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9702/52

May/June 2013

1 hour 15 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

You may lose marks if you do not show your working or if you do not use appropriate units.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **8** printed pages.

- 1 A student is investigating how the peak alternating current I_0 varies with frequency f in a circuit containing a coil of wire.

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Use

It is suggested that

$$\left(\frac{V_0}{I_0}\right)^2 = R^2 + 4\pi^2 f^2 L^2$$

where R is the resistance of the coil, V_0 is the peak voltage and L is a constant.

Design a laboratory experiment to test the relationship between I_0 and f and determine a value for L . You should draw a diagram, on page 3, showing the arrangement of your equipment. In your account you should pay particular attention to

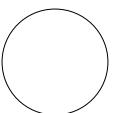
- (a) the procedure to be followed,
- (b) the measurements to be taken,
- (c) the control of variables,
- (d) the analysis of the data,
- (e) the safety precautions to be taken.

[15]

[illegible]

[illegible]

For Examiner's Use	Defining the problem	Methods of data collection	Method of analysis	Safety considerations	Additional detail



- 2 An electron beam is accelerated by a voltage V before entering a uniform electric field of electric field strength E between two parallel plates.

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The electron beam travels a horizontal distance a parallel to the plates before hitting the top plate after being deflected through a vertical distance b . The path of the electrons is shown in Fig. 2.1.

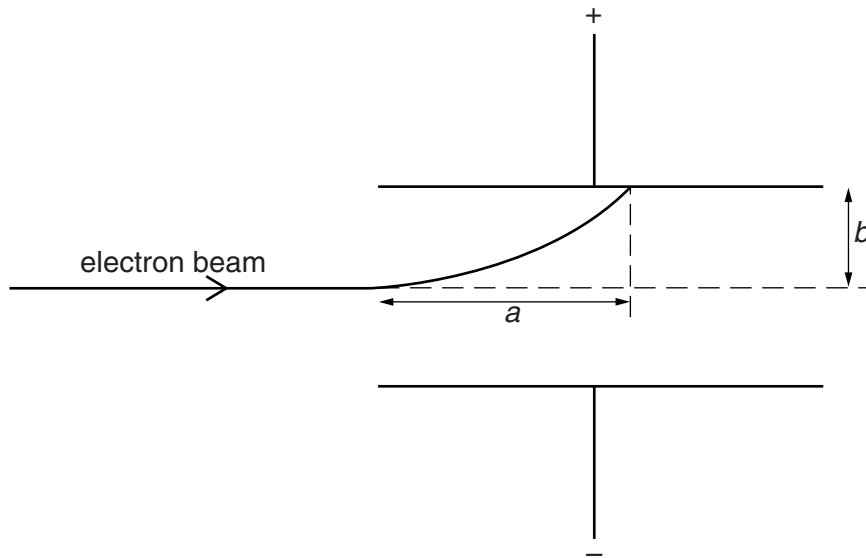


Fig. 2.1

For different values of V , the horizontal distance a is recorded.

Question 2 continues on the next page.

It is suggested that V and a are related by the equation

$$a = \sqrt{\frac{4Vb}{E}}.$$

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- (a) A graph is plotted of a^2 on the y -axis against V on the x -axis. Determine an expression for the gradient in terms of E .

gradient =[1]

- (b) Values of V and a are given in Fig. 2.2.

V/V	$a/10^{-2}\text{m}$	
1000	6.6 ± 0.1	
1200	7.2 ± 0.1	
1400	7.8 ± 0.1	
1600	8.4 ± 0.1	
1800	8.9 ± 0.1	
2000	9.4 ± 0.1	

