

- 1 A student determines the density of sand.

Fig. 1.1 shows a beaker with a mark at the 250 cm^3 level.

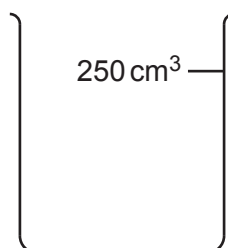


Fig. 1.1

- (a) Estimate the volume of water V_W that the beaker would hold when filled to the top.

$$V_W = \dots\dots\dots \text{ cm}^3 \quad [1]$$

- (b) The student uses string and a metre rule to determine the circumference c of the beaker.

$$c = \dots\dots\dots 21.3 \text{ cm}$$

Explain briefly how to use the string and the metre rule to determine the circumference c as accurately as possible. You may draw a diagram.

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..... [2]

- (c) The student measures the height h of the beaker.

- (i) Show clearly on Fig. 1.1, the height h that he should measure. [1]

His reading is $h = \dots\dots\dots 9.0 \text{ cm}$

- (ii) Calculate the external volume V_B of the beaker using the equation

$$V_B = \frac{hc^2}{12.6}.$$

$$V_B = \dots\dots\dots \text{ cm}^3 \quad [2]$$

(d) The student measures the mass of the beaker on a balance, as shown in Fig. 1.2.

(i) Write down the mass m_B of the beaker, to the nearest gram.

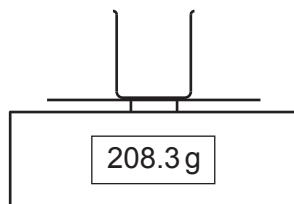


Fig. 1.2

$$m_B = \dots\dots\dots \text{ g [1]}$$

The student fills the beaker to the top with dry sand. He measures the mass m of the beaker containing the sand.

$$m = \dots\dots\dots 724 \text{ g}$$

(ii) Calculate the mass m_S of sand in the beaker. Use the equation $m_S = (m - m_B)$.

$$m_S = \dots\dots\dots \text{ g [1]}$$

(iii) Calculate the density ρ of the sand using the equation

$$\rho = \frac{m_S}{V_B}.$$

Include the unit.

$$\rho = \dots\dots\dots \text{ [2]}$$

(e) The student uses a measuring cylinder to measure the volume of dry sand. Draw a diagram of the measuring cylinder and show the line of sight that the student must use to obtain an accurate volume reading.

[1]

[Total: 11]

[Turn over]

- 2 A student investigates the position of the image in a plane mirror.

Fig. 2.1 shows the ray-trace sheet that the student uses.

