Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2845349779

PHYSICS **9702/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2023**

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.

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1 Two coils, C and D, are placed with their axes on a straight line, as shown in Fig. 1.1.

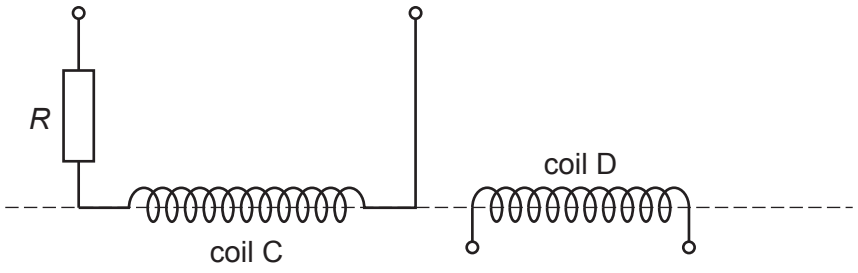

Fig. 1.1

A resistor of resistance R is connected in series with coil C.

A changing magnetic flux of frequency f in coil C causes an electromotive force (e.m.f.) E to be induced across the terminals of coil D.

It is suggested that E is related to f by the relationship

$$E = \frac{pf^q V}{R}$$

where V is the potential difference across the resistor and coil C, and p and q are constants.

Plan a laboratory experiment to test the relationship between E and f.

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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2 A block of modelling clay of mass M is attached to a string as shown in Fig. 2.1.

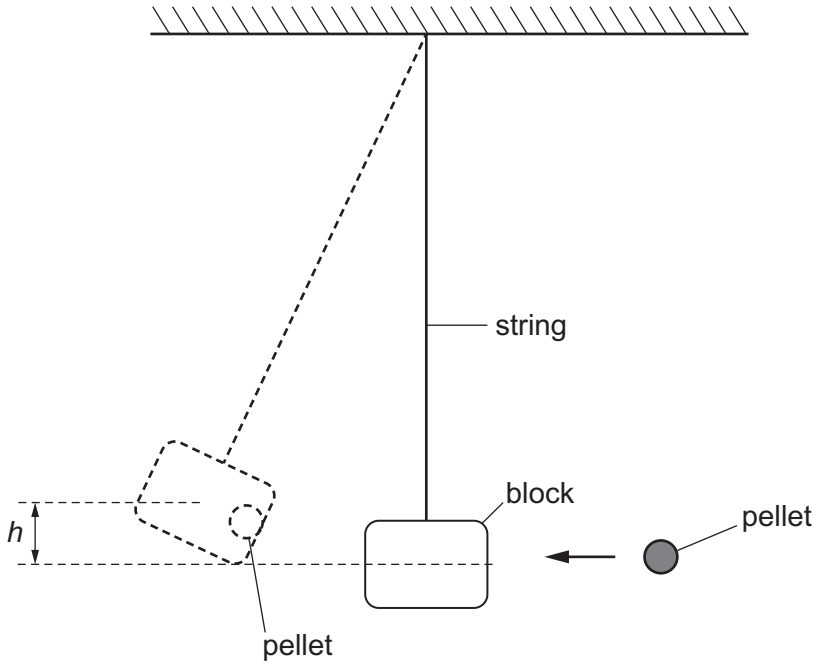

Fig. 2.1

A pellet travelling at speed u enters the block and causes the block to move through a vertical height h.

The experiment is repeated for different values of M.

It is suggested that h and M are related by the equation

$$\frac{1}{h} = 2g\left(\frac{M+Z}{uZ}\right)^2$$

where g is the acceleration of free fall and Z is a constant.

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

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...

[1]

(b) Values of M and h are given in Table 2.1.

Table 2.1

M/g	h/cm	$\sqrt{\frac{1}{h}}/\text{cm}^{-\frac{1}{2}}$
565	21.0 ± 0.2	
637	17.8 ± 0.2	
675	16.2 ± 0.2	
723	14.6 ± 0.2	
790	12.6 ± 0.2	
892	10.2 ± 0.2	

Calculate and record values of $\sqrt{\frac{1}{h}}/\text{cm}^{-\frac{1}{2}}$ in Table 2.1.

Include the absolute uncertainties in $\sqrt{\frac{1}{h}}$. [2]

(c) **(i)** Plot a graph of $\sqrt{\frac{1}{h}}/\text{cm}^{-\frac{1}{2}}$ against M/g.

