



# **Cambridge IGCSE™ (9–1)**

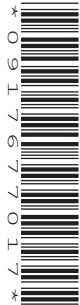
CANDIDATE  
NAME

CENTRE  
NUMBER

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## **PHYSICS**

**0972/61**

Paper 6 Alternative to Practical

**May/June 2023**

**1 hour**

You must answer on the question paper.

No additional materials are needed.

### **INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

### **INFORMATION**

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **12** pages. Any blank pages are indicated.

1 A student investigates the balancing of a metre ruler.

Fig. 1.1 shows the set-up.

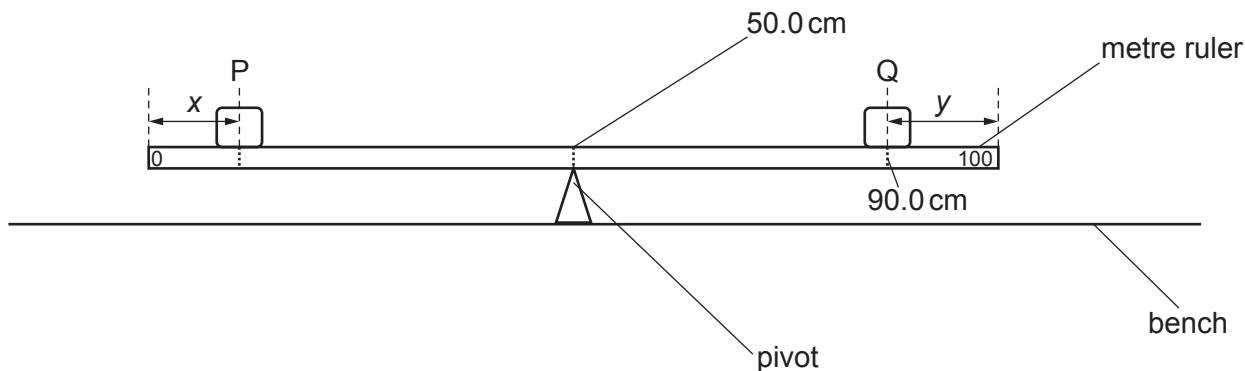


Fig. 1.1

(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.

$$y = \dots \text{ cm} \quad [1]$$

(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  $P = 3.0 \text{ N}$ ,  $4.0 \text{ N}$ ,  $5.0 \text{ N}$  and  $6.0 \text{ N}$ . The values of  $P$  and  $x$  are shown in Table 1.1.

Table 1.1

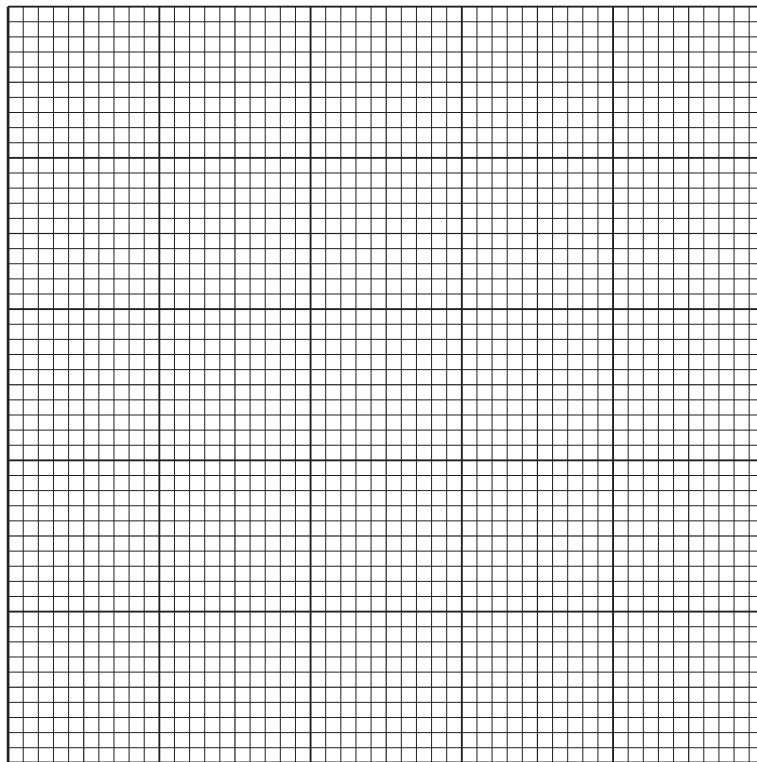
$P/\text{N}$	$x/\text{cm}$
2.0	10.2
3.0	23.1
4.0	30.0
5.0	33.8
6.0	36.8

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

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

(c) Plot a graph of  $P/N$  (y-axis) against  $x/\text{cm}$  (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  $x$ .

