Cambridge Assessment International Education

# Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

*2059024464*

**PHYSICS** **5054/42**

Paper 4 Alternative to Practical **October/November 2022**

**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 30.
- The number of marks for each question or part question is shown in brackets [ ].

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


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**1** A student measures the resistance $R$ of a lamp for different values of the potential difference $V$ across it.

The student connects the circuit shown in Fig. 1.1.

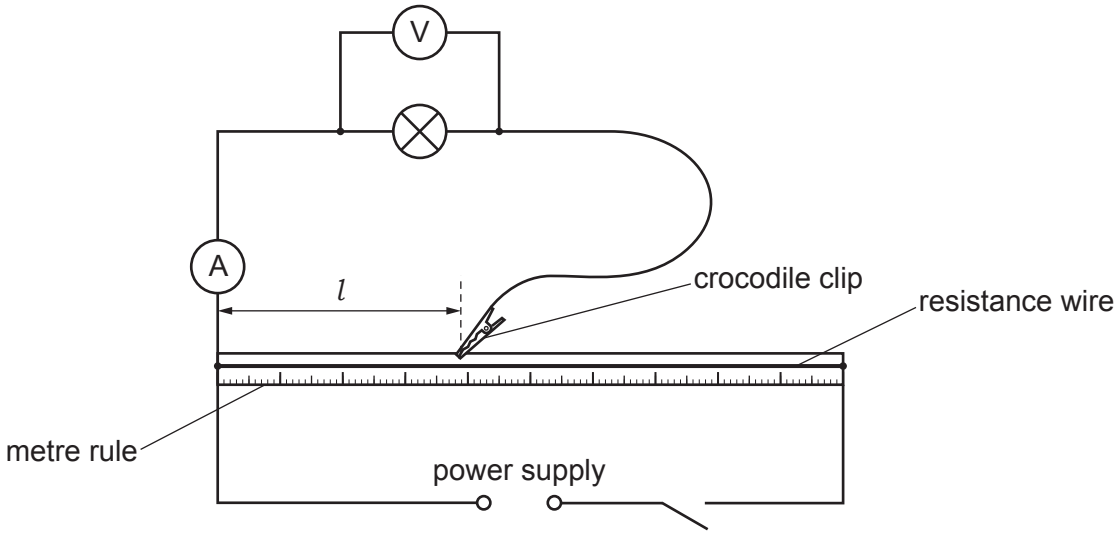



**Fig. 1.1**

The student:

- closes the switch
- connects the crocodile clip at a length $l$ = 10.0 cm of the resistance wire
- records the potential difference $V$ across the lamp
- records the current $I$ in the lamp
- opens the switch.

Fig. 1.2 shows the readings on the voltmeter and the ammeter.

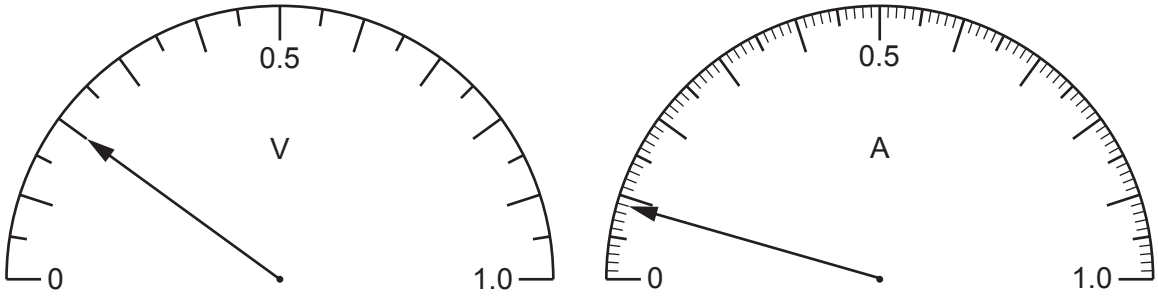



**Fig. 1.2**

**(a)** Record in Table 1.1 the values of $V$ and $I$.

**Table 1.1**

| length $l$/cm | potential difference $V$/V | current $I$/A | resistance $R$/Ω |
|---|---|---|---|
| 10.0 | | | |
| 30.0 | 0.7 | 0.13 | 5.4 |
| 50.0 | 1.2 | 0.14 | 8.6 |
| 70.0 | 1.7 | 0.16 | 10.6 |
| 90.0 | 2.2 | 0.19 | 11.6 |
| 100.0 | 2.5 | | 11.9 |

[2]

The student repeats the procedure with different lengths $l$ of the resistance wire.

The student's results are shown in Table 1.1.

