

1 A student investigates the balancing of a metre ruler.

Fig. 1.1 shows the set-up.

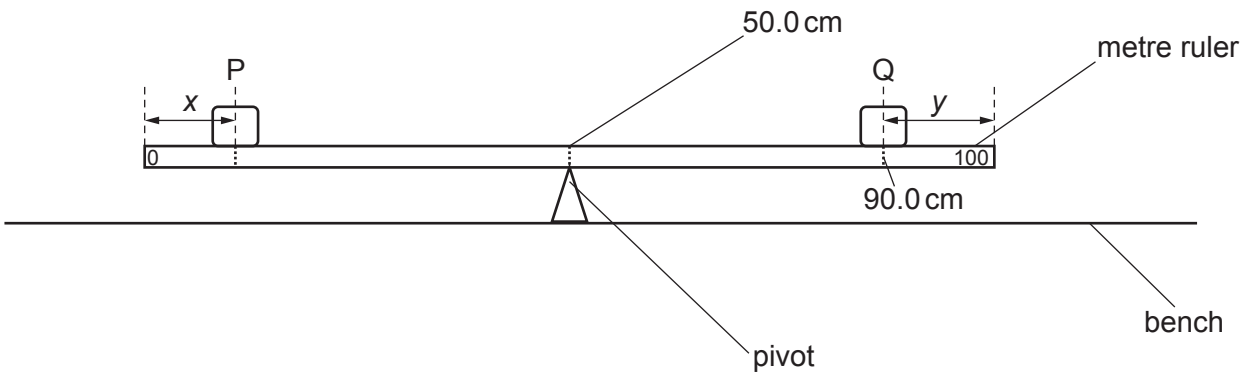


Fig. 1.1

- (a) The student places the metre ruler on the pivot at the 50.0 cm mark with the scale of the ruler facing upwards.
 He places an object Q with its centre on the metre ruler at the 90.0 cm mark.

Calculate the distance y from the centre of Q to the 100.0 cm end of the ruler.

$y = \dots\dots\dots$ cm [1]

- (b) The student places a load P of weight $P = 2.0\text{ N}$ on the metre ruler.
 He adjusts the position of the load so that the metre ruler is as near as possible to being balanced. He measures the distance x from the centre of P to the zero end of the ruler.

He repeats the procedure using loads of weight $P = 3.0\text{ N}$, 4.0 N , 5.0 N and 6.0 N . The values of P and x are shown in Table 1.1.

Table 1.1

P/N	x/cm
2.0	10.2
3.0	23.1
4.0	30.0
5.0	33.8
6.0	36.8

Describe the main difficulty that a student has when doing this experiment as accurately as possible.

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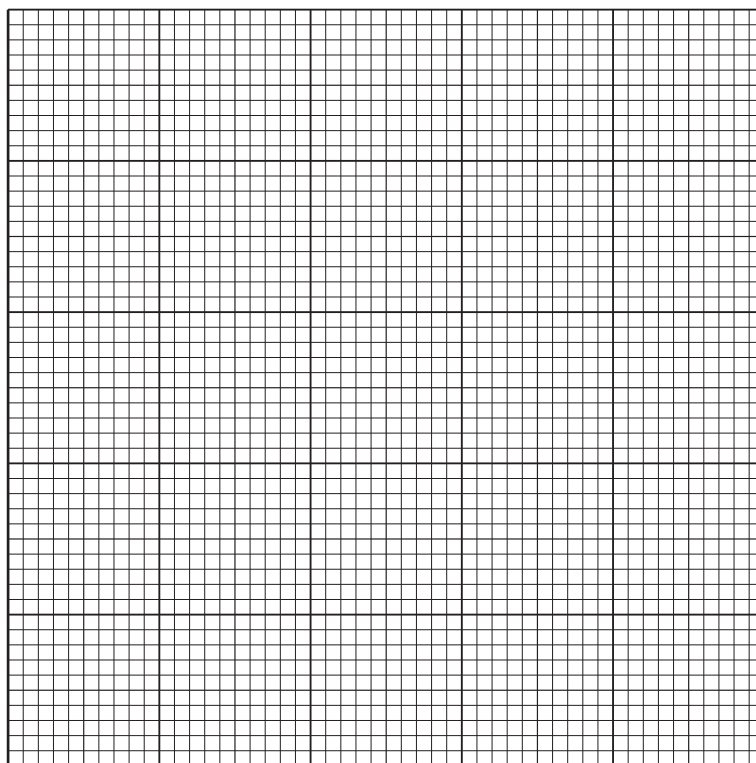
.....