Include error bars for $\sqrt{\frac{1}{h}}$. [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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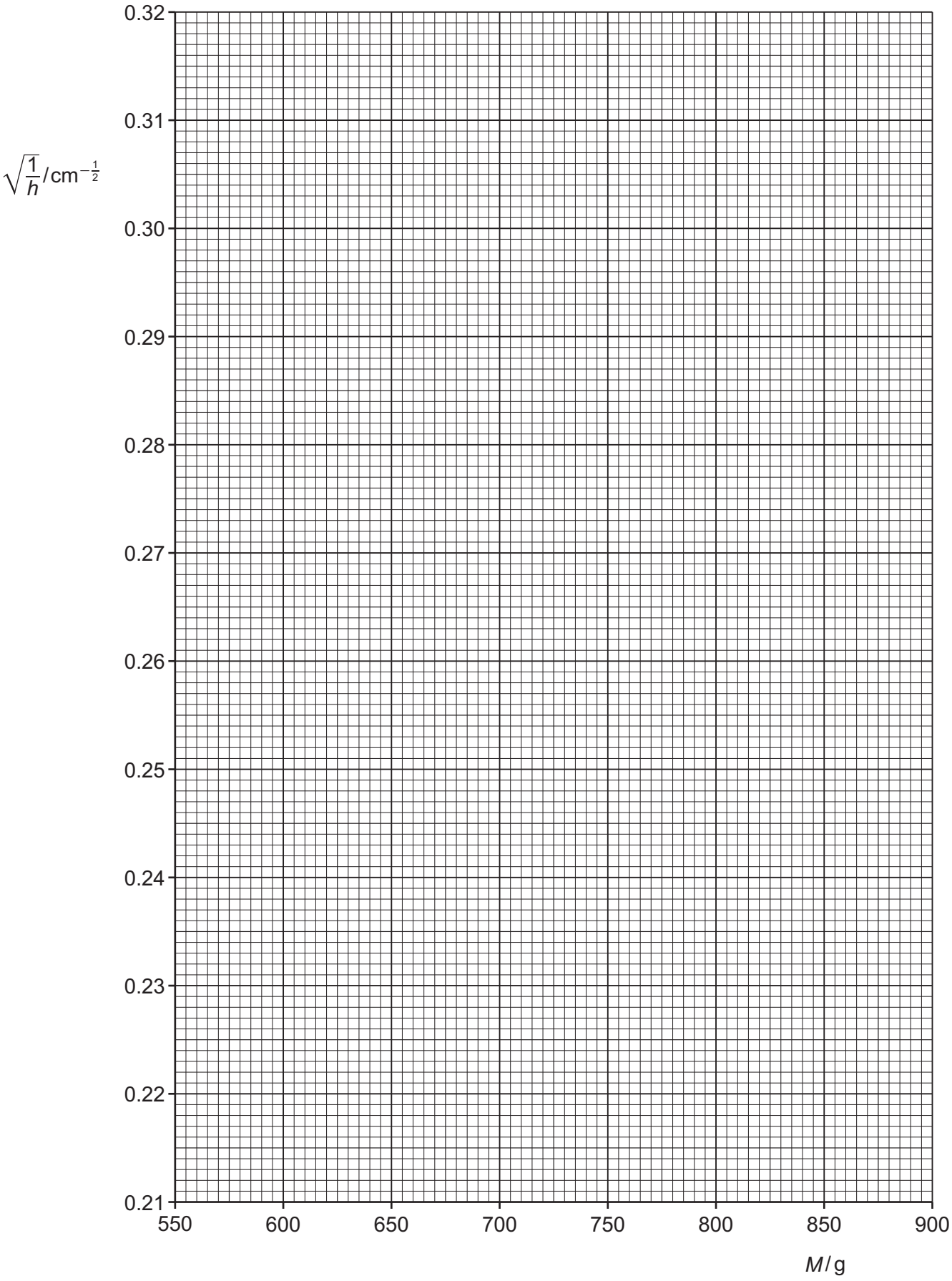
$\sqrt{\frac{1}{h}}$/cm$^{-\frac{1}{2}}$
0.32
0.31
0.30
0.29
0.28
0.27
0.26
0.25
0.24
0.23
0.22
0.21
550
600
650
700
750
800
850
900
M/g

(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 *u* and *Z*. Include appropriate units.

Data: $g = 981\,\text{cm}\,\text{s}^{-2}$

u = ...

Z = ...
[2]

(ii) Determine the percentage uncertainty in *Z*.

percentage uncertainty in *Z* = ... % [1]

(e) The experiment is repeated. Determine the mass *M* that gives a value of *h* of 25.0 cm.

M = ... g [1]

[Total: 15]

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