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Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8540912141

PHYSICS **5054/42**

Paper 4 Alternative to Practical **October/November 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

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1 A student investigates a light dependent resistor (LDR).

The student constructs a **series** circuit consisting of a power supply, the LDR, a 560 Ω resistor and a switch.

(a) Draw a diagram of the circuit arrangement, using the correct symbols for the components in the circuit.

Choose from the symbols shown in Fig. 1.1.

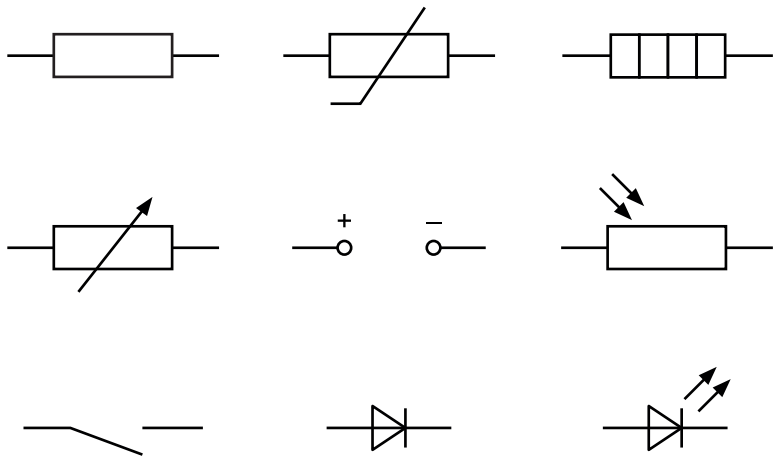

Fig. 1.1

[2]

(b) The student:

- closes the switch
- connects a voltmeter across the LDR
- records the voltmeter reading V_1
- opens the switch.

(i) On your circuit in **(a)**, draw a voltmeter connected across the LDR to measure the potential difference (p.d.) across the LDR.

Use the circuit symbol for a voltmeter. [1]

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(ii) The voltmeter reading V_1 is shown in Fig. 1.2.

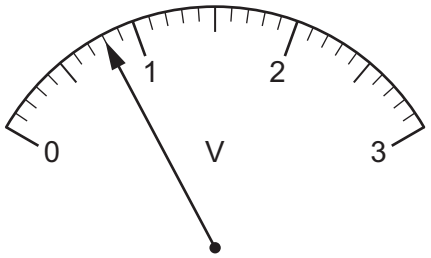

Fig. 1.2

Record the voltmeter reading V_1.

V_1 = ... V [1]

(iii) Suggest why the switch is opened after the voltmeter reading has been recorded.

.....

..... [1]

(c) (i) The student:

- disconnects the voltmeter
- reconnects the voltmeter across the 560 Ω resistor
- closes the switch
- records the voltmeter reading V_2
- opens the switch.

The student measures V_2 as 2.18 V.

The current I in the circuit is calculated using the equation:

$$I = \frac{V_2}{R}$$

where R = 560 Ω.

Calculate the current I.

I = ...A [1]

(ii) Use your answers from **(b)(ii)** and **(c)(i)** to calculate the resistance R_{LDR} of the LDR under normal lighting conditions, using the equation shown.

$$R_{LDR} = \frac{V_1}{I}$$

R_{LDR} = ... Ω [1]

(d) The student:

- disconnects the voltmeter from across the 560 Ω resistor
- reconnects the voltmeter across the LDR
- places a piece of card on top of the LDR to prevent light from reaching the LDR
- closes the switch
- records the voltmeter reading V_3
- opens the switch.

The student measures V_3 as 1.94 V.

Compare V_1, measured under normal lighting conditions in **(b)(ii)**, with V_3, measured in the dark.

Suggest what causes the change in the readings as the intensity of the light reaching the LDR decreases.

.....

..... [1]

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(e) The student:

- holds the card horizontally 50 cm above the LDR
- slowly moves the card towards the LDR until it rests on top of the LDR
- observes the readings on the voltmeter across the LDR as the card is moved.

Table 1.1 shows the voltmeter readings as the distance *d* between the card and the LDR decreases.

