

2

1 In this experiment, you will investigate the balancing of a metre ruler.

Carry out the following instructions, referring to Fig. 1.1.

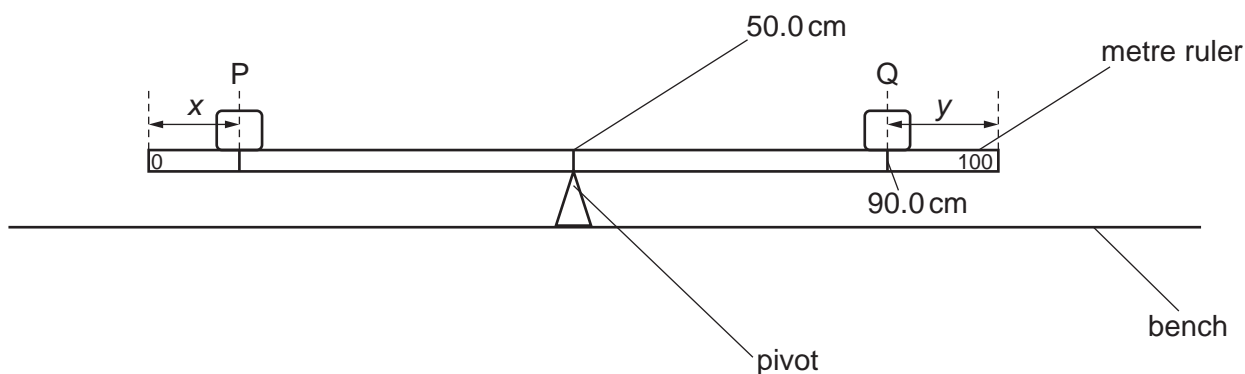


Fig. 1.1

- (a)
- Place the metre ruler on the pivot at the 50.0 cm mark with its scale facing upwards.
 - Place the object Q with its centre on the metre ruler at the 90.0 cm mark.

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

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

- (b)
- Place a load P of weight $P = 2.0\text{ N}$ on the metre ruler.
 - Adjust the position of P so that the metre ruler is as near as possible to being balanced.

(i) Measure, and record in Table 1.1, the distance x from the centre of P to the zero end of the ruler. Record the weight P . [1]

(ii) Repeat the steps above, using loads of weight $P = 3.0\text{ N}$, 4.0 N , 5.0 N and 6.0 N .

Record all the values of P and x in Table 1.1. Ensure that the position of object Q on the metre ruler does **not** change.

