Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0954804635

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **February/March 2024**

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 Fig. 1.1 shows a thin cylindrical metal rod of length *L*.

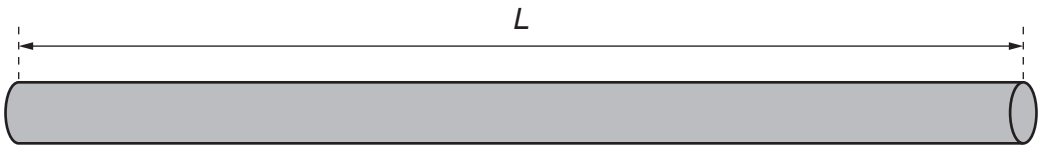

Fig. 1.1

One end of the rod is hit with a hammer. A stationary sound wave is set up within the rod. The rod vibrates at its resonant frequency *f*.

A microphone placed at the other end of the rod detects the sound wave emitted from the rod. The frequency of the detected sound is also *f*.

A number of rods of different length are available.

It is suggested that *f* is related to *L* by the relationship

$$2fL^n = \sqrt{\frac{E}{\rho}}$$

where ρ is the density of the metal, and *E* and *n* are constants.

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

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for *E* and *n*.

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 student investigates an electrical circuit.

A power supply with negligible internal resistance is connected to six resistors, each of resistance Z, and a resistor of resistance R, as shown in Fig. 2.1.

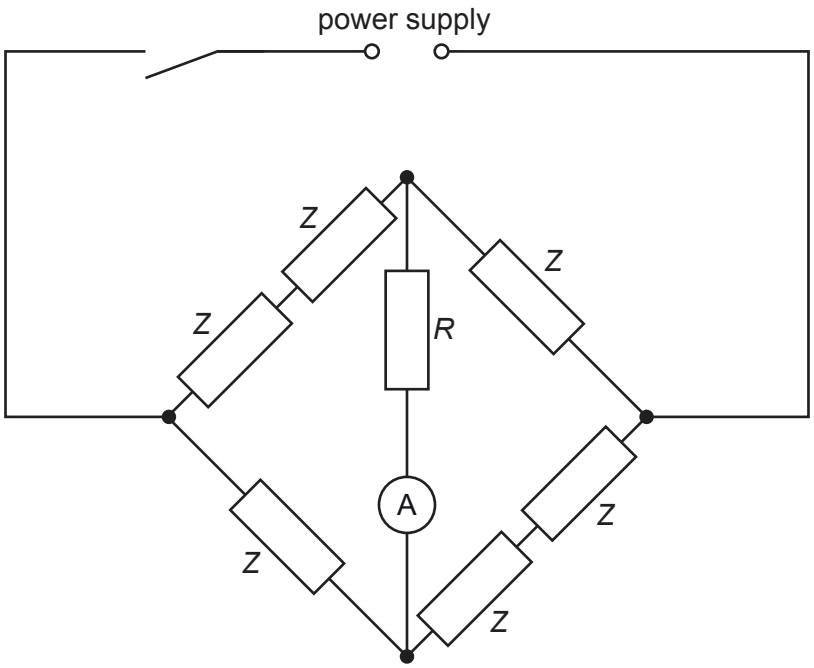

Fig. 2.1

The current measured by the ammeter is I.

The experiment is repeated for different values of R.

It is suggested that I and R are related by the equation

$$E = 3IR + 4IZ$$

where E is the electromotive force (e.m.f.) of the power supply.

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

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...

[1]

(b) Values of R and I are given in Table 2.1.

Table 2.1

R/kΩ	I/μA	$\frac{1}{I}$/A^{-1}
1.25	225 ± 5	
2.55	185 ± 5	
3.90	160 ± 5	
5.25	140 ± 5	
6.55	125 ± 5	
7.80	115 ± 5	

Calculate and record values of $\frac{1}{I}$/A^{-1} in Table 2.1.

