* 0000800000001 * DFD

Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5183551339

PHYSICS **5054/41**

Paper 4 Alternative to Practical **May/June 2025**

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 **16** pages. Any blank pages are indicated.

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[Turn over

1 A student investigates the resistance of a lamp.

(a) Fig. 1.1 shows the circuit used.

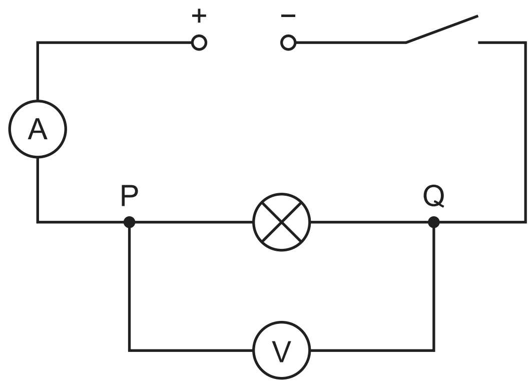

Fig. 1.1

(i) The student closes the switch.

The readings of current I_L and potential difference V_L are shown in Fig. 1.2.

Record the readings shown.

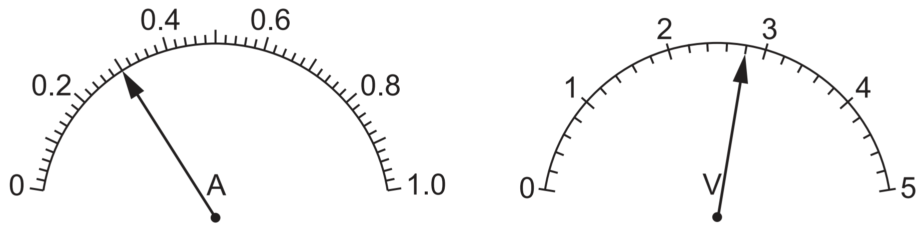

Fig. 1.2

I_L = ... A

V_L = ... V
[2]

(ii) The student opens the switch.

Suggest why the switch is opened after the readings are recorded.

....

.... [1]

(iii) Use the equation

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

to calculate the resistance R_L of the lamp. Give your answer to 2 significant figures.

R_L = ... Ω [2]

(b) (i) The student:

- rearranges the circuit and connects a 10 Ω resistor in series with the lamp
- connects the voltmeter to measure the potential difference across the resistor and lamp combination.

In the space below, draw the new circuit with the resistor added.

[1]

(ii) The reading on the voltmeter does not change.

Fig. 1.3 shows the new current reading on the ammeter. This is current I_C.

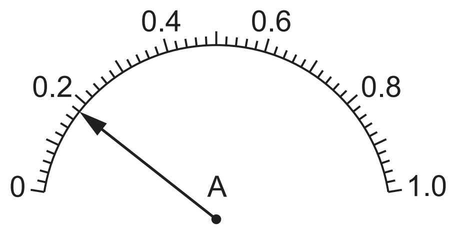

Fig. 1.3

Record I_C.

I_C = ... A

Use the equation in **(a)(iii)** to find the resistance R_C of the lamp and the resistor connected in series.

R_C = ... Ω
[1]

(iii) Theory states that the value of R_L in the new circuit is given by:

$$R_L = R_C - 10$$

Calculate the resistance R_L of the lamp.

R_L = ... Ω [1]

(iv) State how the brightness of the lamp changes in the new circuit compared to the circuit shown in Fig. 1.1, and explain why.

change in brightness of lamp ....

....

explanation ....

....

....
[2]

[Total: 10]

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2 A student investigates the light reflected from a plane mirror.

(a) Fig. 2.1 shows a straight line AB.

Fig. 2.1

(i) Draw a line from point A at an angle of 30° in an anticlockwise direction from AB.

This line should be more than 10 cm long.

Label the end of the line as point C.

[1]

(ii) Mark a point D on the line AB, 4.0 cm from point A.

Draw a line perpendicular to AB **through** point D.

This line must also pass **through** the line AC that you have drawn in part **(a)(i)**.

Label, with an E, the point where the line through point D passes through AC.

[1]

(b) The student:

- places a plane mirror along the line AC with the reflective surface facing point B
- arranges an illuminated slit so that a ray of light passes along the line DE.

The ray reflects from the mirror.

(i) Draw a normal to line AC at point E. [1]

(ii) Label the angle between DE and the normal you have drawn with a θ.

