ... [1]

(d) Suggest a precaution that should be taken in **Method 1** to ensure that the volume reading is as accurate as possible.

.....

.....

.....[1]

(e) Suggest a possible source of experimental inaccuracy in **Method 2**, other than with the volume reading.

State and explain the effect that this would have on your value for ρ_2.

suggestion .....

.....

effect and explanation .....

.....

[2]

[Total: 10]

Density Click for more variations

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7 **(a)(i)(ii)** $m_1 = 40.68\,(g)$ and $m_2 = 113.60\,(g)$
correct answer only (not 40:68, 113:60) [1]

(iii) $V_1 = 72\ (cm^3)$ correct answer only [1]

(iv) ρ_1 with unit of g/cm^3 or kg/m^3 seen in **(a)**, **(b)** or **(c)** and not contradicted
(unit must match value) [1]

(b)(i)(ii) $m_3 = 15.47\,(g)$ and $V_2 = 88\,(cm^3)$ correct answer only [1]

(iii) $V_3 = 16\ (cm^3)$ / ecf [1]

(iv) ρ_2 to 2 / 3 sig. figs. [1]

(c) ρ_{AV} 0.99(1) (g/cm^3) **or** 991 / 990 (kg/m^3) **or** ecf from **(a)** and **(b)** [1]

(d) any one from:
- take reading perpendicularly / at right angles to scale
- read bottom of meniscus
- other suitable precaution [1]

(e) appropriate source of inaccuracy, other than in **(d)**
e.g. balance not at zero / test-tube catches on side of measuring cylinder [1]

matching effect on ρ with explanation
e.g. ρ greater as mass reading larger / ρ greater as volume smaller [1]

[Total: 10]

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8 An aluminium rod is cut into a longer section and a shorter section, as shown in Fig. 4.1.



Fig. 4.1

(a) The shorter section of the rod is placed into a measuring cylinder containing water.

Fig. 4.2 shows the appearance of the measuring cylinder before and after this is done.

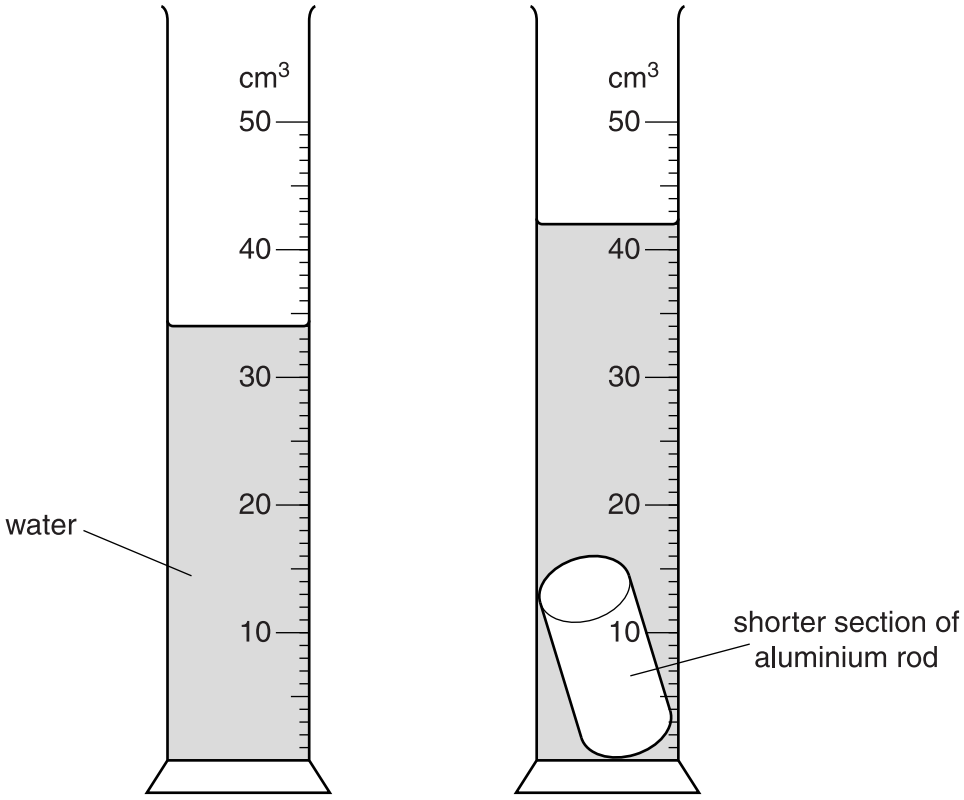


Fig. 4.2 (not full size)

(i) Calculate the volume of the shorter section of aluminium rod.

volume = ... cm^3 [3]

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(ii) The mass of this shorter section is measured as 21.2 g.

