Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

0742236374

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2017**

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 flat circular coil P carrying a current produces a magnetic field. When a second coil Q is placed with its centre a distance x from the centre of coil P, as shown in Fig. 1.1, an e.m.f. V may be induced in coil Q.

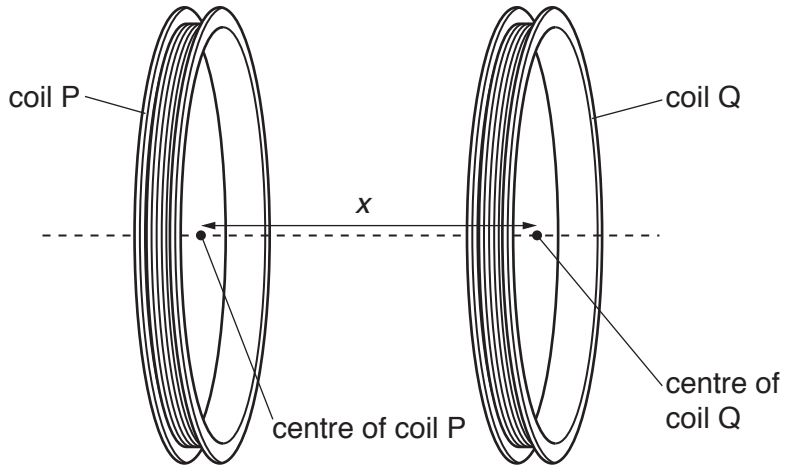

Fig. 1.1

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

$$V = V_0 e^{-kx}$$

where V_0 and k are constants.

Design a laboratory experiment to test the relationship between V and x. Explain how your results could be used to determine a value for k. You should draw a diagram, on page 3, showing the arrangement of your equipment. In your account you should pay particular attention to

- 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.

[15]

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Diagram

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[Total: 15]

2 A student is investigating stationary waves on a stretched elastic cord. A vibrator attached to the cord is connected to a signal generator.

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

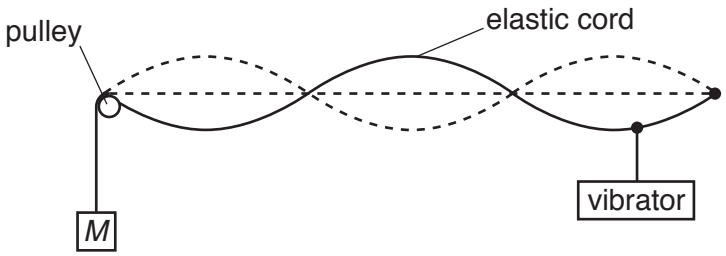

Fig. 2.1

The mass M attached to the cord is adjusted until resonance is obtained. The number n of antinodes on the stationary wave is recorded.

The experiment is repeated with different masses to obtain different values of n.

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

$$f = \frac{n}{2L}\sqrt{\frac{Mg}{\mu}}$$

where f is the frequency of the vibrator, g is the acceleration of free fall, L is the length of the elastic cord and μ is the mass per unit length of the elastic cord.

(a) A graph is plotted of M on the y-axis against $\frac{1}{n^2}$ on the x-axis.

Determine an expression for the gradient.

gradient = ... [1]

(b) Values of n and M are given in Fig. 2.2.
The percentage uncertainty in each value of M is ±10%.

n	M/g	$\frac{1}{n^2}$
3	850 ±	
4	500 ±	
5	300 ±	
6	200 ±	
7	150 ±	
8	100 ±	

Fig. 2.2

Calculate and record values of $\frac{1}{n^2}$ in Fig. 2.2.
Determine the absolute uncertainties in M. [2]

(c) **(i)** Plot a graph of M/g against $\frac{1}{n^2}$.
Include error bars for M. [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 absolute uncertainty in your answer.

gradient = ...[2]