**(b)** **(i)** Complete the top row of Table 1.1 by calculating the resistance $R$ of the lamp when $l$ = 10.0 cm.

Use the equation shown.

$$R = \frac{V}{I}$$

[1]

**(ii)** The student forgets to write in the current value for $l$ = 100.0 cm.

Calculate the current and write its value in Table 1.1.

[1]

**(c)** The student examines Table 1.1 and states that the resistance $R$ of the lamp is directly proportional to the length $l$.

State if you agree with the student's statement.

Justify your answer by using values from Table 1.1.

statement .....

justification .....

.....

.....

[1]

**(d) (i)** On the grid provided in Fig. 1.3, plot a graph of *R* on the *y*-axis against *V* on the *x*-axis.

Start both axes from the origin (0, 0).

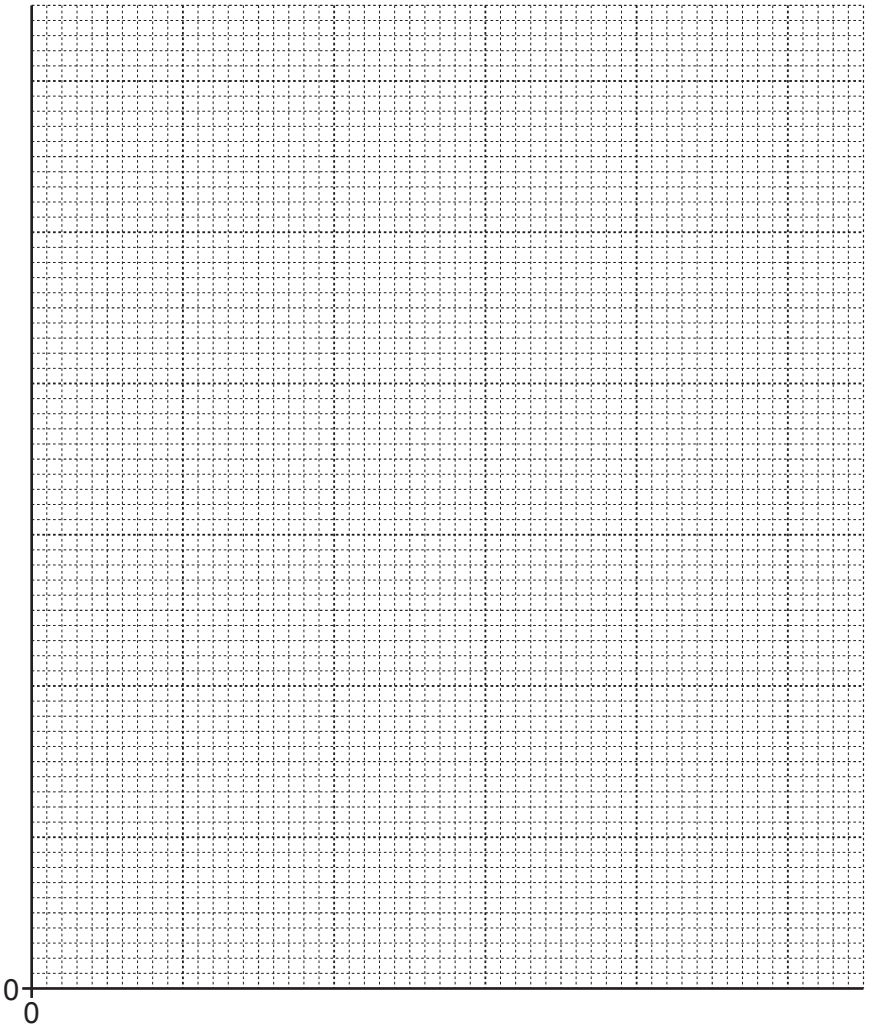



**Fig. 1.3**

Draw a smooth curve of best fit. [4]

**(ii)** Using your graph, describe how the resistance *R* of the lamp changes as the potential difference *V* across it changes.

.....

.....

..... [2]

**(e)** Another student makes changes to the circuit shown in Fig. 1.1.

She uses a variable resistor to vary the current and potential difference, instead of the resistance wire and the crocodile clip.

Complete the circuit diagram in Fig. 1.4 to show how this is done.

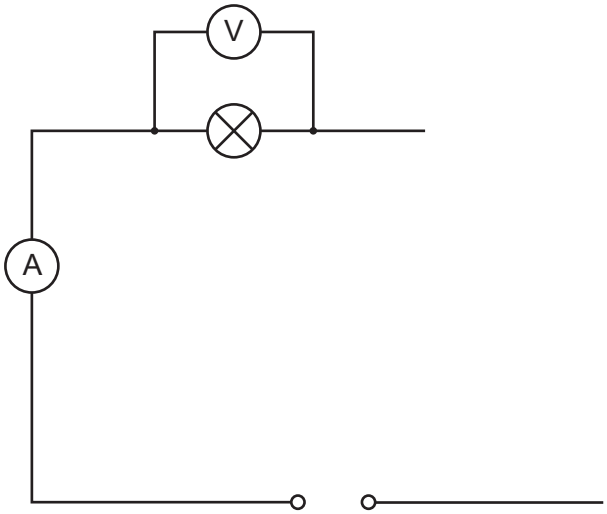



**Fig. 1.4**

[2]

[Total: 13]

**2** A student determines the acceleration of free-fall by timing the oscillations of a pendulum. The pendulum is shown in Fig. 2.1.