..... [1]

3

- (c) Plot a graph of P/N (y -axis) against x/cm (x -axis).

Draw the best-fit line.



[4]

- (d) Use the graph to find the value of x required to balance the ruler when $P = 3.5\text{ N}$. Show clearly on the graph how you determined the value of x .

$x = \dots\dots\dots$ [3]

- (e) Using apparatus from Fig. 1.1, explain briefly how you would determine the position of the centre of mass of the ruler.

.....

..... [2]

[Total: 11]

- 2 A student investigates the cooling of water under different conditions.

Fig. 2.1 shows the set-up.

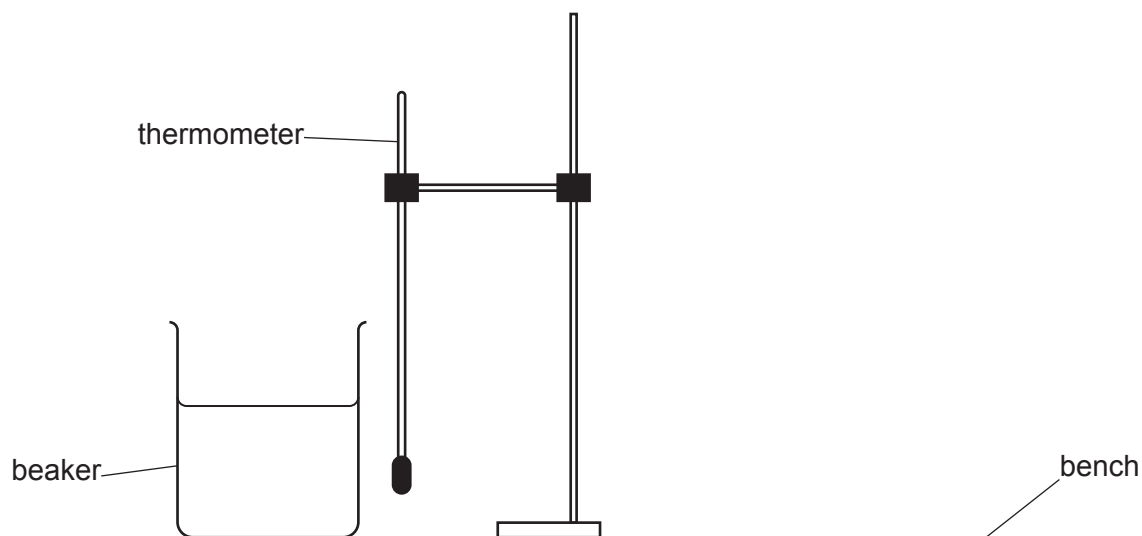


Fig. 2.1

- (a) The thermometer in Fig. 2.2 shows the room temperature θ_R at the beginning of the experiment. Record θ_R .

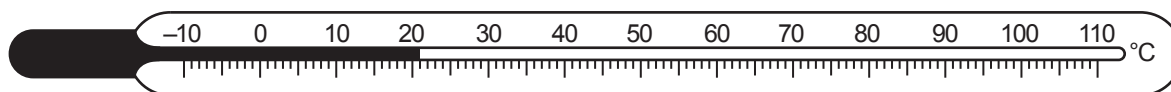


Fig. 2.2

$\theta_R = \dots\dots\dots$ [1]

- (b) The student pours 200 cm^3 of hot water into the beaker.

She records the temperature θ of the hot water at time $t = 0$. She immediately starts a stop-watch.

She continues recording the temperature at 30 s intervals. The temperature readings are shown in Table 2.1.

- (i) Complete the column headings in Table 2.1. [1]
- (ii) Complete the first column of Table 2.1.

Table 2.1

$t/$	$\theta/$
	92
	84
	78
	74
	71
	69
	67

[1]

- (c) (i) Calculate the decrease in temperature $\Delta\theta$ between $t = 0$ and $t = 180\text{ s}$.

$$\Delta\theta = \dots\dots\dots [1]$$

- (ii) Calculate the average rate of cooling R of the water using the equation $R = \frac{\Delta\theta}{\Delta t}$, where $\Delta t = 180\text{ s}$. Include the unit.

$$R = \dots\dots\dots [2]$$

- (d) A student states that the average rate of cooling of the water decreases as the temperature comes nearer to room temperature.

- (i) Suggest **one** change to the experiment that you could make to test the statement.

.....

..... [1]

- (ii) Suggest how to display the results to make it easier to see the trend in the rate of cooling.

.....

.....

..... [2]

- (e) Explain briefly why it is good practice to read the thermometer scale at right angles.

