



Cambridge International AS & A Level

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PHYSICS

9702/53

Paper 5 Planning, Analysis and Evaluation

October/November 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.

- 1 A thin cylindrical bar magnet of length L and cross-sectional area A is attached to a block. An identical magnet is attached to a trolley, as shown in Fig. 1.1.

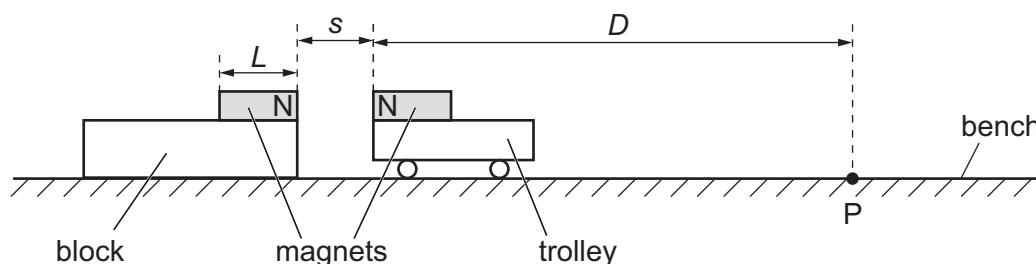


Fig. 1.1

The trolley is held so that the separation of the N poles of the two magnets is s .

Point P is a distance D from the N pole of the magnet on the stationary trolley.

The trolley is released. The speed v of the trolley at point P is determined using one light gate.

It is suggested that v is related to s by the relationship

$$\frac{mv^2}{2D} = \frac{KA^2B^2L^2}{s^4} - Q$$

where B is the magnetic flux density at the N pole of one of the magnets, m is the mass of the trolley, and K and Q are constants.

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

Draw a diagram showing the arrangement of your equipment.

Explain how the results could be used to determine values for K 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 an electrical circuit. A power supply of electromotive force (e.m.f.) E_s and negligible internal resistance is connected in series to three resistors, each of resistance Z .

A cell, an ammeter and a resistor of resistance R are connected in parallel across one of these resistors, as shown in Fig. 2.1.

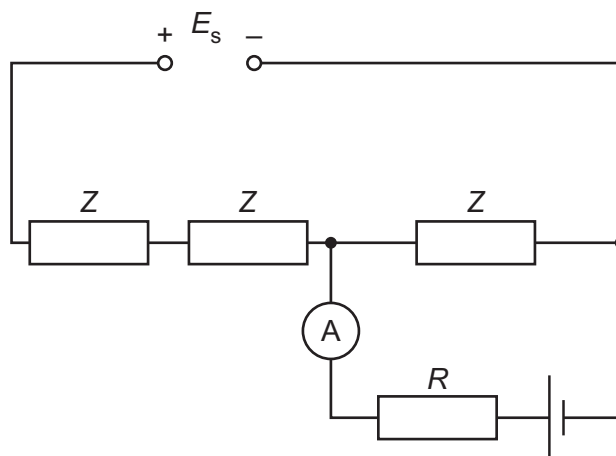


Fig. 2.1

The current I is measured by the ammeter for different values of R .

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

$$3E - E_s = I(3R + 2Z)$$

where E is the e.m.f. of the cell.

- (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

$R/\text{k}\Omega$	$I/\mu\text{A}$	$\frac{1}{I}/\text{A}^{-1}$
1.50	194 ± 2	
1.75	180 ± 2	
1.92	172 ± 2	
2.22	160 ± 2	
2.48	150 ± 2	
2.72	144 ± 2	

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

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

(c) (i) Plot a graph of $\frac{1}{I}/\text{A}^{-1}$ against $R/\text{k}\Omega$. 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]

