Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **9702/51**

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.

[Turn over

1 Fig. 1.1 shows a thin coil of cross-sectional area A and length l connected to a resistor of resistance S and two terminals.

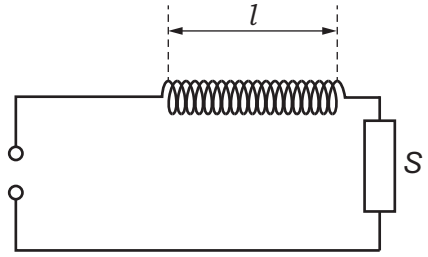


Fig. 1.1

An alternating voltage is applied to the terminals. The peak value of the alternating voltage is E and the frequency is f. The peak value of the potential difference V across the resistor is determined using an oscilloscope.

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

$$\frac{ES}{V} = \frac{KAN^2f}{l}$$

where N is the number of turns on the coil and K is a constant.

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

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine a value for K.

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.

Diagram

[15]

2 A student investigates an electrical circuit.

The circuit is set up as shown in Fig. 2.1.

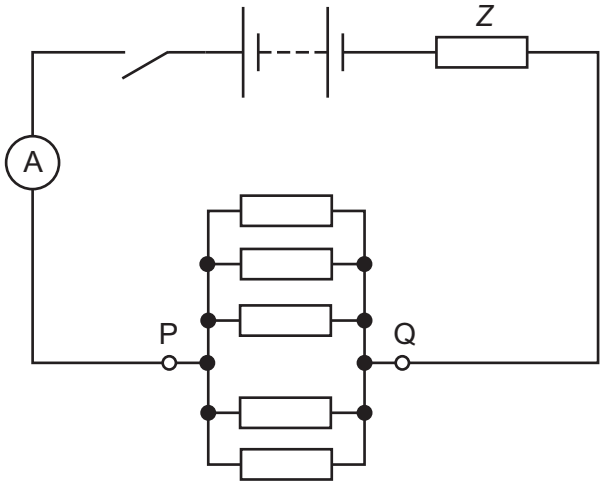


Fig. 2.1

A battery of negligible internal resistance is connected to a resistor of resistance Z. Five resistors, each of resistance R, are connected in parallel between P and Q.

The switch is closed. The total current I in the circuit is measured using the ammeter.

The experiment is then repeated by changing the number n of resistors, each of resistance R, connected in parallel between P and Q.

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

$$E = I\left(\frac{R}{n} + Z\right)$$

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

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

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...

[1]

(b) Values of n, $\frac{1}{n}$ and I are given in Table 2.1.

Table 2.1

n	$\frac{1}{n}$	I/μA	$\frac{1}{I}/10^3\text{A}^{-1}$
5	0.200	455 ± 5	
6	0.167	525 ± 5	
7	0.143	580 ± 5	
8	0.125	635 ± 5	
9	0.111	685 ± 5	
11	0.0909	765 ± 5	