Table 1.1

d / cm	*V* / V
30	0.77
25	0.76
20	0.77
15	0.76
10	0.84
5	0.99
0	1.94

Describe the relationship between *d* and *V* shown by these readings.

.....

.....

..... [2]

[Total: 10]

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2 A student investigates the absorption of thermal radiation by different coloured surfaces.

The student has arranged a thermometer which has a piece of white card attached to its bulb so that the bulb is level with the filament of a lamp.

The lamp is switched off.

Fig. 2.1 shows the apparatus.

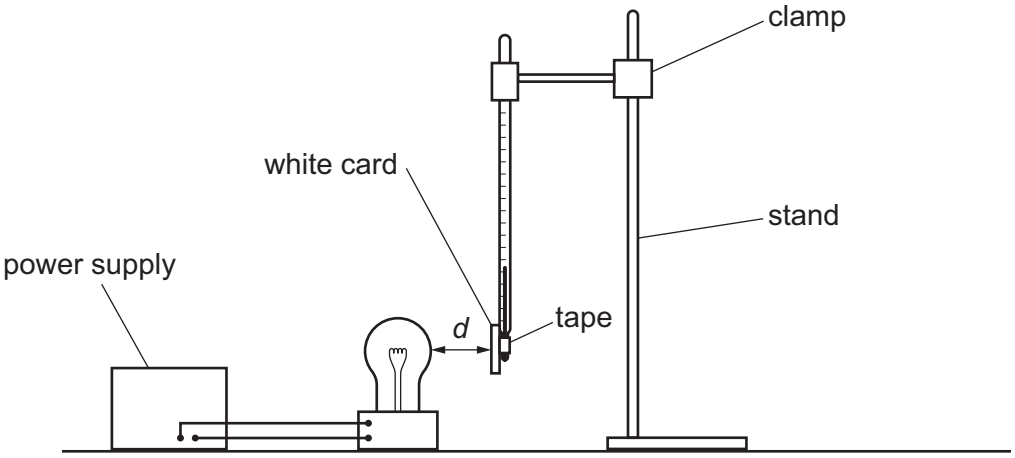

Fig. 2.1

(a) (i) procedure

The student:

- adjusts the distance *d* between the white card attached to the thermometer bulb and the lamp until it is approximately 1 cm
- records, in Table 2.1, the initial temperature θ_W recorded by the thermometer.

The thermometer is shown in Fig. 2.2.

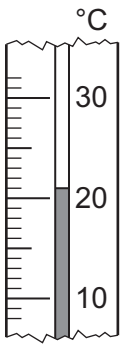

Fig. 2.2

Record θ_W in Table 2.1 at time $t = 0$. [1]

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(ii) The student:

- switches on the lamp and, at the same time, starts the stop-watch
- records, in Table 2.1, the reading on the thermometer every 60 s for 5 minutes
- switches off the lamp.

The student's results are shown in Table 2.1.

Table 2.1

time t / s	white card temperature θ_W / °C	black card temperature θ_B / °C
0	.....	20
.....	24	28
.....	26	33
.....	28	37
.....	30	41
.....	31	44

Complete Table 2.1 by completing the time column. [1]

(b) The student

- removes the thermometer from the clamp
- replaces it with a thermometer with a black card attached to its bulb
- repeats the procedure in **(a)** and records temperatures θ_B.

(i) Determine the temperature increase $\Delta\theta$ between t = 0 and t = 300 s for each card.

$\Delta\theta$ for white card = ... °C

$\Delta\theta$ for black card = ... °C
[1]

(ii) Calculate the rate of increase of temperature of each card. Use the equation:

$$\text{rate of temperature increase} = \frac{\Delta\theta}{t}$$

Include the unit in your answer.

rate of temperature increase of white card = ... unit .....

rate of temperature increase of black card = ... unit .....
[2]

(iii) Use your answers to **(b)(ii)** to reach a conclusion which compares the absorption of thermal radiation by the two different cards.

State your conclusion.

.....

..... [1]

(iv) A student suggests that the rate of temperature increase is greater at the start of the experiment than at the end.

State if the results for the black card support this suggestion.

Justify your answer by referring to the results.

statement .....

justification .....

.....

.....

[2]

(c) State **two** variables that are controlled in this experiment so that the comparison between the absorbing properties of white and black surfaces is valid.

controlled variable 1 .....

