



Cambridge International AS & A Level

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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.

- 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.

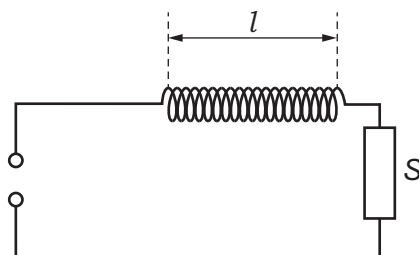


Fig. 1.1

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.



[illegible]

..... [15]

- 2 A student investigates an electrical circuit.

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

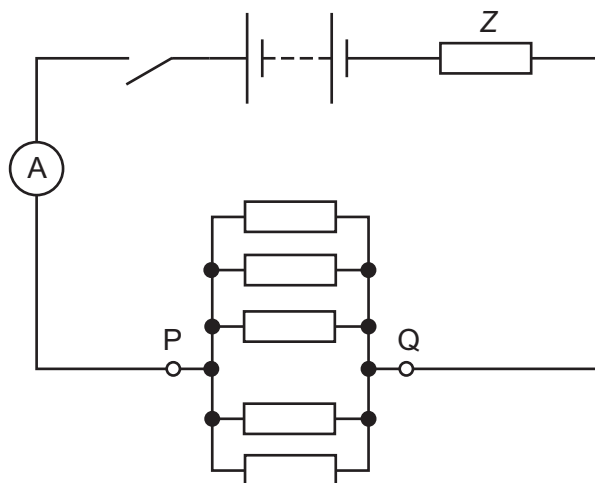


Fig. 2.1

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	$\frac{1}{n}$	$I/\mu\text{A}$	$\frac{1}{I}/10^3\text{A}^{-1}$
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]

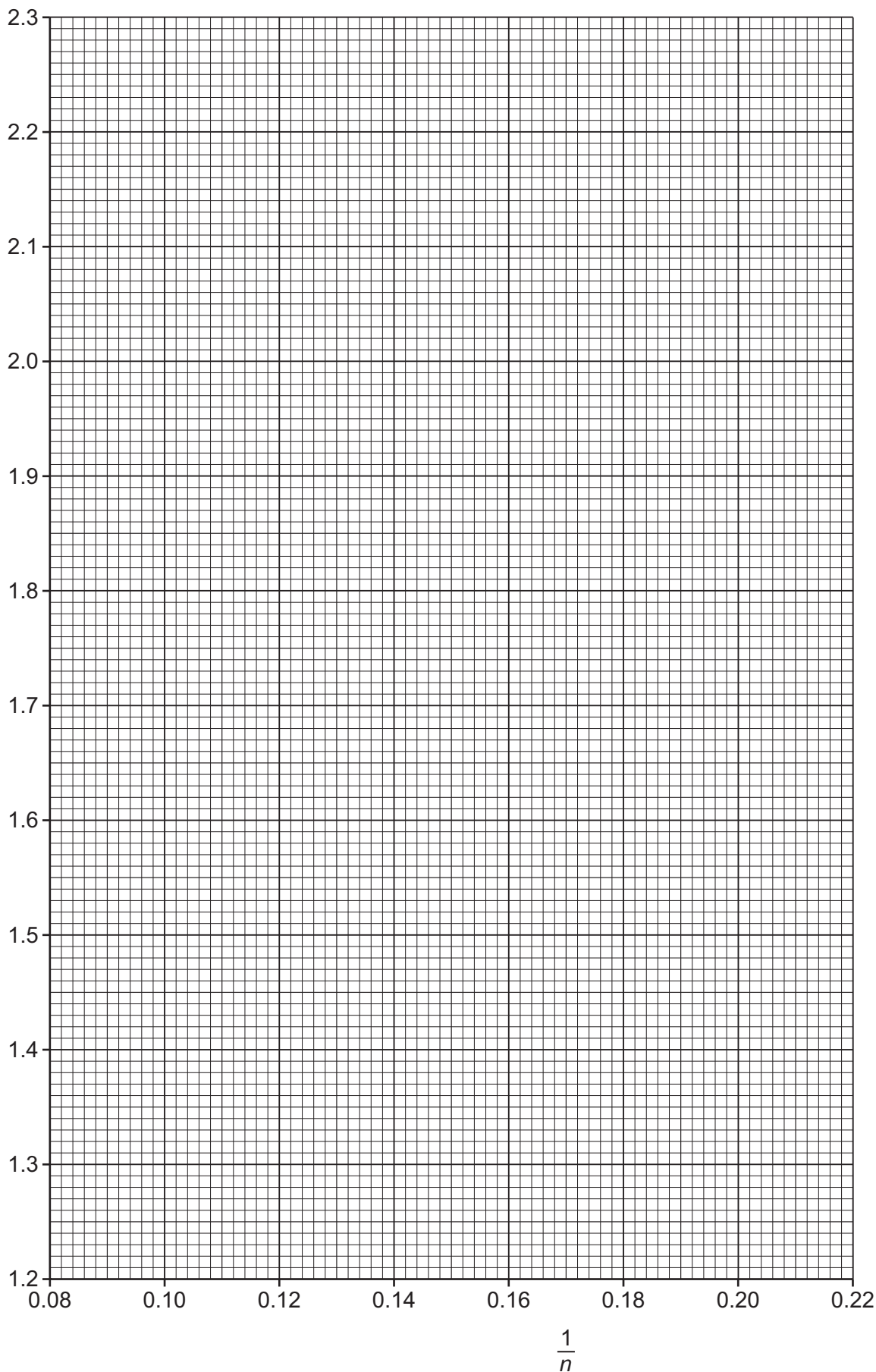
- (c) (i) Plot a graph of $\frac{1}{I}/10^3\text{A}^{-1}$ against $\frac{1}{n}$. Include error bars for $\frac{1}{I}$. [2]
- (ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Label both lines. [2]
- (iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = [2]





$\frac{1}{I} / 10^3 \text{A}^{-1}$





- (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]