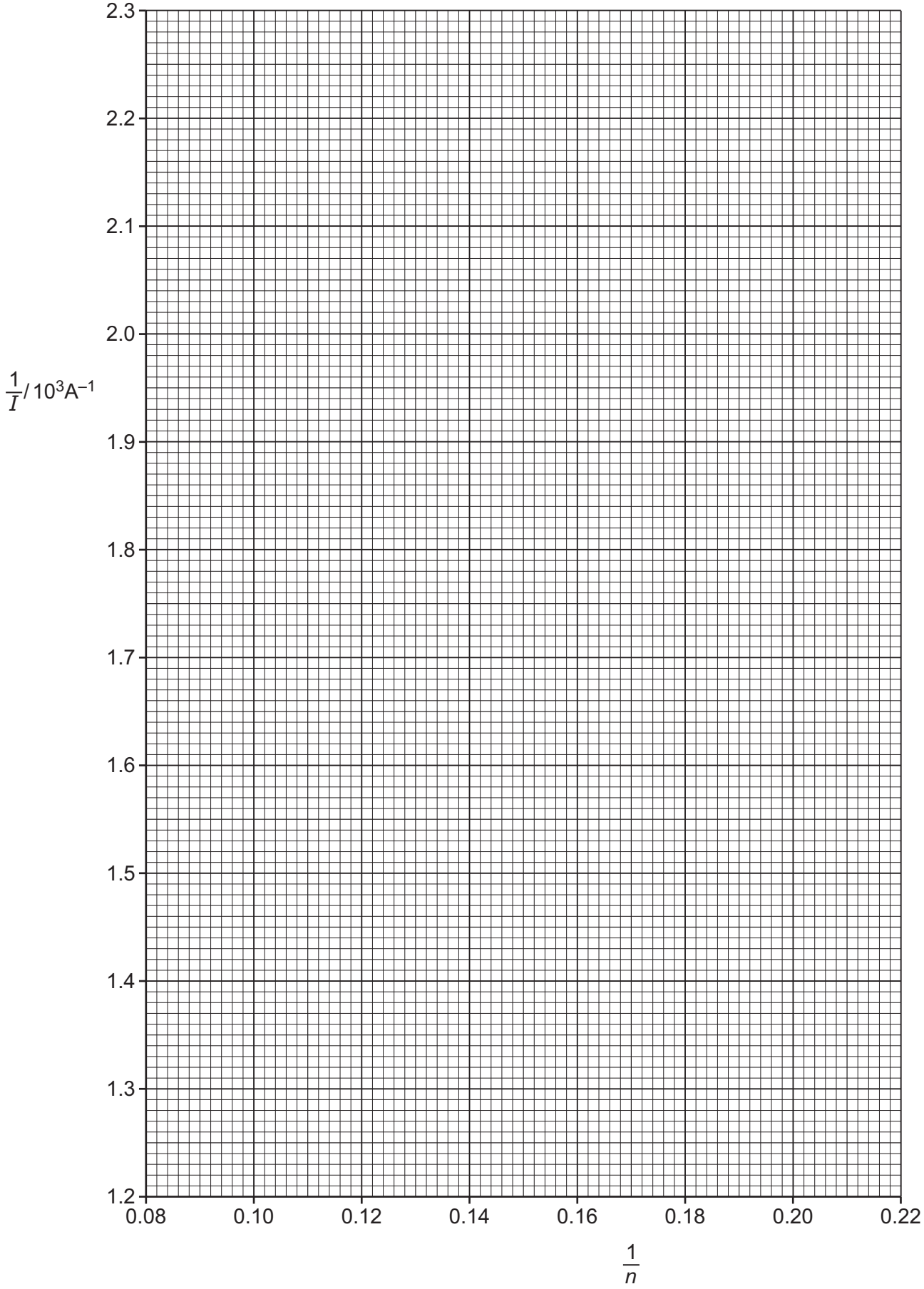
Calculate and record values of $\frac{1}{I}/10^3\text{A}^{-1}$ in Table 2.1. Include the absolute uncertainties in $\frac{1}{I}$. [2]

(c) (i) Plot a graph of $\frac{1}{I}/10^3\text{A}^{-1}$ against $\frac{1}{n}$. 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]



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

y-intercept = ... [2]

(d) The e.m.f. *E* of the battery is determined twice during the experiment. The values obtained are 5.6 V and 6.0 V.

(i) Using your answers to **(a)**, **(c)(iii)** and **(c)(iv)**, determine the values of *R* and *Z*. Include appropriate units.

R = ...

Z = ...
[2]

(ii) Determine the percentage uncertainty in your value of *R*.

percentage uncertainty = ... % [1]

(e) The experiment is repeated with 20 resistors, each of resistance *R*, connected in parallel between P and Q. Determine the total current *I* in the circuit.

I = ... A [1]

[Total: 15]