.....

controlled variable 2 .....

.....

[2]

[Total: 10]

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3 A student uses a balancing method to determine the mass of a metre rule.

(a) The student:

- places the metre rule on a pivot
- places a mass m = 20 g on the metre rule with its centre at the 5.0 cm mark
- adjusts the position of the metre rule on the pivot until the metre rule is as close to balance as possible.

Fig. 3.1 shows the balanced metre rule.

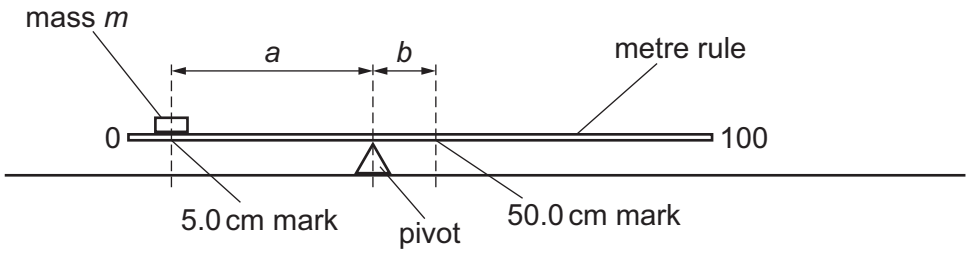
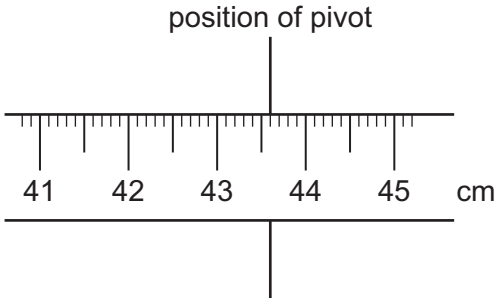


Fig. 3.1

(i) Fig. 3.2 shows the position of the pivot under the metre rule when the metre rule is balanced.



view from above

Fig. 3.2

Read the position of the pivot on the metre rule when the metre rule is balanced.

Record the reading in centimetres to the nearest millimetre in Table 3.1 on page 10. [1]

(ii) Calculate and record, in Table 3.1 on page 10:

1 the distance a between the 5.0 cm mark and the pivot

2 the distance b between the pivot and the 50.0 cm mark.

[1]

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(b) The student repeats the procedure in **(a)** for m = 40 g, 60 g, 80 g and 100 g.

The results are shown in Table 3.1.

Describe how the student makes sure that the centre of each mass placed on the metre rule is directly above the 5.0 cm mark.

.....

.....

..... [1]

Table 3.1

m / g	position of pivot / cm	a / cm	b / cm	$r = \frac{b}{a}$
20	.....	.....	.....	.....
40	38.1	33.1	11.9	0.36
60	34.7	29.7	15.3	0.52
80	31.2	26.2	18.8	0.72
100	29.2	24.2	20.8	0.86

(c) Calculate the ratio $r = \frac{b}{a}$ for m = 20 g.

Record, in Table 3.1, your answer to **two** significant figures.

[2]

(d) On the grid provided in Fig. 3.3 on page 11, plot a graph of r on the y-axis against m on the x-axis.

Start from the origin (0, 0).

Draw the straight line of best fit.