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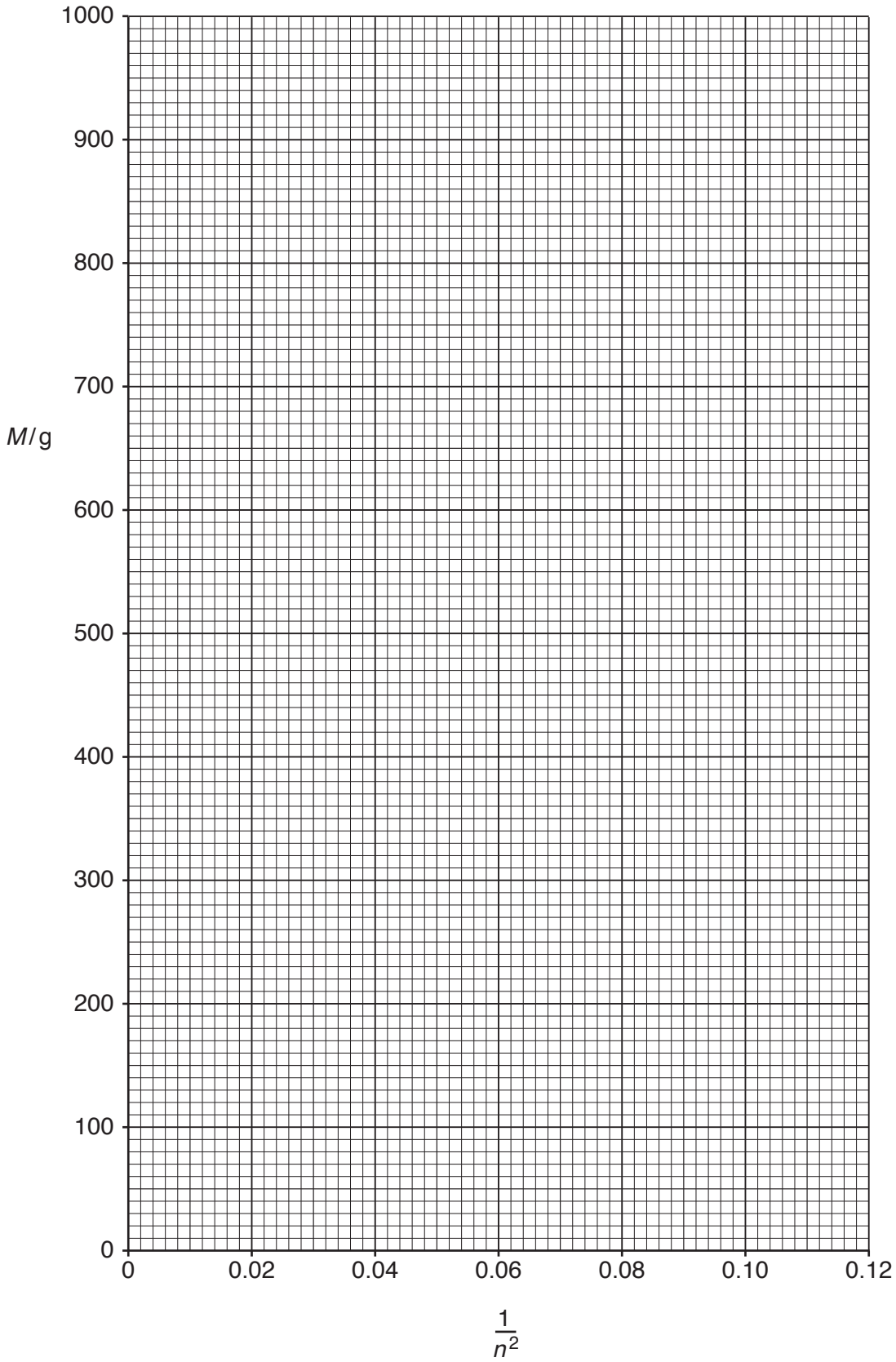
1000
900
800
700
M/g
600
500
400
300
200
100
0
0
0.02
0.04
0.06
0.08
0.10
0.12
1/n²

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

Data: $g = 9.81\,\text{m s}^{-2}$, $L = 1.54 \pm 0.01\,\text{m}$ and $f = 120 \pm 5\,\text{Hz}$.

μ = ...[3]

(ii) Determine the percentage uncertainty in μ.

percentage uncertainty in μ = ... % [1]

(e) The experiment is repeated using the same cord. The frequency is changed to $180 \pm 5\,\text{Hz}$. Determine the mass M required to produce a wave with two antinodes. Include the absolute uncertainty in your answer.

M = ... kg [2]

[Total: 15]

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