Measure and record angle θ.

θ = ...° [1]

(iii) The student:

- marks two points P_1 and P_2 on the reflected line
- removes the mirror and draws the reflected line through points P_1 and P_2.

Describe how points P_1 and P_2 are chosen to give as accurate a reflected line as possible.

....

.... [1]

(c) The student repeats the procedure with a ray of light striking the mirror at a different angle.

(i) Fig. 2.2 shows a second line, labelled A′B′.

On Fig. 2.2, draw a line from point A′ at an angle of 60° in an anticlockwise direction from line A′B′.

The line should be more than 10 cm long.

Label the end of the line with a C′. [1]

Fig 2.2

(ii) Mark a point D′ on the line A′B′, 4.0 cm from point A′.

Draw a line perpendicular to A′B′ **through** point D′.

This line must also pass **through** the line A′C′.

Label the point where the line through point D′ passes through A′C′ with an E′.

Draw a normal to line A′C′ at point E′. [1]

(iii) Label the angle between D′E′ and the normal you have drawn with an α.

Explain one practical precaution that you take to ensure that the normal is accurately drawn.

....

.... [1]

(iv) Measure and record angle α.

α = ...° [1]

(d) Theory suggests that:

$$\alpha = 2\theta.$$

State whether your results support this theory.

Give a reason for your answer.

....

....

.... [1]

[Total: 10]

3 A student investigates the time taken for water to flow through a small hole in the bottom of a can.

The apparatus is arranged as shown in Fig. 3.1.

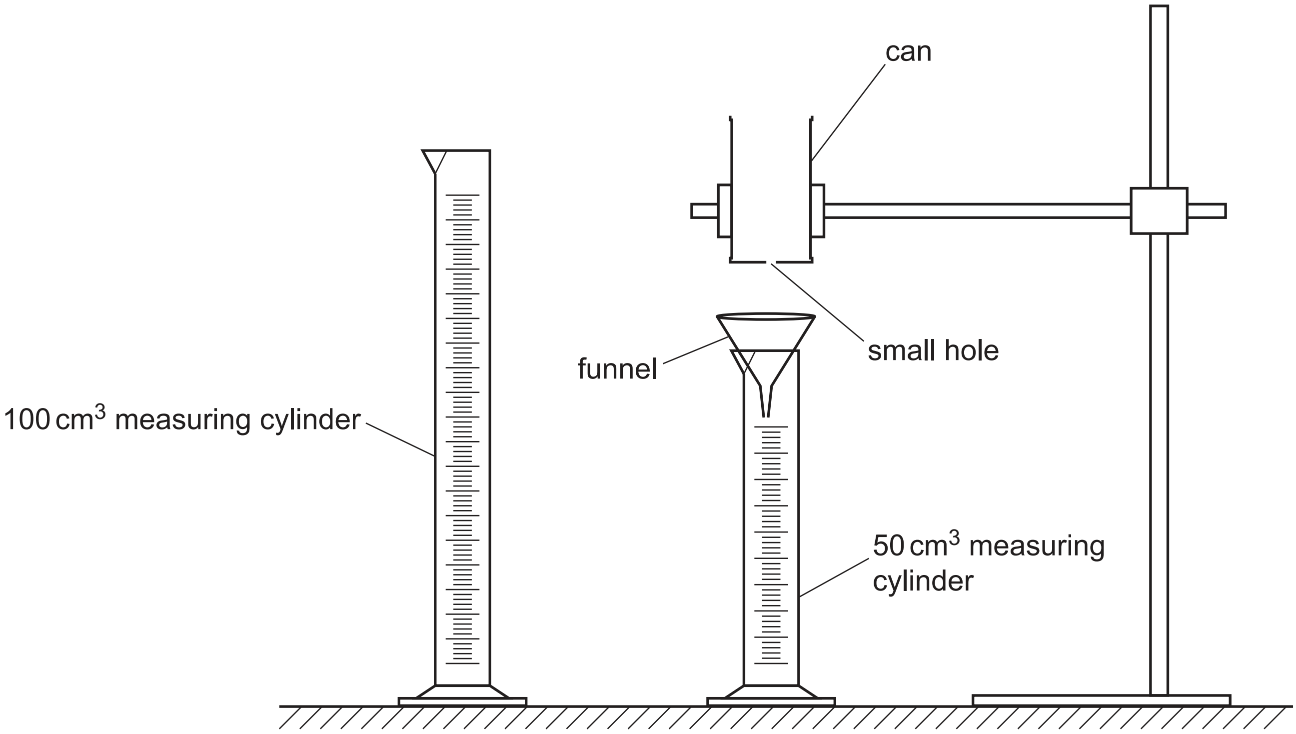

Fig. 3.1

(a) (i) The student:

- uses the 100 cm^3 measuring cylinder to measure a volume V = 70 cm^3 of water
- places a finger under the hole at the bottom of the can and pours the water into the can from the measuring cylinder
- removes the finger and, at the same time, starts the stopwatch
- records the time t_1 when the volume of water collected in the measuring cylinder is 30 cm^3
- stops the stopwatch.

Fig. 3.2 shows the reading on the stopwatch at time t_1.

Fig. 3.2

Record t_1.

t_1 = ... s [1]

(ii) The student repeats **(a)(i)** and records the time t_2 shown in Fig. 3.3.

Fig. 3.3

Record t_2 and find the average time t_{av} of t_1 and t_2.

Give your answer to the nearest 0.1 s.

t_2 = ... s

t_{av} = ... s [2]

(iii) The average rate of flow R is given by:

$$R = \frac{30\,\text{cm}^3}{t_{av}}$$

Calculate R and give the unit of your answer.

R = ... unit .... [2]

(b) The student repeats **(a)(i)** and **(a)(ii)** for values of V = 100 cm^3, 90 cm^3, 80 cm^3, 60 cm^3 and 50 cm^3. The volume of water collected in the measuring cylinder underneath the can is 30 cm^3 for each value of V.

The readings are shown in Table 3.1.

In Table 3.1:

- complete the headings, with units, in the top row of the table
- add your readings from **(a)(i)** and **(a)(ii)**
- calculate the average time for each set of readings.

Table 3.1

V	....	....	....
100	16.0	16.2	....
90	16.9	17.4	....
80	18.9	19.7	....
70	....	....	....
60	25.3	25.9	....
50	31.1	31.3	....

[3]

(c) On the grid provided in Fig. 3.4, plot a graph of t_{av} on the y-axis against V on the x-axis.

You do not need to start your axes at (0,0).

Draw the curve of best fit. [4]

(d) Suggest why times t_1 and t_2 for values of V below 50 cm^3 are not measured.

....

.... [1]

(e) On your graph, sketch the line you would expect to see if the small hole in the can is made slightly bigger. Label this line L. [1]

[Total: 14]