$x = \dots$  [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.

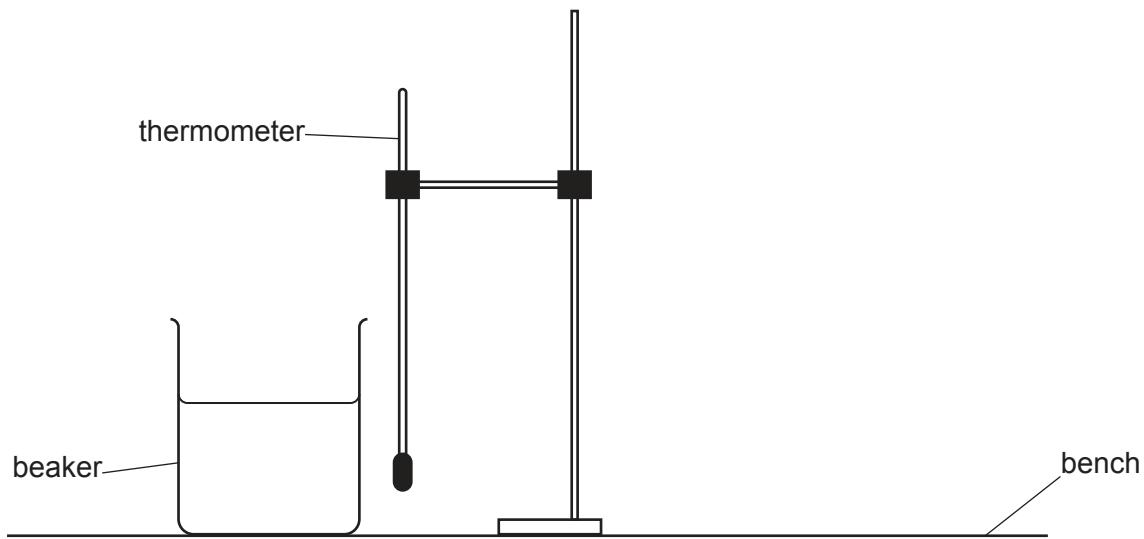


Fig. 2.1

(a) The thermometer in Fig. 2.2 shows the room temperature  $\theta_R$  at the beginning of the experiment. Record  $\theta_R$ .

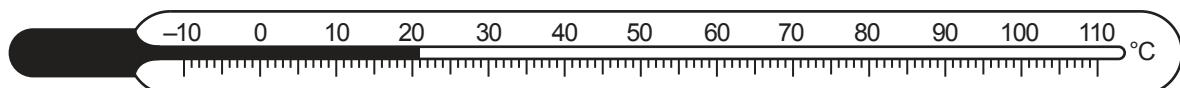


Fig. 2.2

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

(b) The student pours 200 cm<sup>3</sup> of hot water into the beaker.

She records the temperature  $\theta$  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**

$t/\text{s}$	$\theta/\text{°C}$
	92
	84
	78
	74
	71
	69
	67

[1]

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

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

(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.

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

(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  $200\text{ cm}^3$  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.