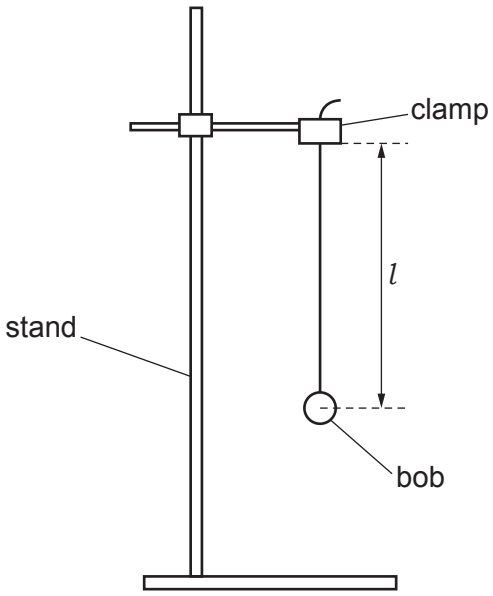



**Fig. 2.1**

**(a)** On Fig. 2.1, measure the length $l$ of the pendulum in centimetres to the nearest millimetre.

$l$ = ..... cm [1]

**(b)** Fig. 2.1 is drawn one-eighth actual size.

Length $L$ is the actual length of the pendulum.

Calculate $L$.

$L$ = ..... cm [1]

**(c)** The student gives the bob a small displacement and releases it so that it swings backwards and forwards. Fig. 2.2 shows one complete oscillation of the pendulum.

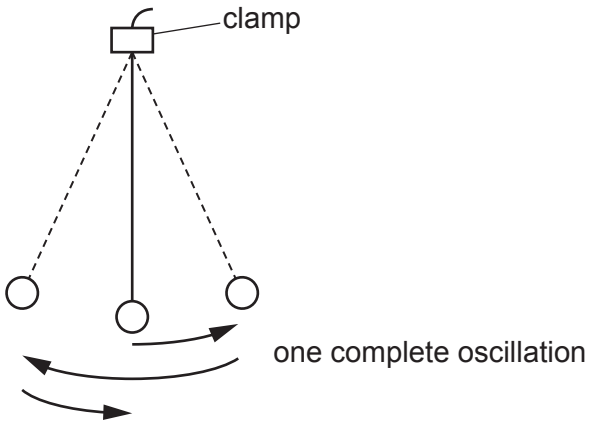



**Fig. 2.2**

The student measures the time $t$ for 20 complete oscillations. The time $t$ is shown on the stop-watch in Fig. 2.3.




**Fig. 2.3**

**(i)** Write down the time $t$.

$t$ = ..... s [1]

**(ii)** The student measures the time $t$ for 20 oscillations twice more. These times are shown.

21.30 s 21.28 s

Find the average time $t_{AV}$ for 20 oscillations of the pendulum.

$t_{AV}$ = ..... s [1]

**(d)** The period $T$ is the time for **one** complete oscillation of the pendulum.

Calculate $T$.

$T$ = ..... s [1]

**(e)** Calculate a value for $g$, the acceleration of free-fall. Use the equation shown.

$$g = \frac{11.1}{T^2}$$

Give your answer to 3 significant figures.

$g$ = ..... m/s$^2$ [2]

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**(f)** To find the period $T$ of the pendulum, the student first measures the average time for 20 oscillations.

Suggest why the student did **not** choose to measure the average time for:

**(i)** 2 oscillations

.....

..... [1]

**(ii)** 200 oscillations.

.....

..... [1]

[Total: 9]

**3** A student uses a ray box to investigate the refraction of a ray of red light as it passes through a semi-circular glass block.

He sets up the apparatus on a sheet of paper as shown in Fig. 3.1.