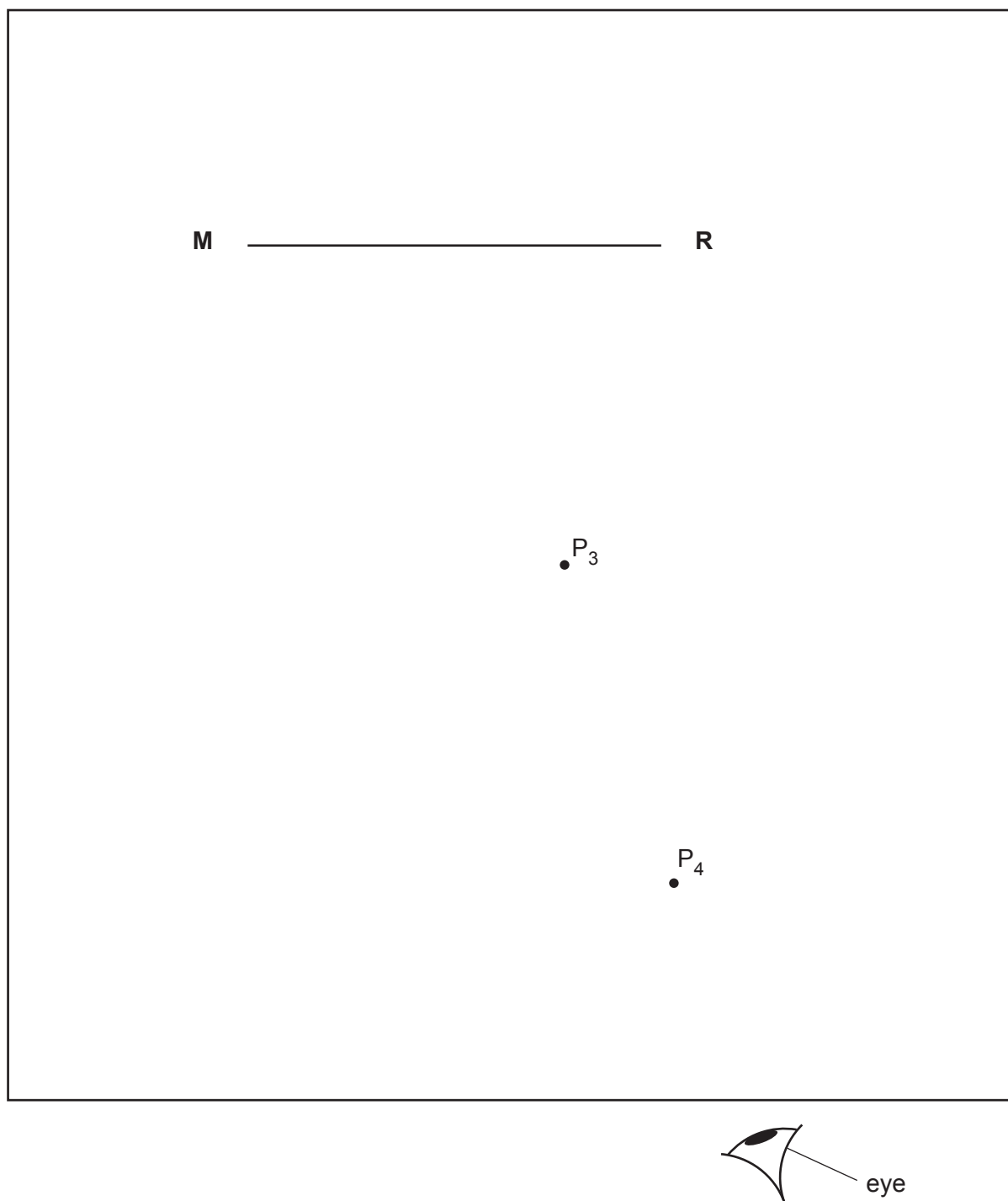


Fig. 2.1

- (a)
- The line **MR** shows the position of a plane mirror. Draw a normal to this line that passes through its centre. Continue the normal so that it reaches the bottom of the ray-trace sheet. Label the normal **NL**. Label the point at which **NL** crosses **MR** with the letter **B**.
 - Draw a line **CD** 5.0 cm below **MR** and parallel to **MR**.
 - Label the point **X** where **CD** crosses **NL**.
 - Draw a line **EF** 5.0 cm below **CD** and parallel to **CD**.
 - Label the point **Y** where **EF** crosses **NL**.

[2]

- (b) Draw a line 7.0 cm long from **B** at an angle of incidence $\theta_1 = 20^\circ$ to the normal below **MR** and to the left of the normal. Label the end of this line **A**. [1]

- (c) The student places two pins, P_1 and P_2 , on line **AB**. Suggest a suitable distance x between the pins for this type of ray-trace experiment.

$$x = \dots\dots\dots [1]$$

- (d) The student views the images of pins P_1 and P_2 from the direction indicated by the eye in Fig. 2.1. She places pin P_3 on line **CD** so that the images of P_2 and P_1 appear exactly behind pin P_3 .

She places pin P_4 on line **EF** so that pin P_3 , and the images of P_2 and P_1 , all appear exactly behind pin P_4 . The positions of P_3 and P_4 are shown on Fig. 2.1.

- (i) Measure and record the distance a from **X** to P_3 .

$$a = \dots\dots\dots [1]$$

- (ii) Measure and record the distance b from **Y** to P_4 .

$$b = \dots\dots\dots [1]$$

- (iii) Calculate $\frac{a}{b}$.

$$\frac{a}{b} = \dots\dots\dots [1]$$

- (e) The student repeats the procedure using an angle of incidence $\theta_2 = 40^\circ$. She records the new values of a and b .

$$a = \dots\dots\dots 4.2 \text{ cm}$$

$$b = \dots\dots\dots 8.3 \text{ cm}$$

Calculate the new value $\frac{a}{b}$.

$$\frac{a}{b} = \dots\dots\dots [2]$$

- (f) State and explain whether the two values of $\frac{a}{b}$ can be considered to be equal in this experiment.

