Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8195809274

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **May/June 2015**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

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

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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

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1 A student is investigating how the intensity of the reflection of sound from a wall varies with the thickness of foam attached to the wall, as shown in Fig. 1.1.

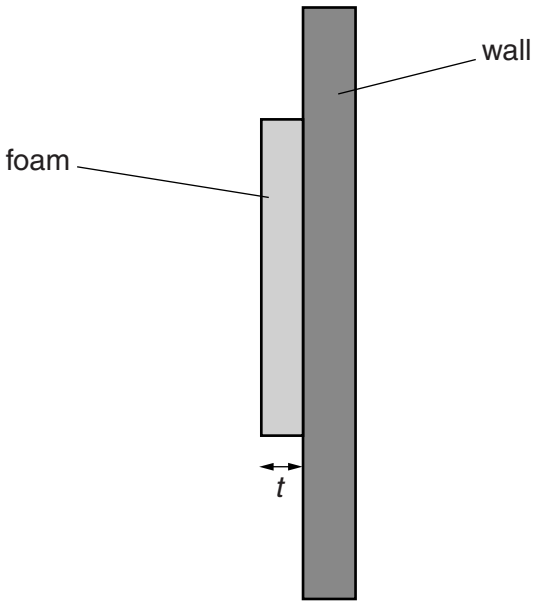

Fig. 1.1

It is suggested that the intensity I of the reflected sound is related to the thickness t of the foam by the relationship

$$I = I_0 e^{-\alpha\rho t}$$

where I_0 is the intensity of the sound before reflection, ρ is the density of the foam and α is a constant.

Design a laboratory experiment to test the relationship between I and t. Explain how your results could be used to determine a value for α. 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]

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Diagram

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Defining the problem	Methods of data collection	Method of analysis	Safety considerations	Additional detail

2 A student is investigating a circuit containing two horizontal parallel plates separated by an insulator.

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

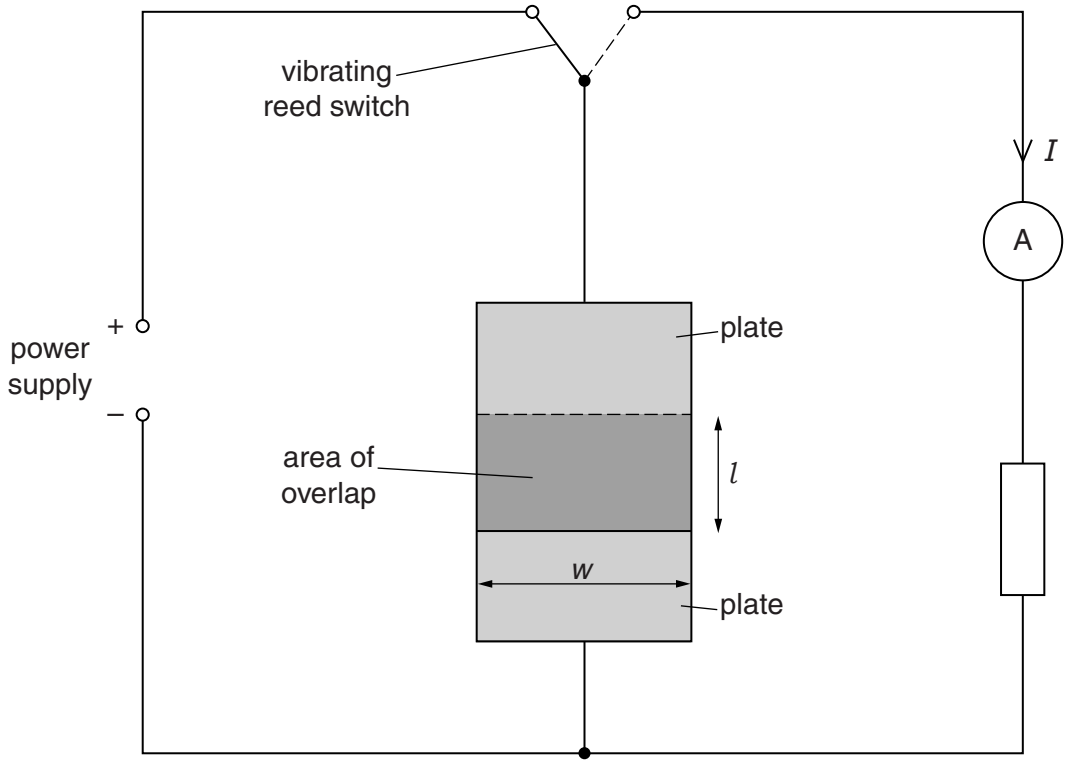

Fig. 2.1

An experiment is carried out to investigate how the current I varies with the area X of overlap of the parallel plates. The student measures the length l of overlap. To determine the area X of overlap, the student uses the relationship

$$X = wl$$

where w is the width of the plates.

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

$$\frac{I}{fX} = \frac{\varepsilon E}{d}$$

where E is the e.m.f. of the power supply, f is the frequency of the vibrating reed switch, d is the separation of the two parallel plates and ε is a constant.

(a) A graph is plotted of I on the y-axis against X on the x-axis.
Determine an expression for the gradient.

gradient = ...[1]

(b) The width w of the plates has a value of 0.300 ± 0.005 m.