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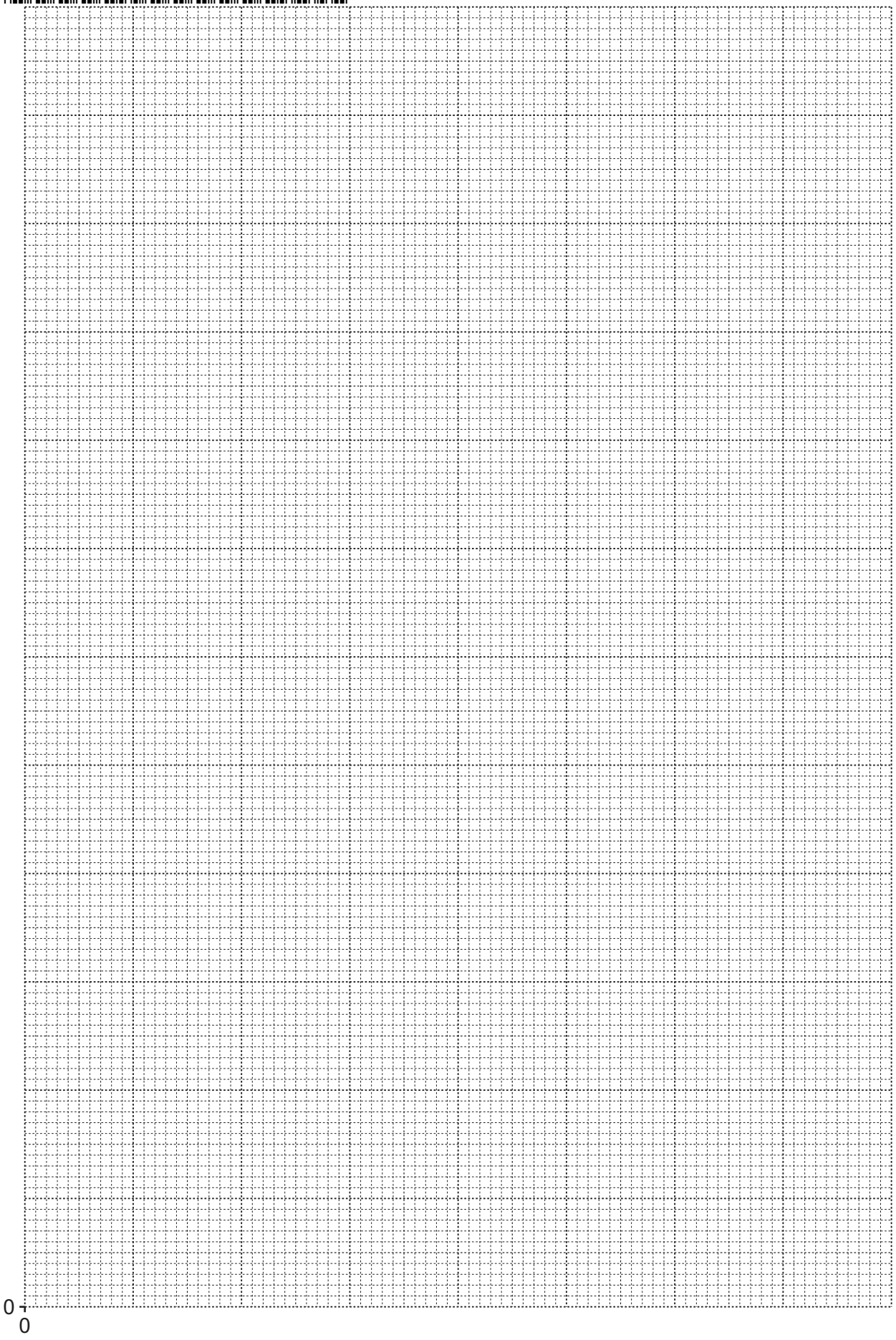

Fig. 3.3

[4]

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(e) **(i)** Calculate the gradient G of your graph.

Show clearly on the graph how you obtained the numbers you use for your calculation.

G = ... [2]

(ii) The mass M of the metre rule in grams is given by the equation:

$$M = \frac{1}{G}$$

Determine the mass of the metre rule to the nearest gram.

M = ... g [1]

(iii) Name a piece of apparatus that the student can use to measure the mass of the metre rule directly.

..... [1]

(f) A student says that the centre of mass of the metre rule is at the 50.0 cm mark.

Describe how you use the apparatus provided to check that this statement is correct.

.....

.....

..... [1]

[Total: 14]

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4 A student investigates the rate of cooling of hot water in a beaker.

Plan an experiment to investigate the relationship between the thickness of the cardboard insulation wrapped around the beaker and the rate of cooling of the hot water in the beaker.

The apparatus available includes:

- a supply of hot water
- a beaker
- a thermometer
- a supply of 1 mm thick cardboard sheets

In your plan include:

- any other apparatus needed
- a brief description of the method, including what you will measure and how you make sure that your measurements are accurate
- the variables you will control
- a results table to record your measurements (you are not required to enter any readings in the table)
- how you will process your results to reach a conclusion.

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