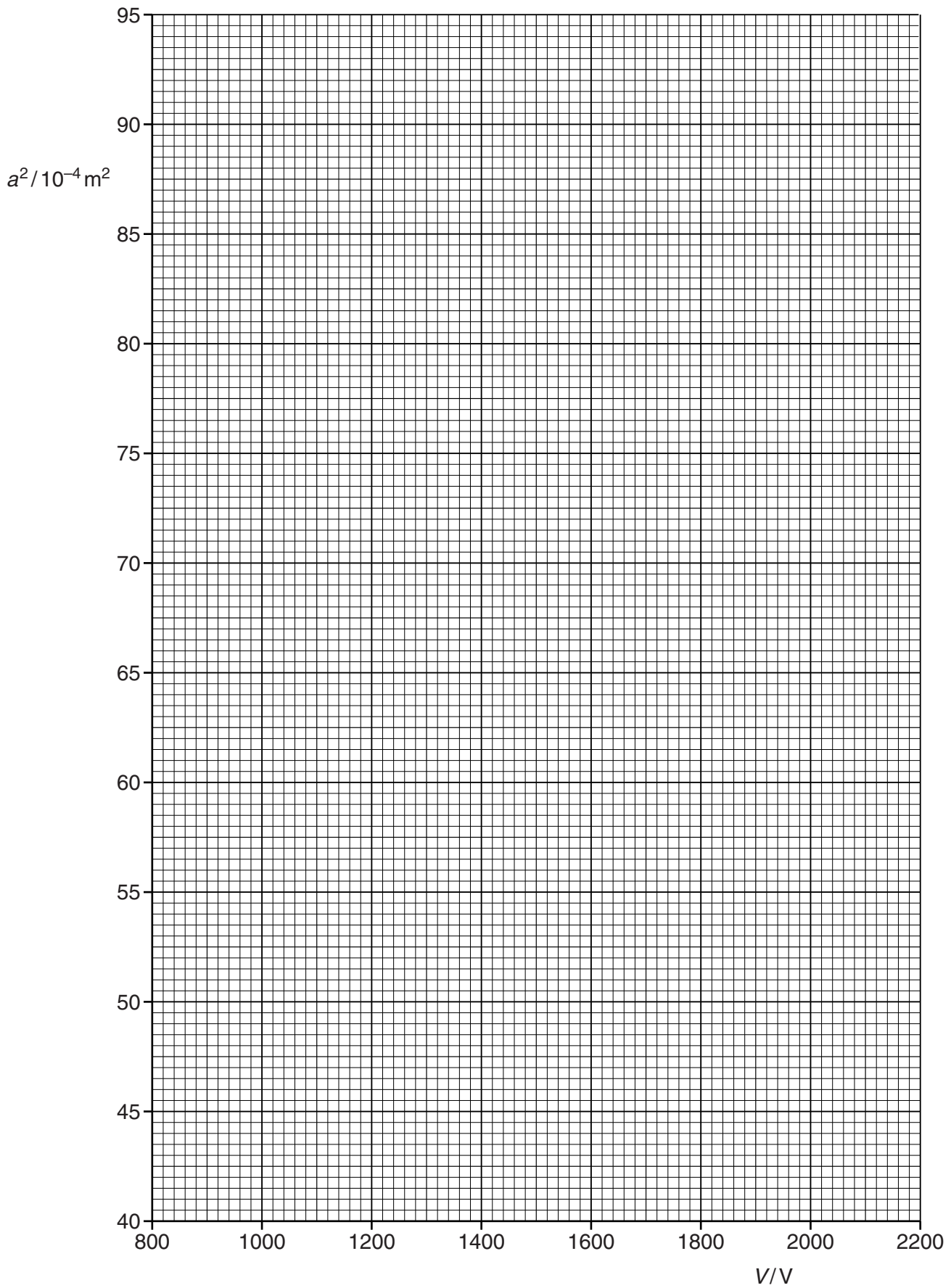
Fig. 2.2

Calculate and record values of $a^2/10^{-4}\text{m}^2$ in Fig. 2.2. Include the absolute uncertainties in a^2 . [3]

- (c) (i) Plot a graph of $a^2/10^{-4}\text{m}^2$ against V/V . Include error bars for a^2 . [2]
- (ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]
- (iii) Determine the gradient of the line of best fit. Include the uncertainty in your answer.

gradient = [2]

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- (d) (i) Using your answer to (c)(iii), determine a value for E . Include an appropriate unit in your answer.

Data: $b = (4.0 \pm 0.1) \times 10^{-2} \text{ m}$

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$E = \dots\dots\dots$ [2]

- (ii) Determine the percentage uncertainty in your value of E .

percentage uncertainty = $\dots\dots\dots\%$ [1]

- (e) Using your answers to (d), determine a value for V to give a distance $a = 5.0 \pm 0.1 \text{ cm}$. Include the absolute uncertainty in your answer.

$V = \dots\dots\dots$ V [2]

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