Table 1.1

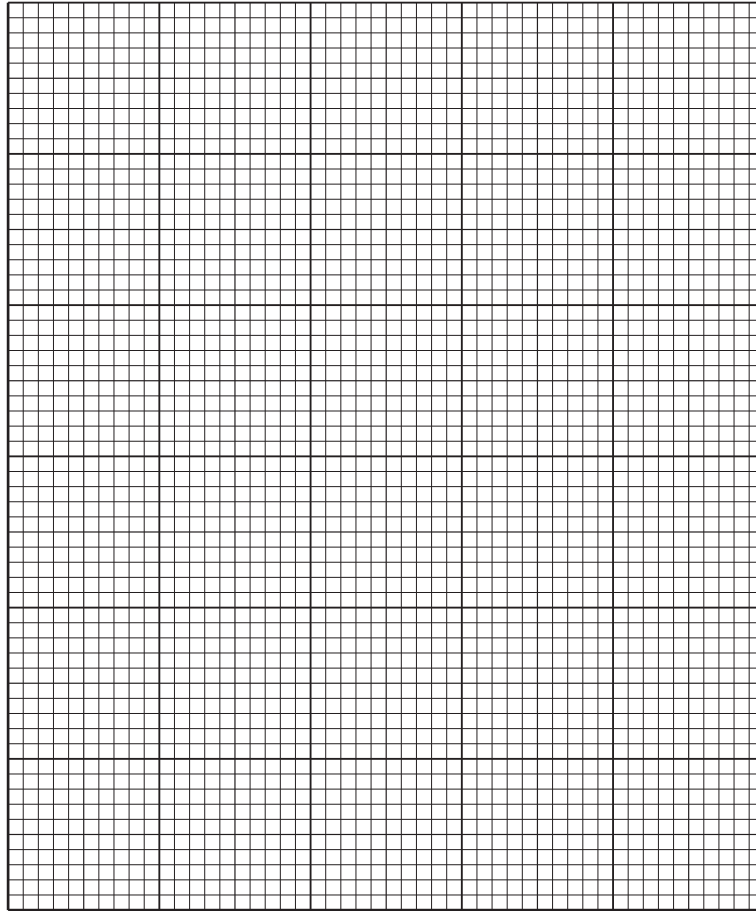
P/N	x/cm

[3]

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 .

$x = \dots\dots\dots \text{ cm}$ [2]

[Total: 11]

4

2 In this experiment, you will investigate the cooling of water.

Carry out the following instructions, referring to Fig. 2.1.

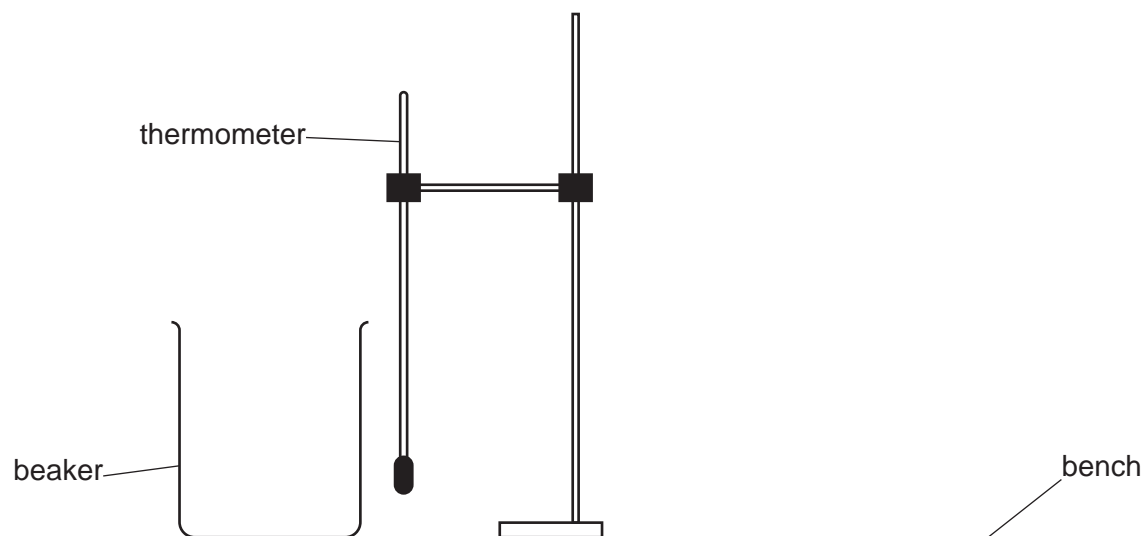


Fig. 2.1

(a) Use the thermometer to measure the room temperature θ_R .

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

(b) (i) Pour 200 cm^3 of hot water into the beaker. Place the thermometer in the hot water in the beaker.

Record in Table 2.1 the temperature θ of the hot water at time $t = 0$. Immediately start the stop-watch.

Continue recording the temperature in Table 2.1 at 30s intervals until you have seven sets of readings. [2]

(ii) Complete the column headings in Table 2.1.

Table 2.1

$t/$	$\theta/$
0	
30	
60	
90	
120	
150	
180	

[1]

- (c) (i) Calculate the decrease in temperature $\Delta\theta$ between $t = 0$ and $t = 180$ 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 $\Delta t = 180$ 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]

[Total: 11]

3 In this experiment, you will investigate the refraction of light using a semicircular transparent block.

Carry out the following instructions using the separate ray-trace sheet provided. You may refer to Fig. 3.1 and Fig. 3.2 for guidance.