1. Name a laboratory instrument that might have been used to measure this mass.

.....[1]

2. Calculate the density of aluminium.

density = ...[4]

(b) (i) Name an instrument that could be used to measure the length of the longer section of aluminium rod.

.....[1]

(ii) Suggest a method, different from that in Fig. 4.2, that could be used to determine the volume of this longer section.

.....

.....

.....

.....[2]

[Total: 11]

Density Click for more variations

8 **(a) (i)** 34 (cm^3) C1
42 (cm^3) C1
8 (cm^3) A1

(ii) **1.** balance (accept spring balance) OR newtonmeter
OR scales NOT scale B1
2. $D = M/V$ in any form C1
21.2 / his 8 C1
2.65 e.c.f. A1
g / cm^3 B1

(b) (i) rule(r) OR vernier/digital calipers IGNORE just calipers B1

(ii) measure diameter / radius / c.s.a. B1
use cylinder formula (need not be quoted) to calculate B1
OR
measure mass B1
use density from (a) in $V = M/D$ B1 [11]

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9 A student determines the density of a block of wood.

(a) Fig. 1.1 shows one face of the block of wood that the student uses.

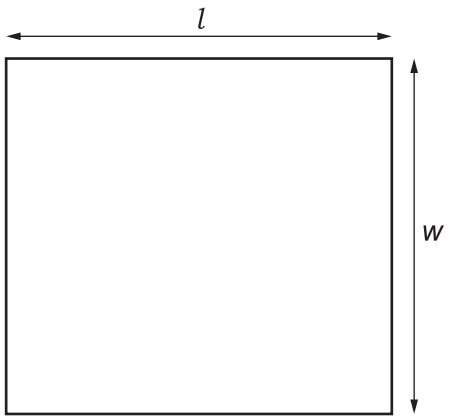


Fig. 1.1

(i) Measure the length l and width w of the block of wood. Fig. 1.1 is drawn actual size.

l = ... cm

w = ... cm
[1]

(ii) The student measures the height h of the block of wood.

h = 4.0 ..... cm

Calculate the volume V of the block of wood using the equation $V = l \times w \times h$.

V = ... cm^3 [1]

(iii) The student measures the mass m of the block of wood on a balance.

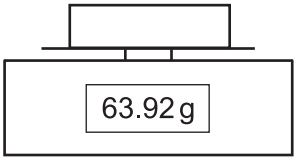


Fig. 1.2

Write down the mass m of the block as shown in Fig. 1.2. Give your answer to the nearest gram.

m = ... g [1]

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(iv) Calculate the density ρ of the wood using the equation $\rho = \frac{m}{V}$. Give your answer to a suitable number of significant figures for this experiment and include the unit.

ρ = ... [2]

(b) The student places the block of wood carefully in water in a glass dish. The wood floats as shown in Fig. 1.3.

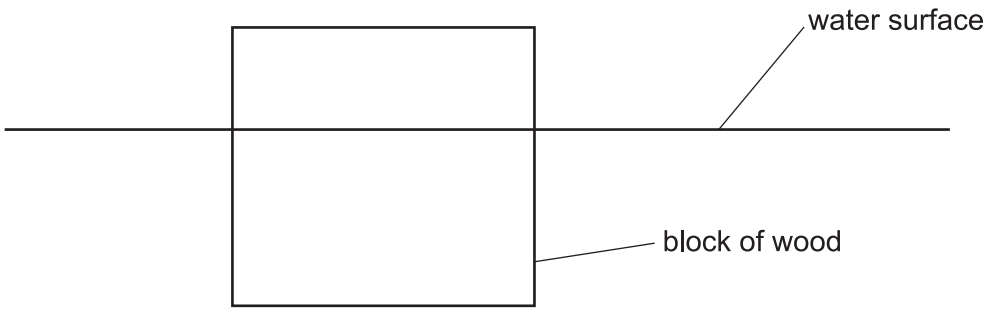


Fig. 1.3

(i) Using Fig. 1.3, estimate, without taking a measurement, the volume V_1 of wood that is below the water surface.

V_1 = ... cm^3 [1]

(ii) Calculate m_W, the mass of water with volume V_1, using the equation $m_W = \rho_W \times V_1$, where $\rho_W = 1.00$ in the same units as ρ in part **(a)(iv)**.

m_W = ... [1]

(c) A student suggests that the mass m of the block of wood should be equal to the mass m_W of the water with volume V_1.

(i) Calculate the difference d between your values of m and m_W.

d = ... [1]

(ii) Discuss whether the difference d is small enough to conclude that $m = m_W$.

.....

.....

..... [1]

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(d) Another student wants to obtain a more accurate value for V_1. He uses the method of floating the block of wood in water as described in **(b)**.

Suggest how the student could obtain a more accurate value by taking a measurement.

.....