.....
 [1]

- (g) A student carries out this experiment with care. Suggest a practical reason why the results may **not** be accurate.

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 [1]

[Total: 11]

3 A student investigates resistance.

Fig. 3.1 shows the circuit used.

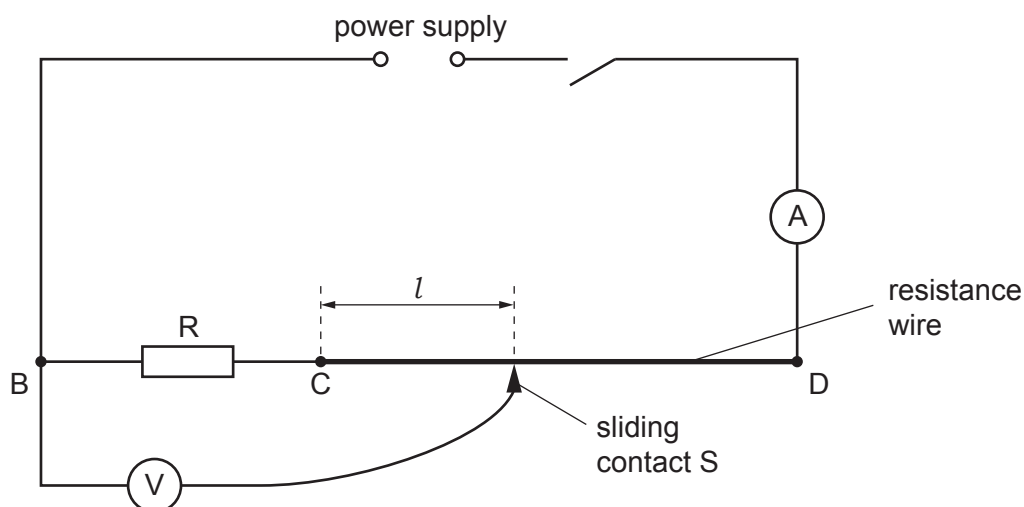


Fig. 3.1

(a) The student measures the current I in the circuit.

He places the sliding contact S at C and measures the potential difference (p.d.) V_1 across the resistor R.

The voltmeter and ammeter are shown in Fig. 3.2 and Fig. 3.3.

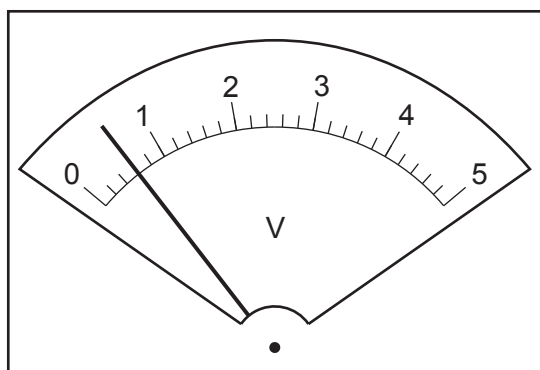


Fig. 3.2

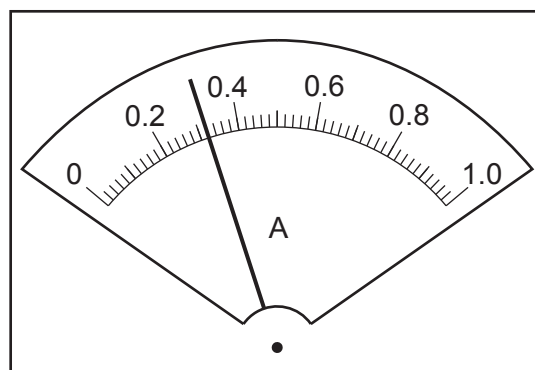


Fig. 3.3

- (i) Write down the readings.
Include the units for potential difference, current or resistance where appropriate in all parts of the question.

$$V_1 = \dots\dots\dots$$

$$I_1 = \dots\dots\dots$$

[2]

- (ii) Calculate the resistance R_1 of the resistor using the equation $R_1 = \frac{V_1}{I_1}$.