Values of l and I are given in Fig. 2.2.

l/m	$I/10^{-6}$ A	
0.160 ± 0.005	4.6	
0.180 ± 0.005	5.3	
0.210 ± 0.005	6.2	
0.240 ± 0.005	7.1	
0.270 ± 0.005	8.0	
0.300 ± 0.005	8.8	

Fig. 2.2

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

(c) (i) Plot a graph of $I/10^{-6}$ A against $X/10^{-2}\,m^2$. Include error bars for X. [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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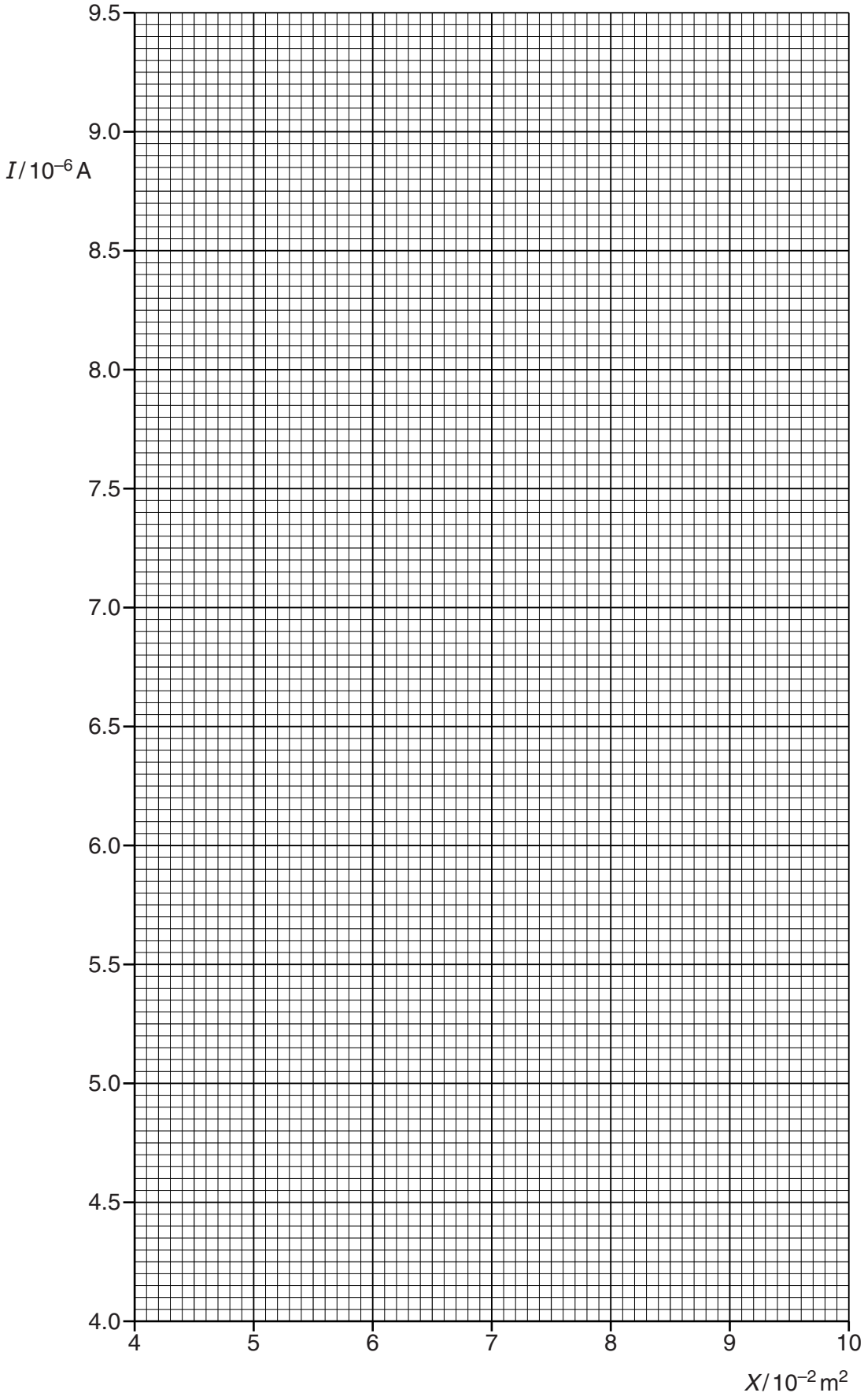
9.5
9.0
$I/10^{-6}$ A
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
4
5
6
7
8
9
10
$X/10^{-2}\,m^2$

(d) (i) Using your answers to **(a)** and **(c)(iii)**, determine the value of ε. Include an appropriate unit.

Data: $E = 12.0 \pm 0.2\,\text{V}$, $f = 400 \pm 10\,\text{Hz}$ and $d = 0.0030 \pm 0.0002\,\text{m}$.

ε = ...[2]

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

percentage uncertainty = ...% [1]

(e) The experiment is repeated with two square plates of length $0.500 \pm 0.001\,\text{m}$ which completely overlap. Determine the frequency f of the reed switch that will produce a current of $5.0 \pm 0.1\,\mu\text{A}$. Include the absolute uncertainty in your answer.

Data: $E = 12.0 \pm 0.2\,\text{V}$ and $d = 0.0030 \pm 0.0002\,\text{m}$.

f = ...Hz [2]

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