.....

..... [2]

[Total: 11]

Density Click for more variations

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9(a)(i)	l = 5.1 (cm) and w = 4.7 (cm)	**1**
9(a)(ii)	V = 95.88 (cm^3)	**1**
9(a)(iii)	64 (g)	**1**
9(a)(iv)	ρ to 2 or 3 significant figures	**1**
	unit g / cm^3	**1**
9(b)(i)	estimate of V_1 given to the nearest cm^3 and > ½V < V	**1**
9(b)(ii)	m_W numerically equal to V_1	**1**
9(c)(i)	d = candidate's **(a)(iii)** – **(b)(ii)** correct	**1**
9(c)(ii)	YES/NO and suitable comparison of d with m or m_W	**1**
9(d)	(float wood and) mark water level / remove and mark the water level	**1**
	measure submerged depth and multiply by the cross-sectional area	**1**
	OR	
	measure height of block that is not submerged	(1)
	multiply by the cross-sectional area then subtract from total volume of block.	(1)
	OR	
	use of a measuring cylinder / displacement can	(1)
	measure the volume of water displaced (by the floating block)	(1)

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10 A student determines the density of a ball.

(a) He places the ball between two wooden blocks, as seen from above in Fig. 1.1.

He takes two measurements, d_1 and d_2.

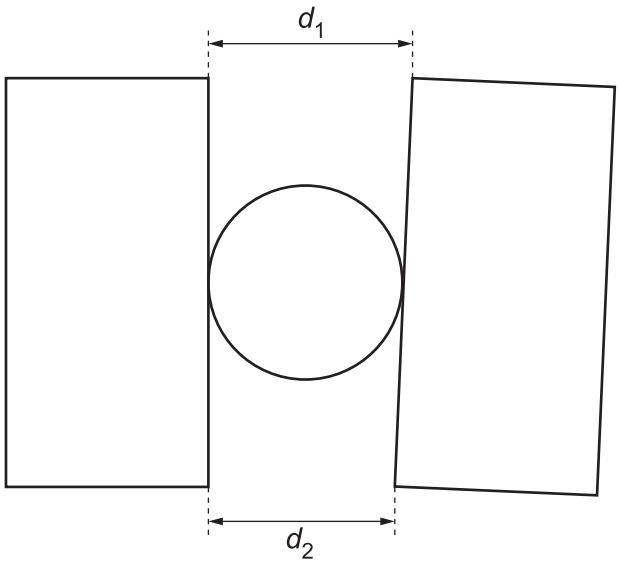


Fig. 1.1

(i) On Fig. 1.1, measure the lengths d_1 and d_2.

d_1 = ... cm

d_2 = ... cm
[1]

(ii) Using your measurements, calculate the diameter d of the ball. Show your working.

d = ... cm [1]

(iii) Explain why this method is used to measure the diameter of the ball.

.....

..... [2]

(b) Calculate the volume V of the ball using the equation $V = 0.52d^3$.

Include the unit.

V = ... [2]

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(c) The student measures the mass m_D of a dish.

m_D = 102.5 g

He places the ball in the dish and measures the combined mass m_C of the dish and the ball.

Fig. 1.2 shows the dish and the ball on a balance.

Record the reading shown on the balance.

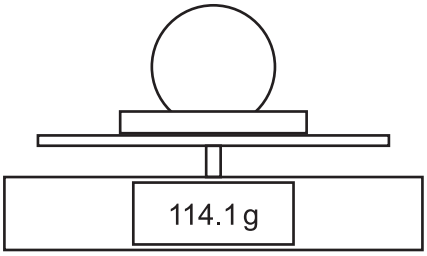


Fig. 1.2

m_C = ... g

Calculate the mass m_B of the ball. Show your working.

m_B = ... g
[2]

(d) Calculate the density ρ of the ball using the equation:

$$\rho = \frac{m_B}{V}.$$

Give your answer to a suitable number of significant figures for this experiment. Include the unit.

ρ = ... [3]

[Total: 11]

Density Click for more variations

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10(a)(i)	two measurements in cm 2.7 and 2.5, both given to nearest mm	**1**
10(a)(ii)	correct average: expect 2.6 (cm)	**1**
10(a)(iii)	any reasonable advantage for the method in the question given **OR** it is difficult to measure the diameter directly **OR** hard to find centre of ball	**1**
	a ruler for measuring the diameter directly would give rise to parallax errors	**1**
10(b)	V = 9.1(4)	**1**
	unit: cm^3	**1**
10(c)	correct **method** for calculation of m_B shown	**1**
	m_B = 11.6 (g)	**1**
10(d)	ρ on answer line correctly calculated to 2 or more significant figures	**1**
	unit: g / cm^3	**1**
	answer given to 2 or 3 significant figures	**1**

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