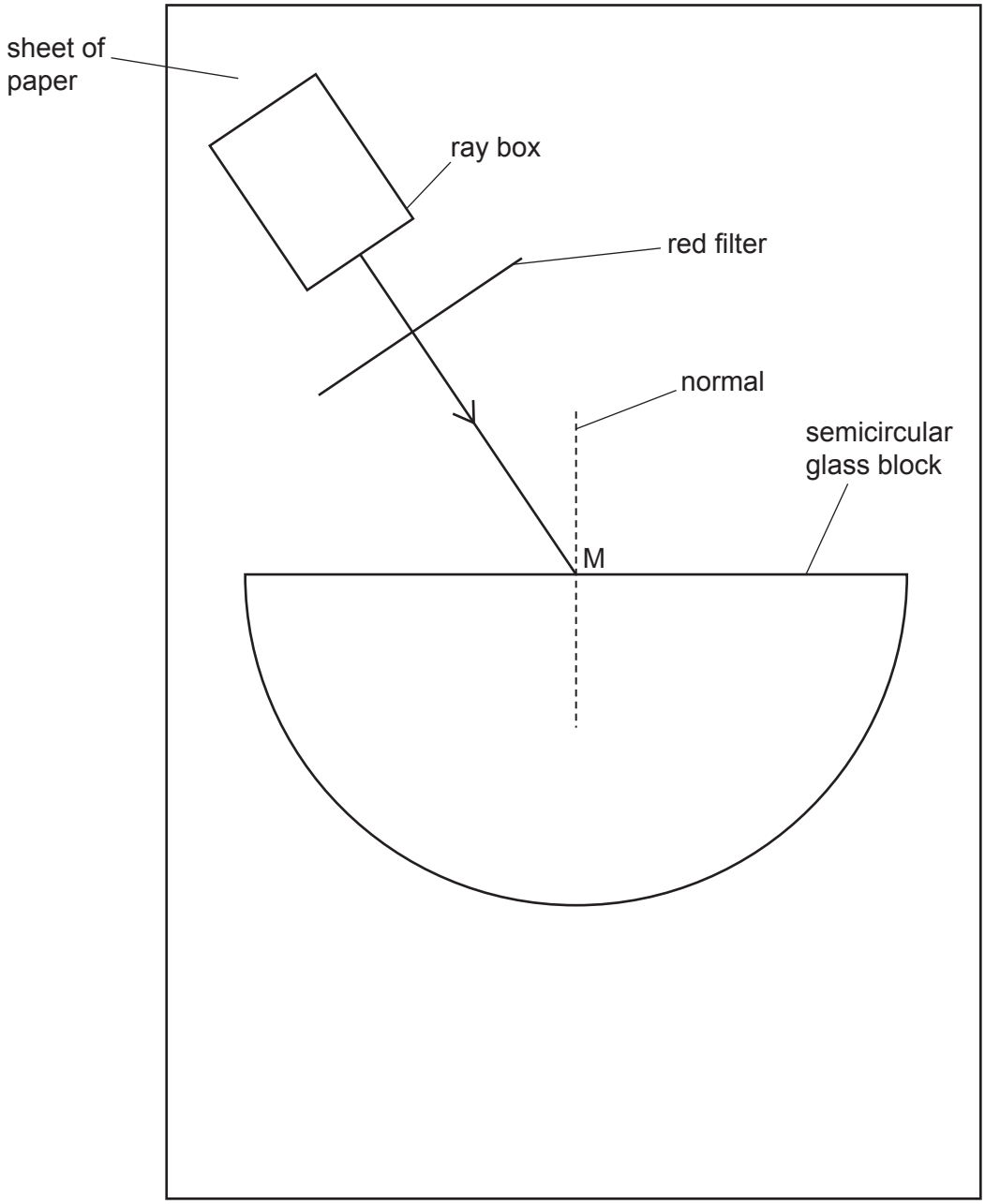



**Fig. 3.1**

The ray is incident at M, the mid-point at the flat surface of the semi-circular glass block.

**(a)** Measure the angle of incidence *i* of the ray at point M.

*i* = ..... [1]

**(b)** The angle of refraction at M is 22°.

On Fig. 3.1:

**(i)** draw the refracted ray inside the glass block [1]

**(ii)** label with the letter N, the point where the refracted ray leaves the glass block. [1]

**(c)** The ray emerges from the glass block at N without further deviation.

**(i)** Draw the path of the ray after it leaves the glass block. [1]

**(ii)** Describe how the student uses optics pins to mark the path of the ray accurately.

.....

.....

..... [1]

[Total: 5]

**Question 4 begins over the page.**

**4** A student uses a thermometer to measure the temperature of hot water as it cools down in a beaker.

Explain why he takes the following steps to ensure that the values are accurate.

**(a)** He makes sure that the thermometer bulb does not touch the sides or the base of the beaker.

.....

..... [1]

**(b)** He stirs the water each time before taking a reading.

.....

..... [1]

**(c)** He takes the temperature reading by viewing the scale on the thermometer at eye level, perpendicular to the scale.

.....

..... [1]

[Total: 3]

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