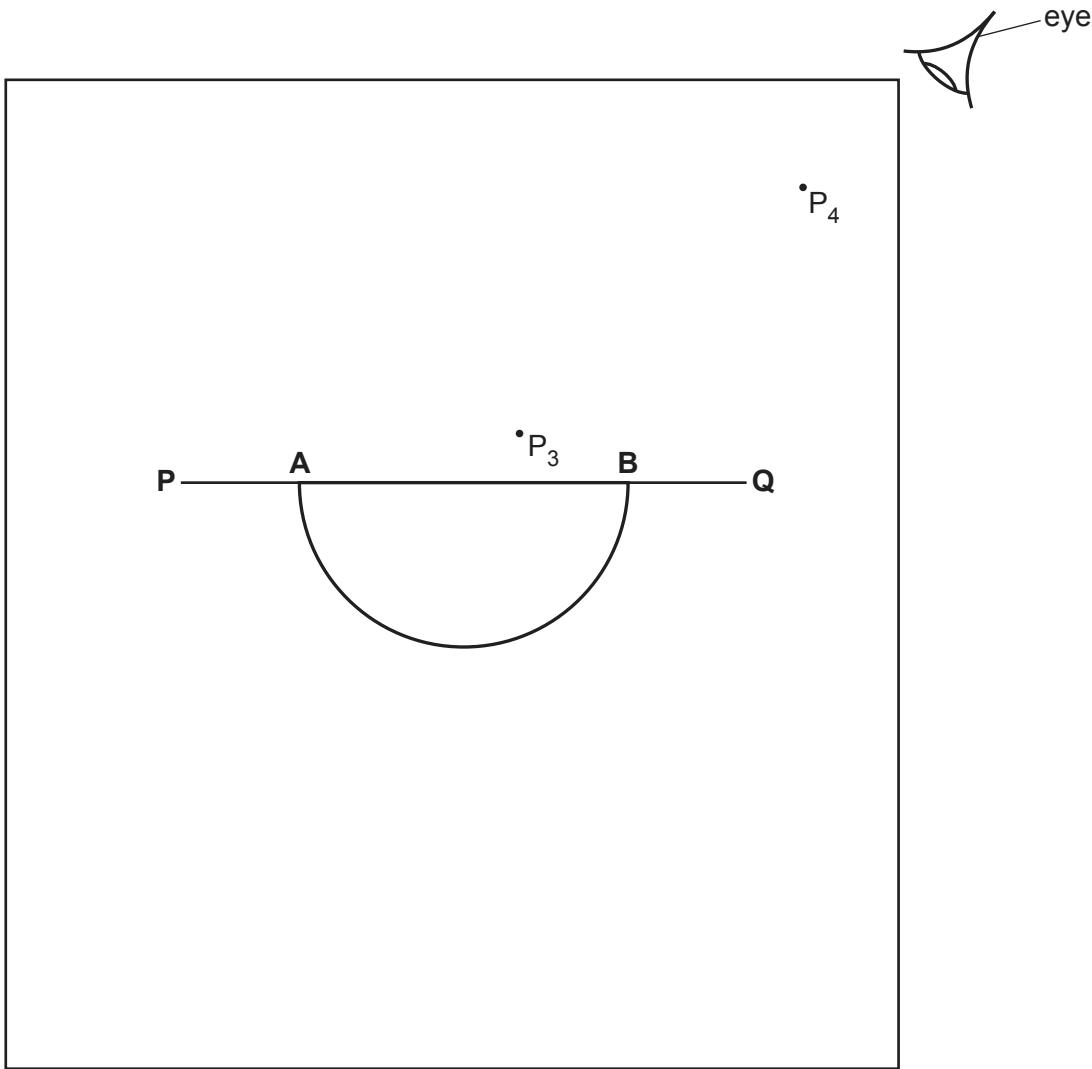


Fig. 3.1

(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<sub>1</sub>** and **P<sub>2</sub>**. [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  $\alpha$  between the line **NL** and the line **CE**. (An acute angle is less than  $90^\circ$ .)

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

(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.

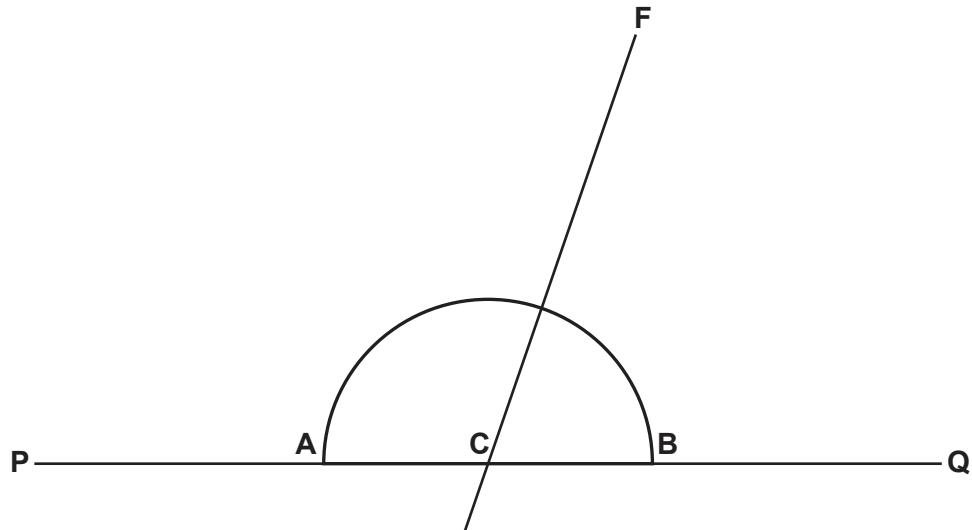


Fig. 3.2

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  $\beta$  between the line **AB** and the line **CF**. (An acute angle is less than  $90^\circ$ .)

$$\beta = \dots \text{ } [1]$$

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

$$\theta = \dots \text{ } ^\circ \text{ [2]}$$

(f) A student suggests that angle  $\alpha$  should be equal to angle  $\theta$ . 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.

[7]

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