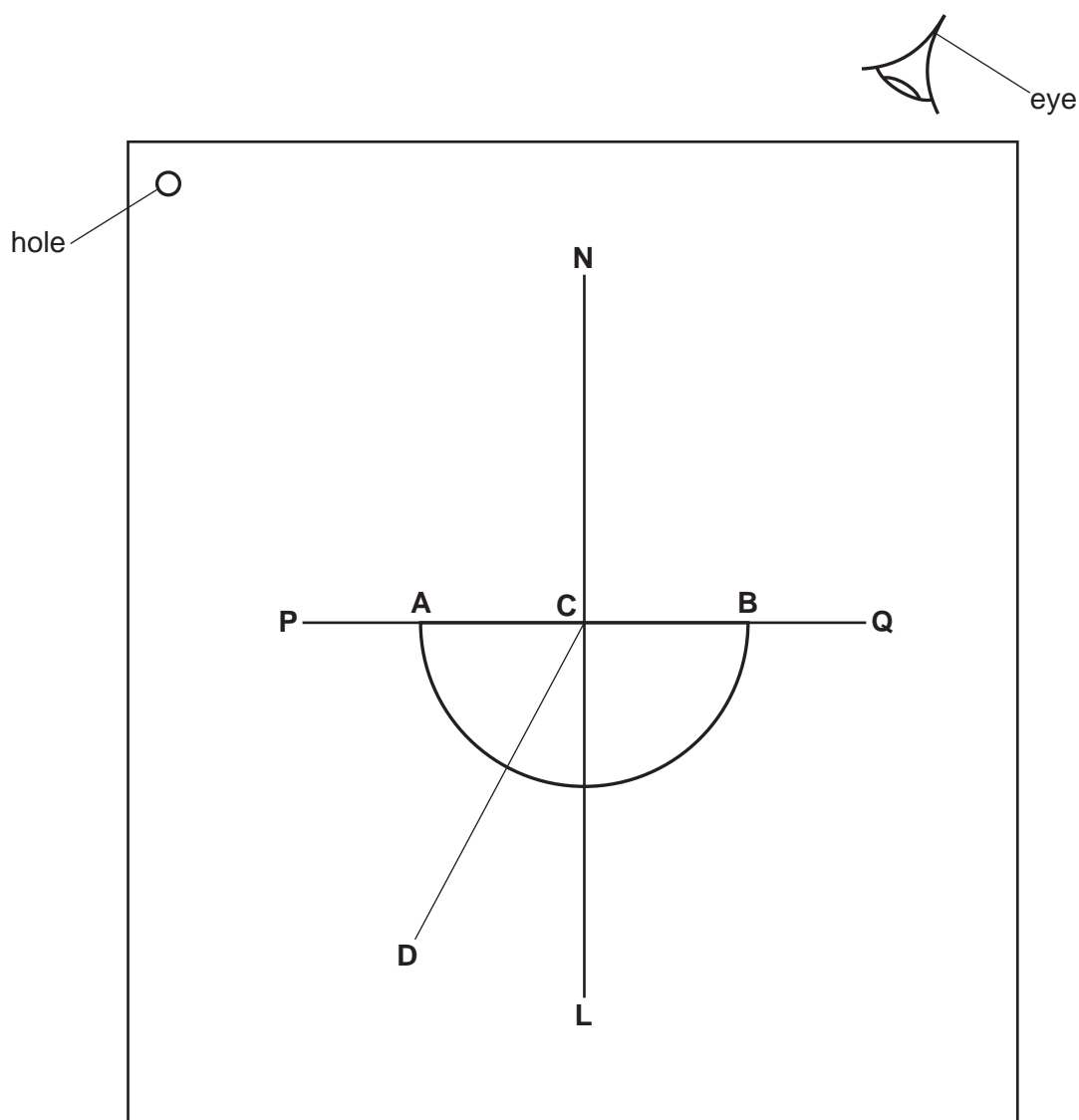


Fig. 3.1

- (a)
- Draw a line across the ray-trace sheet supplied, approximately in the middle. Label the line **PQ**.
 - Place the transparent block, largest face down, with the straight side on the line **PQ** and the curved side below the line.
 - Draw round the outline of the block. Label the ends of the straight side of the block **A** and **B**.
 - Remove the block and 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 point **C** where the normal **NL** crosses **AB**.