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

(c) (i) Plot a graph of $\frac{1}{I}$/A^{-1} against R/kΩ. Include error bars for $\frac{1}{I}$. [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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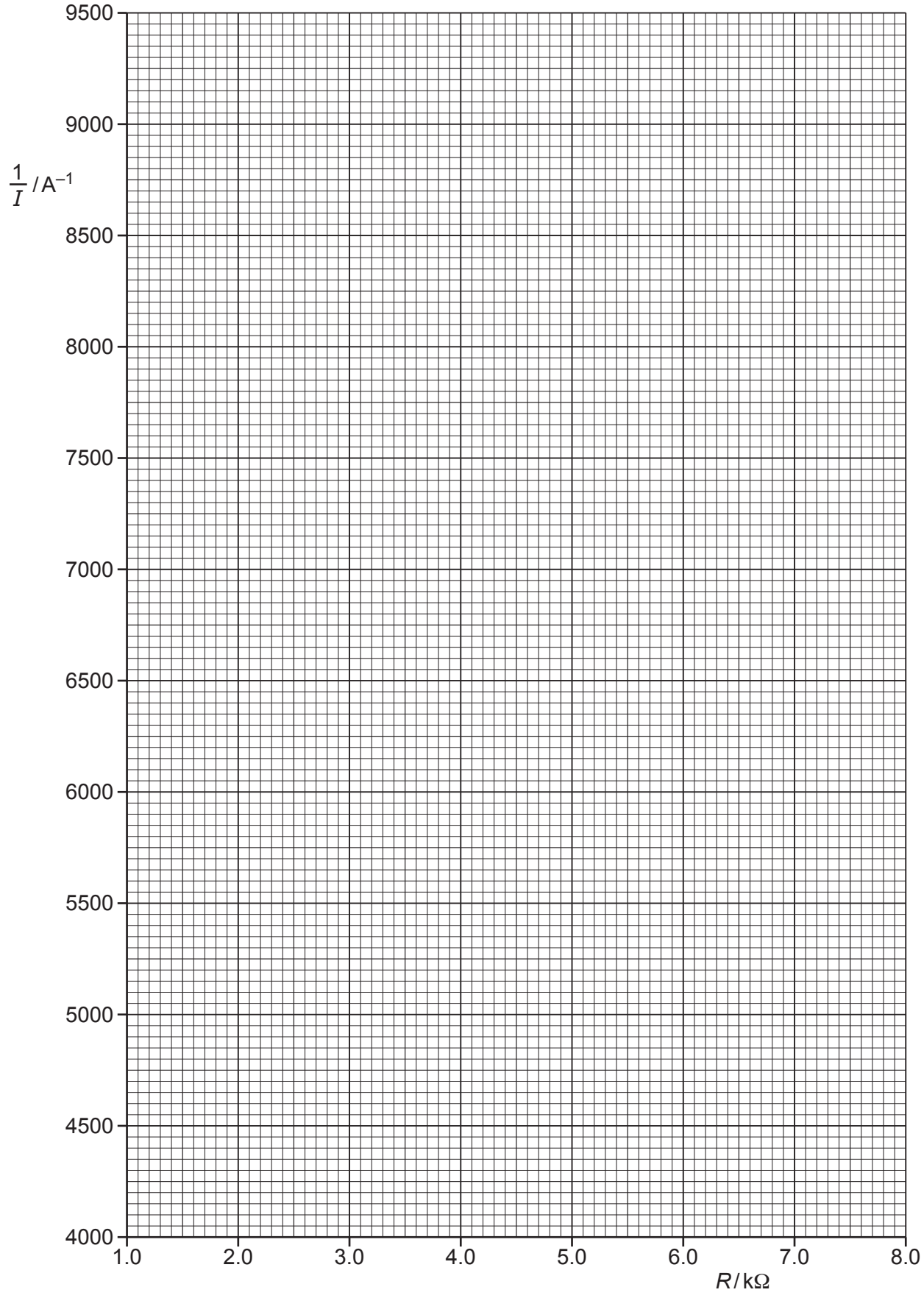
9500
9000
8500
8000
7500
7000
6500
6000
5500
5000
4500
4000
1/I / A⁻¹
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
R / kΩ

(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 *Z*. Include appropriate units.

E = ...

Z = ...
[2]

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

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

(e) The experiment is repeated. Determine the resistance *R* that gives a value of *I* of 0.10 mA.

R = ... Ω [1]

[Total: 15]

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