



# Cambridge International AS & A Level

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## PHYSICS

9702/52

Paper 5 Planning, Analysis and Evaluation

May/June 2025

1 hour 15 minutes

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 8 pages.



- 1 A thin solid disc of radius  $r$  and thickness  $z$  is attached to a thin axle. String is wrapped around the axle, as shown in Fig. 1.1.

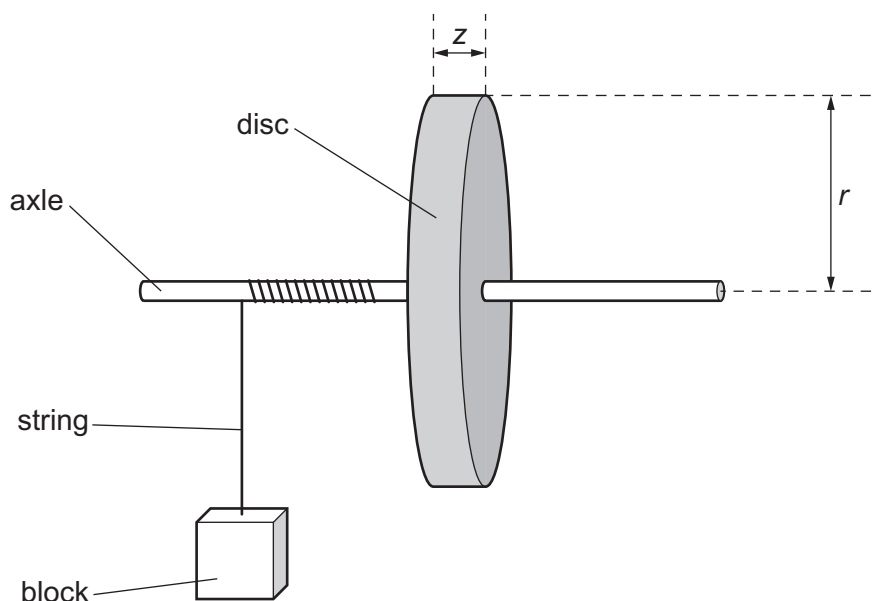


Fig. 1.1

A block of mass  $m$  is attached to the string.

The block is released from rest and falls downwards. The block has speed  $v$  when it has fallen through a distance  $h$  from the point of release. The value of  $v$  is determined using **one** light gate connected to a timer.

It is suggested that  $v$  is related to  $m$  by the relationship

$$\frac{h}{v^2} = \frac{\pi r^2 z}{2PQm} + \frac{1}{P}$$

where  $P$  and  $Q$  are constants.

Plan a laboratory experiment to test the relationship between  $v$  and  $m$ .

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for  $P$  and  $Q$ .

In your plan you should include:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.



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Diagram

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..... [15]



- 2 A student investigates a circuit containing capacitors. The circuit is connected with a capacitor of capacitance  $A$ , as shown in Fig. 2.1.

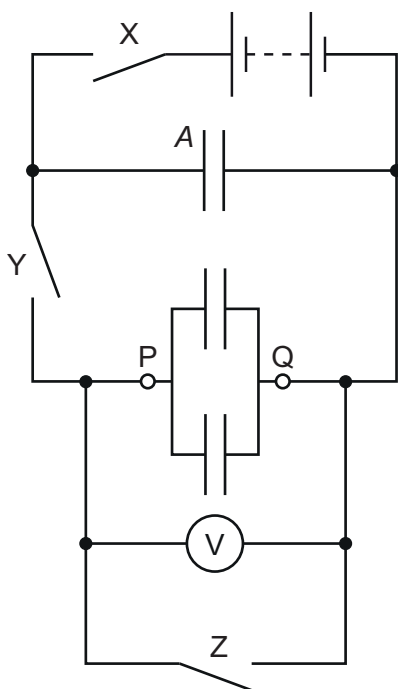


Fig. 2.1

Two capacitors, each of capacitance  $C$ , are connected in parallel between P and Q.

Initially, switch X and switch Z are closed and switch Y is open.

Switches X and Z are opened. Switch Y is then closed. The maximum potential difference between P and Q is measured using the voltmeter. This procedure is repeated and the mean maximum potential difference  $V$  between P and Q is determined.

The experiment is then repeated by changing the number  $n$  of capacitors, each of capacitance  $C$ , connected in parallel between P and Q.

It is suggested that  $V$  and  $n$  are related by the equation

$$EA = V(nC + A)$$

where  $E$  is the electromotive force (e.m.f.) of the battery.

- (a) A graph is plotted of  $\frac{1}{V}$  on the  $y$ -axis against  $n$  on the  $x$ -axis.

Determine expressions for the gradient and  $y$ -intercept.

gradient = .....

$y$ -intercept = .....

[1]



- (b) Values of  $n$  and the two measured values of the maximum potential difference  $V_1$  and  $V_2$  are given in Table 2.1.