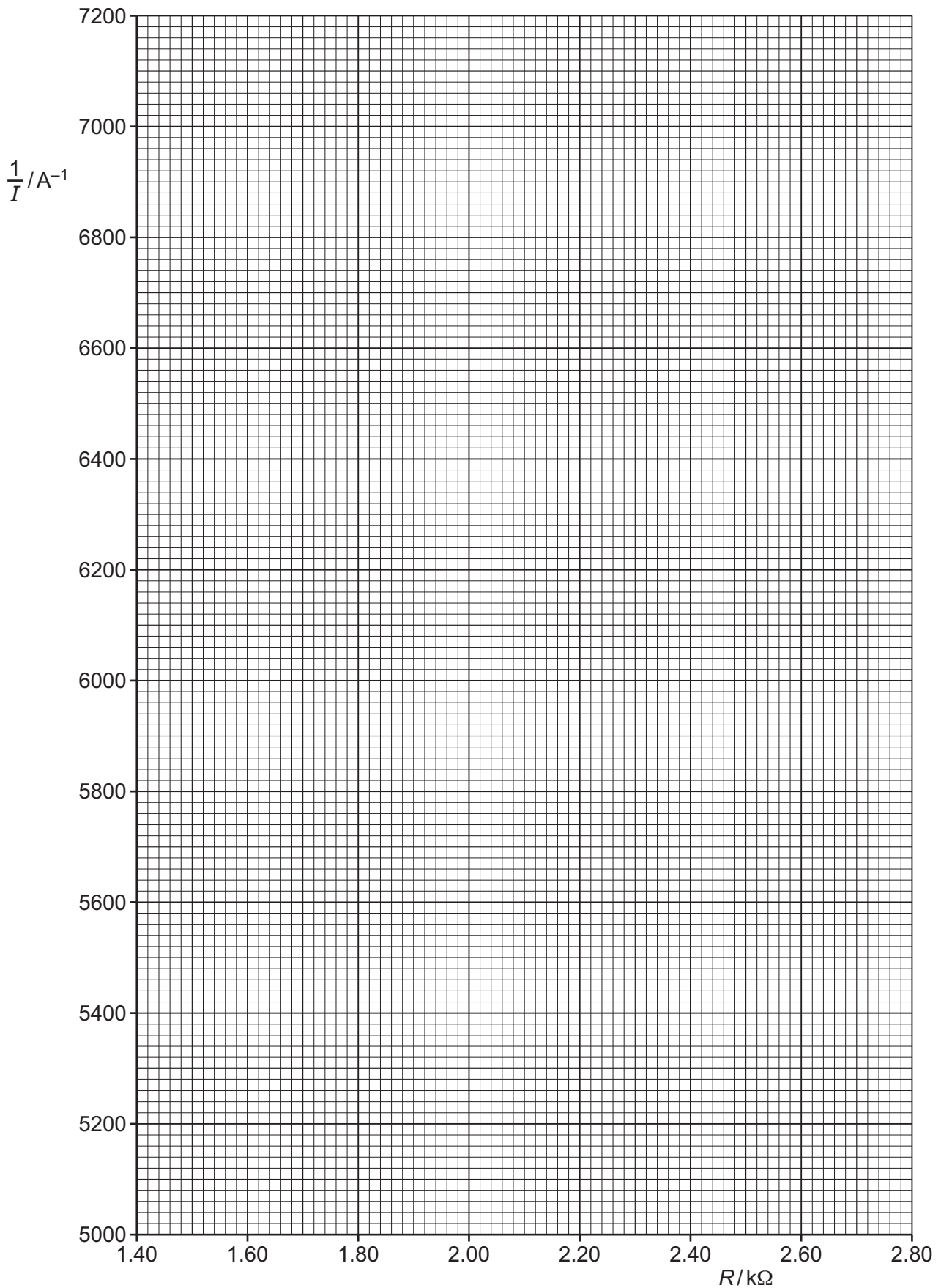
(iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = [2]





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- (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.

Data: $E_s = (2.20 \pm 0.05) \text{ V}$

$E = \dots\dots\dots$

$Z = \dots\dots\dots$ [2]

- (ii) Determine the absolute uncertainty in E .

absolute uncertainty in $E = \dots\dots\dots$ [1]

- (e) The experiment is repeated. Determine the resistance R that gives a value of I of $250 \mu\text{A}$.

$R = \dots\dots\dots \Omega$ [1]

[Total: 15]