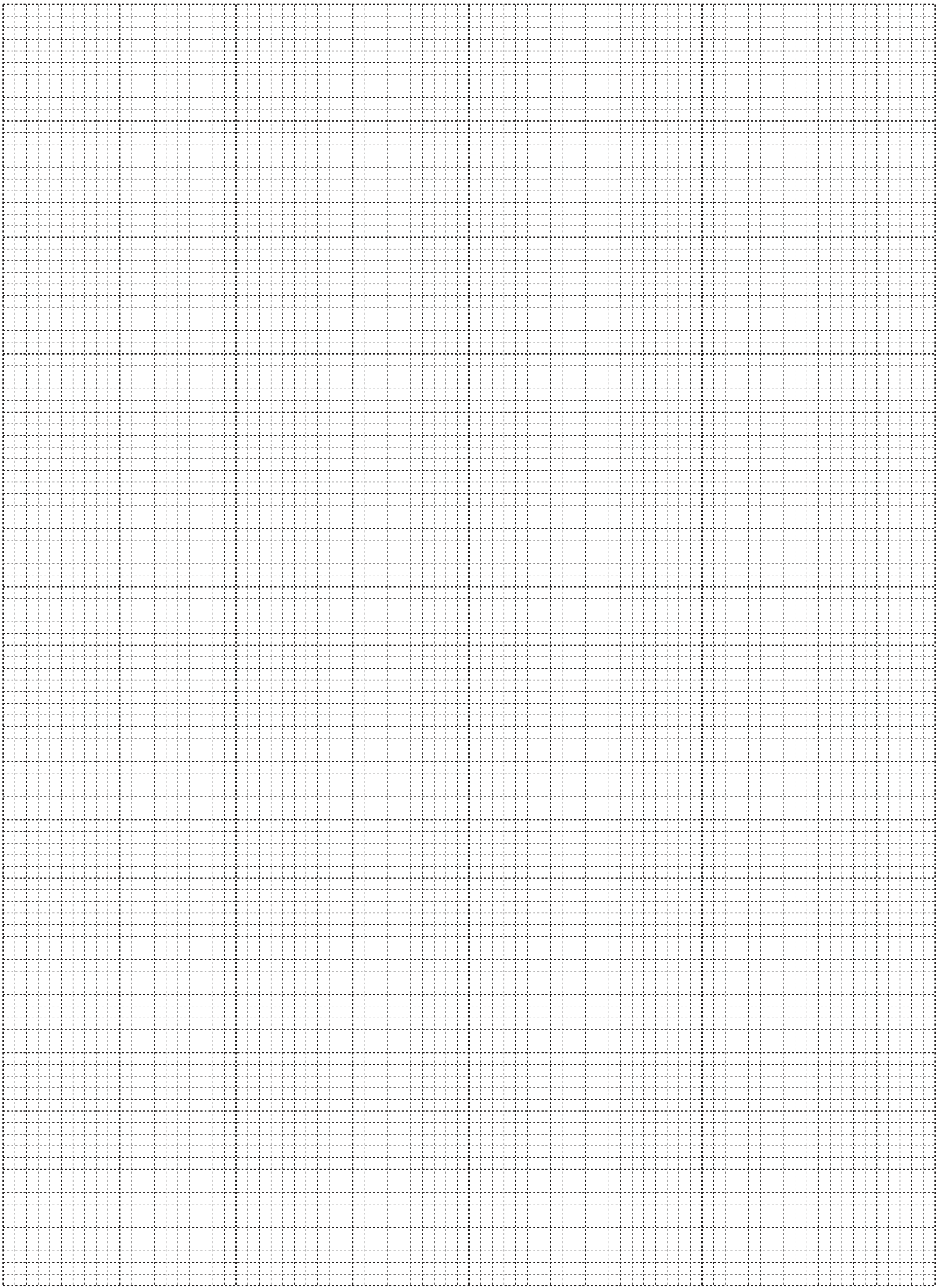

Fig. 3.4

4 When a table tennis ball is dropped as shown in Fig. 4.1, it will bounce back upwards. Some of the initial gravitational potential energy (GPE) of the ball is lost in the bounce.

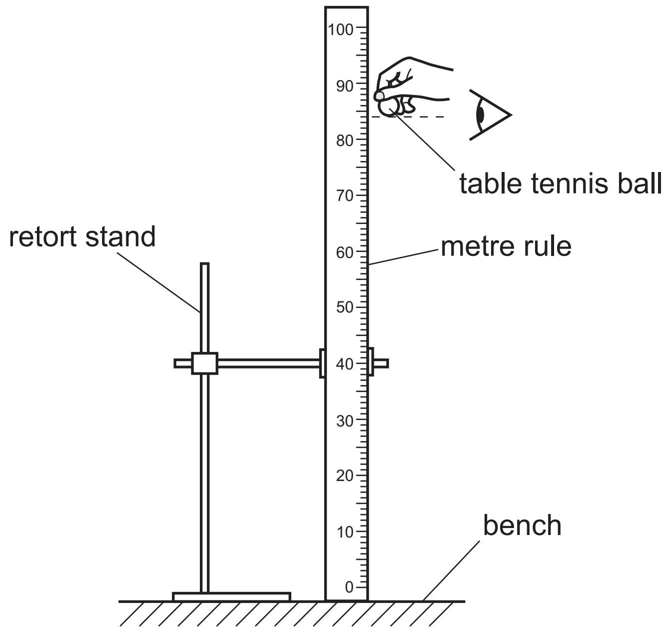

Fig. 4.1

Plan an experiment to investigate how the height from which the ball is dropped affects the percentage of GPE lost in each bounce.

You may use any apparatus commonly found in a school laboratory in addition to the apparatus shown in Fig. 4.1.

GPE is given by the equation:

$$\text{GPE} = mgh$$

where m is the mass of the ball, g is the gravitational field strength and h is the height above the bench from which the ball is dropped.

In your plan, you should:

- state what you will measure (dependent variable) and any additional apparatus you may use
- state any key variables to keep constant
- explain how you will ensure the results are as accurate as possible
- draw a table with column headings to display the results
- explain how you will use the results to draw a conclusion.

[6]