.....
..... [1]

- (f) The student uses a measuring cylinder to measure 200 cm^3 of hot water. She reads the scale at right angles.

Suggest another precaution to obtain an accurate reading of the volume of the water.

.....
..... [1]

[Total: 11]

- 3 A student investigates the refraction of light using a semicircular transparent block.

Fig. 3.1 and Fig. 3.2 show his ray-trace sheet.

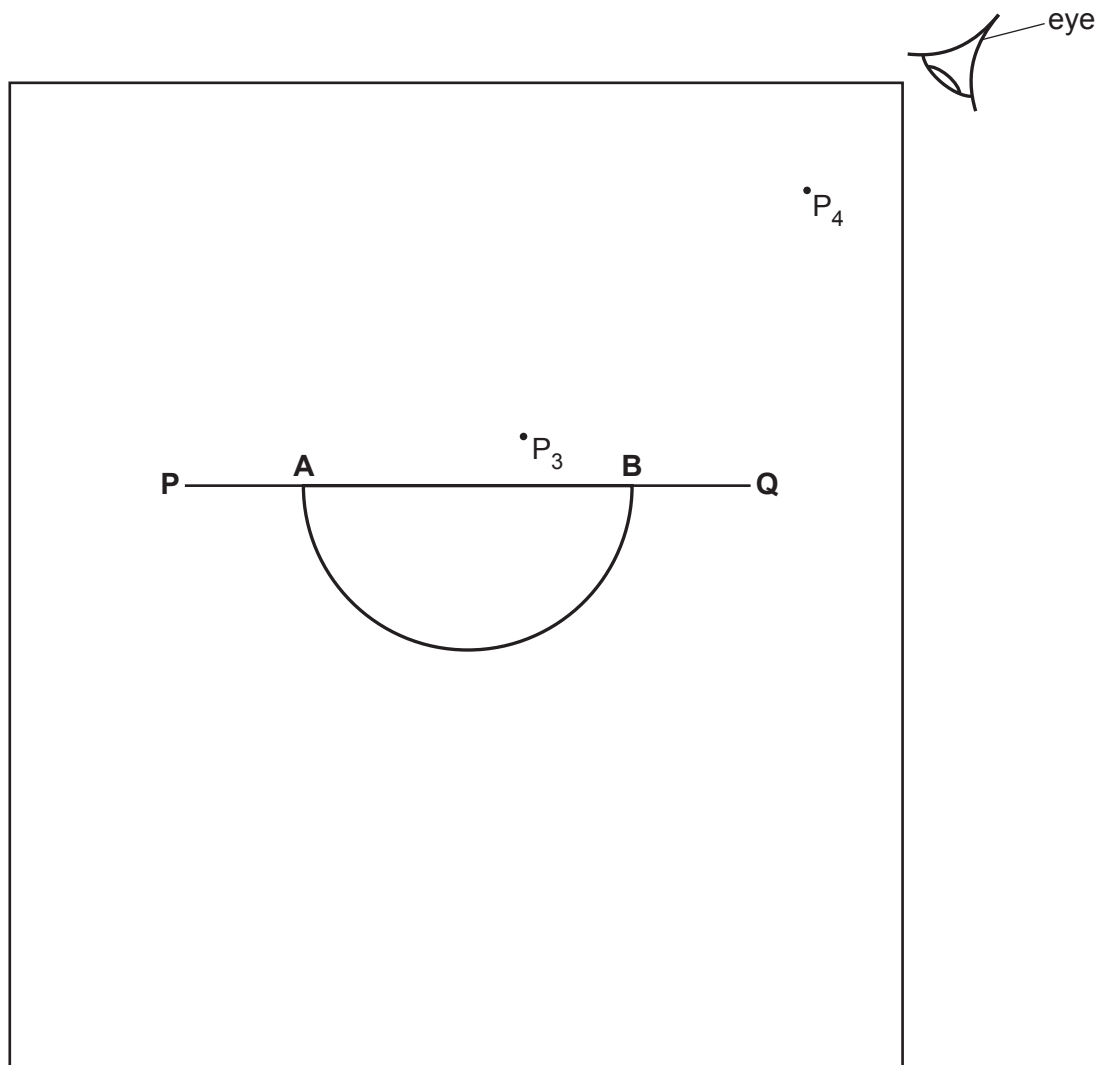


Fig. 3.1

- (a) • On Fig. 3.1, draw the normal **NL** through the centre of **AB**.
 • Continue the normal so that it passes through the curved side of the block.
 • Label the normal **NL**.
 • Label the point **C** where the normal **NL** crosses **AB**. [1]
- (b) (i) Draw a line **DC**, below line **PC**, at an angle $i = 30^\circ$ to the normal and to the left of the normal. [1]
- (ii) • Mark with neat crosses (X) the positions for two pins on line **DC** at a suitable distance apart for this type of ray-trace experiment.
 • Label the positions P_1 and P_2 . [1]

- (c) The student looks from the position of the eye shown in Fig. 3.1, to observe the images of P_1 and P_2 through side **AB** of the block.
He adjusts his line of sight until the images of P_1 and P_2 appear one behind the other.