[1]

- (b)
- Draw the line **DC** at an angle $i = 30^\circ$ to the normal, as shown in Fig. 3.1.
 - Place the paper on the pin board.
 - Place two pins, P_1 and P_2 , on line **DC** at a suitable distance apart for this experiment.
 - Replace the block and look 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. Adjust your line of sight until the images of P_1 and P_2 appear one behind the other.
 - Place two pins, P_3 and P_4 , between your 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.
 - Label the positions of P_1 , P_2 , P_3 and P_4 .
 - Remove the block and the pins.
 - 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**.

[3]

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

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

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

.....

..... [1]

(e) Place the transparent block on the ray-trace sheet in the position shown in Fig. 3.2.

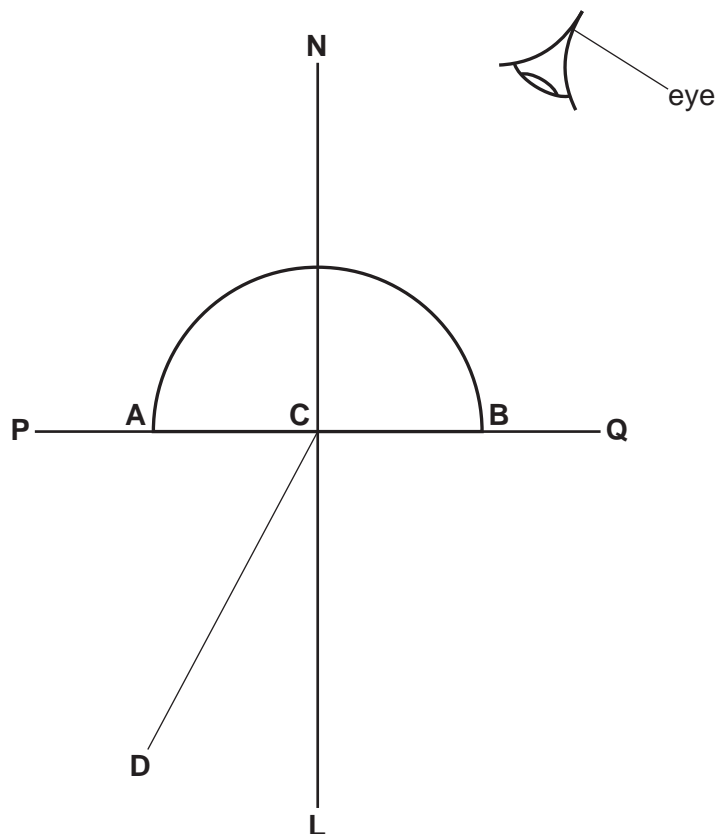


Fig. 3.2

- Replace pins P_1 and P_2 on line **DC** in the same positions used in (b).
- Observe the images of P_1 and P_2 through the curved side of the block. Adjust your line of sight until the images of P_1 and P_2 appear one behind the other.
- Place two pins, P_5 and P_6 , between your 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.
- Label the positions of P_5 and P_6 .
- Remove the block and the pins.
- Draw a line joining the positions of P_5 and P_6 . Continue the line to **AB**.
- Label **F**, the end of the line furthest from **AB**.

[2]

(f) Measure the acute angle θ between the line **NL** and the line **CF**. (An acute angle is less than 90° .)

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

[Total: 11]

Tie your ray-trace sheet into this question booklet between pages 8 and 9.

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- 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 are **not** required to do this investigation.

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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