$$R_1 = \dots\dots\dots$$

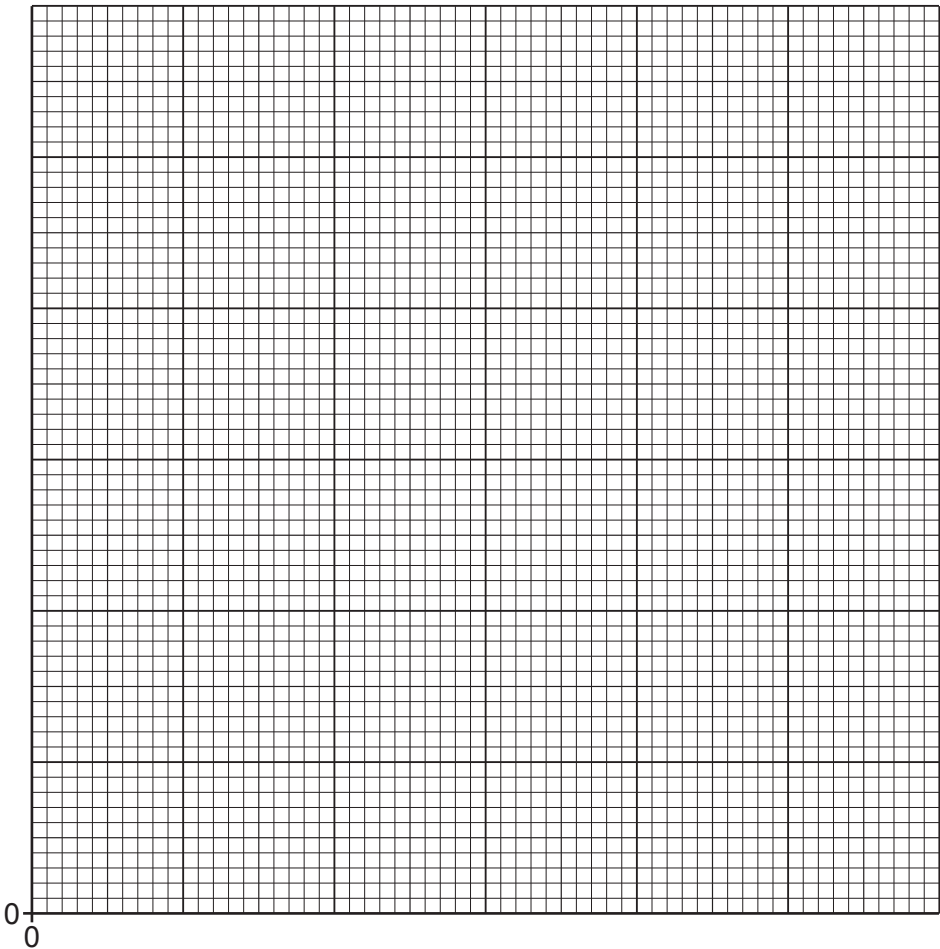
[2]

- (b) The student disconnects the voltmeter from terminal B and connects the voltmeter to terminal C. He places the sliding contact S at a distance $l = 20.0\text{ cm}$ from C. He records, in Table 3.1, the reading on the voltmeter. He repeats the procedure using $l = 40.0\text{ cm}$, 60.0 cm , 80.0 cm and 100.0 cm . His readings are shown in Table 3.1.

Table 3.1

l/cm	V/V
20.0	0.4
40.0	0.8
60.0	1.1
80.0	1.5
100.0	1.9

Plot a graph of V/V (y -axis) against l/cm (x -axis). Start both axes at the origin (0,0).



[4]

- (c) Use your value of V_1 from (a)(i) to find the length l_R of resistance wire that has the same resistance as resistor R. Show clearly on the graph how you obtained the necessary information.

$l_R = \dots\dots\dots$ cm [2]

- (d) The resistance of the resistance wire is proportional to its length. Estimate the resistance of 100 cm of the resistance wire.

estimate $\dots\dots\dots$ [1]

[Total: 11]

- 4 A student investigates springs made from different metals.

Plan an experiment to investigate the extension of springs made from different metals.

The following apparatus is available:

boss, clamp and stand
metre rule
springs made from different metals
selection of loads with hangers.

You can also use other apparatus and materials that are usually available in a school laboratory.

In your plan, you should:

- write a list of suitable metals for the springs
- draw a diagram of the set up you would use
- explain briefly how to carry out the investigation
- state the key variables to keep constant
- draw a table, or tables, with column headings, to show how to display your readings (you are **not** required to enter any readings in the table)
- explain how you would use the readings to reach a conclusion.

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