He places two pins, P_3 and P_4 , between his eye and the block so that P_3 , P_4 , and the images of P_1 and P_2 seen through the block, appear one behind the other.

The positions of P_3 and P_4 are shown on Fig. 3.1.

- (i) • Draw a line joining the positions of P_3 and P_4 . Continue the line to **AB**.
• Label **E**, the end of the line furthest from **AB**.

[1]

- (ii) Measure the acute angle α between the line **NL** and the line **CE**. (An acute angle is less than 90° .)

$$\alpha = \dots\dots\dots^\circ \quad [2]$$

- (d) State **one** precaution that you would take in order to produce an accurate ray trace.

.....
..... [1]

- (e) The student moves the transparent block to a new position on the ray-trace sheet, as shown in Fig. 3.2.

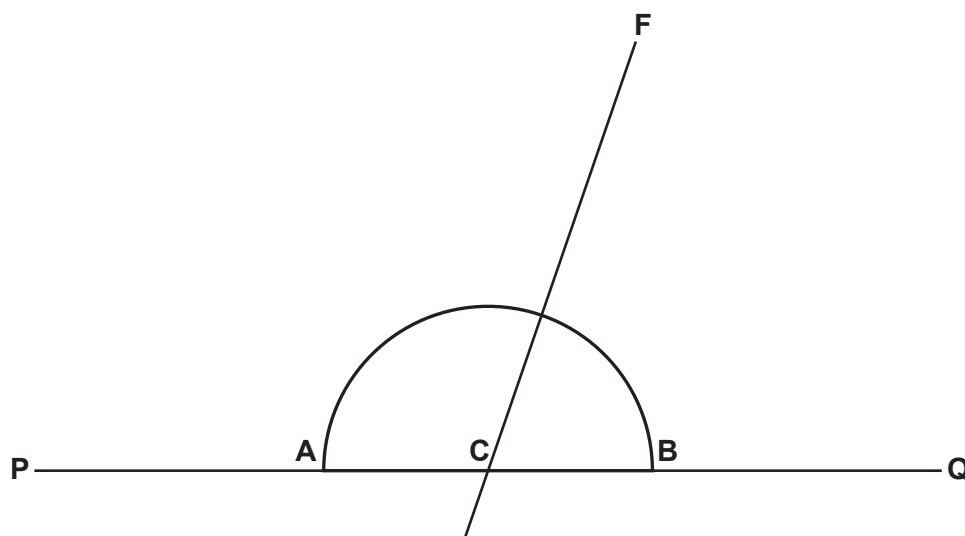


Fig. 3.2

He places pins P_1 and P_2 on line **DC** in the same positions used in (b)(ii).
He observes the images of P_1 and P_2 through the curved side of the block.

He places pins P_5 and P_6 between his eye and the block so that P_5 , P_6 , and the images of P_1 and P_2 seen through the block, appear one behind the other.

He draws a line **CF** through the positions of P_5 and P_6 .

- (i) Measure the acute angle β between the line **AB** and the line **CF**. (An acute angle is less than 90° .)

$$\beta = \dots\dots\dots^\circ \quad [1]$$

(ii) Calculate the angle θ between line **CF** and the normal to line **AB**. Show your working.

$$\theta = \dots\dots\dots^\circ \quad [2]$$

(f) A student suggests that angle α should be equal to angle θ . State whether your results support the suggestion and justify your answer with reference to the results.

statement

justification

.....

..... [1]

[Total: 11]

- 4 A student investigates the change in resistance of a lamp filament when the current in the lamp is increased.

The following apparatus is available:

- a power supply
- a low-voltage filament lamp
- an ammeter
- a voltmeter
- connecting wires.

Other apparatus normally found in a school laboratory is also available.

Plan an experiment to investigate the change in resistance of the lamp filament when the current in the lamp is increased.

Resistance R is given by the equation $R = \frac{V}{I}$, where V is the potential difference (p.d.) across the lamp and I is the current in the lamp.

You should:

- draw a diagram of the circuit used
- explain briefly how to do the investigation, including how to change the current
- 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 to use your readings to reach a conclusion.

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