Table 2.1

| $n$ | $V_1/V$ | $V_2/V$ | $V/V$ | $\frac{1}{V}/V^{-1}$ |
|-----|---------|---------|-------|----------------------|
| 2   | 4.30    | 4.20    |       |                      |
| 3   | 3.65    | 3.75    |       |                      |
| 4   | 3.30    | 3.20    |       |                      |
| 5   | 2.85    | 2.95    |       |                      |
| 6   | 2.65    | 2.55    |       |                      |
| 7   | 2.30    | 2.40    |       |                      |

Calculate and record values of  $V/V$  and  $\frac{1}{V}/V^{-1}$  in Table 2.1. Include the absolute uncertainties in  $V$  and  $\frac{1}{V}$ . [2]

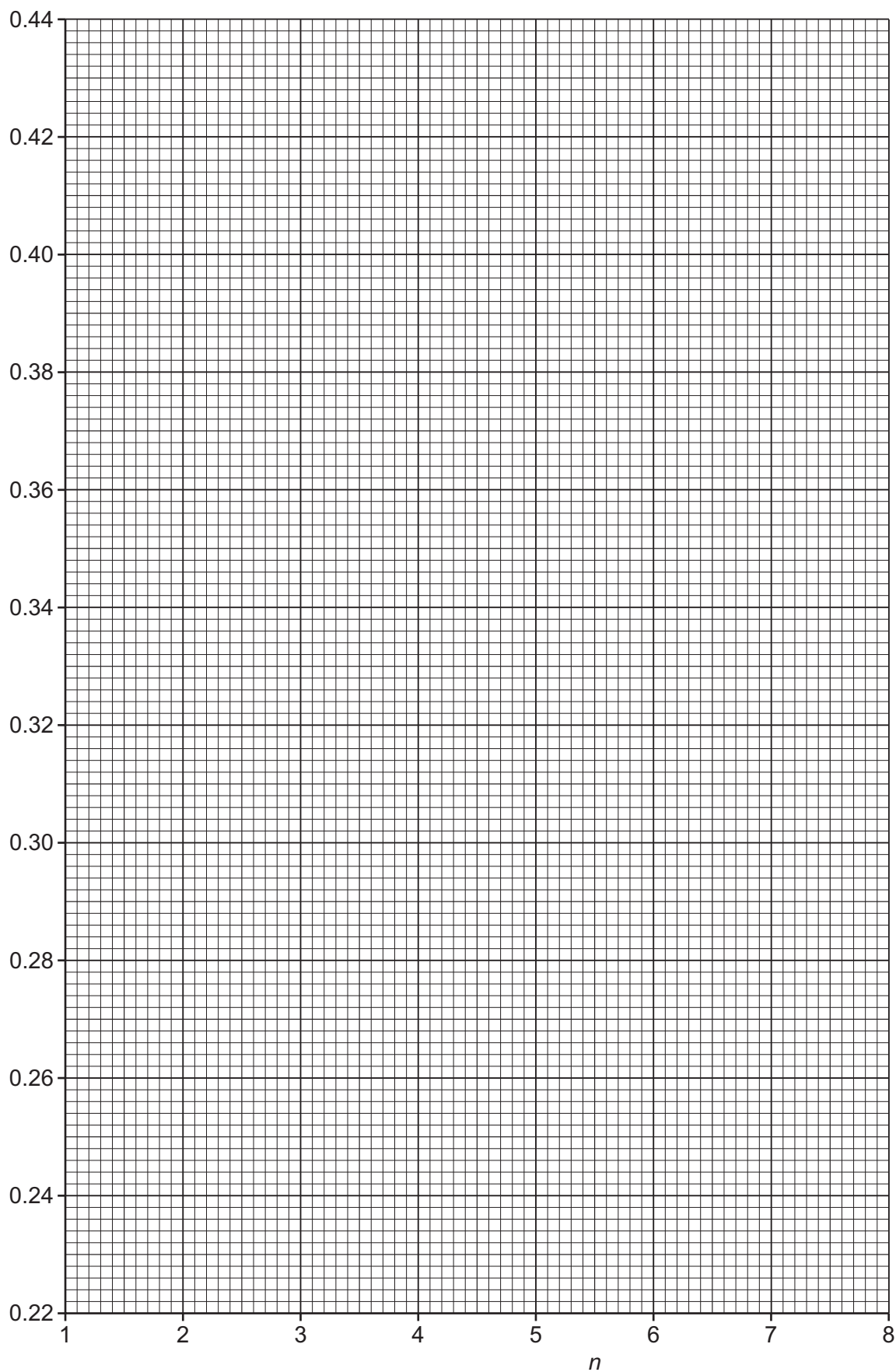
- (c) (i) Plot a graph of  $\frac{1}{V}/V^{-1}$  against  $n$ . Include error bars for  $\frac{1}{V}$ . [2]
- (ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Label both lines. [2]
- (iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ..... [2]



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 $\frac{1}{V}/V^{-1}$ 



- (iv) Determine the  $y$ -intercept of the line of best fit. Include the absolute uncertainty in your answer.

$y$ -intercept = ..... [2]

- (d) (i) Using your answers to (a), (c)(iii) and (c)(iv), determine the values of  $E$  and  $C$ . Include appropriate units.

Data:  $A = (2.2 \pm 0.2) \text{ mF}$

$E = \dots\dots\dots$

$C = \dots\dots\dots$  [2]

- (ii) Determine the percentage uncertainty in your value of  $C$ .

percentage uncertainty = .....% [1]

- (e) The experiment is repeated with 10 capacitors, each of capacitance  $C$ , connected in parallel between P and Q. Determine the maximum potential difference  $V$  between P and Q.

$V = \dots\dots\dots V$  [1]

[Total: 15]

