OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

PHYSICS A — 2826/03/TEST

Practical Examination 2 (Part B – Practical Test)

Friday **30 JANUARY 2004** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Electronic Calculator
Candidate's Plan (Part A of the Practical Test)

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read the questions carefully.

INFORMATION FOR CANDIDATES

- In the Practical Test you will be assessed on the Experimental and Investigative Skills:
  Skill I Implementing
  Skill A Analysing evidence and drawing conclusions
  Skill E Evaluating
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- You will be awarded marks for the quality of written communication where this is indicated in the question.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
Planning	**16**	
1	**28**	
2	**16**	
TOTAL	**60**	

This question paper consists of 12 printed pages.

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For Examiner's Use

It is recommended that you spend about 1 hour on this question.

1 In this experiment, you will investigate the variation of the fundamental frequency of vibration of a metal strip (hacksaw blade) with length of strip. You will use the results of your experiment to find a value for the Young modulus E of the metal from which the strip is made.

(a) Clamp the metal strip to the benchtop using the G-clamp and the small blocks of wood which have been provided so that the protruding length is about 25 cm. The arrangement is shown in Fig. 1.1. The metal strip has two small 50 g masses, M, attached to one end. You should not disturb the position of these masses during the course of the experiment. The protective tape covering the serrated edge does not affect the results of the experiment.

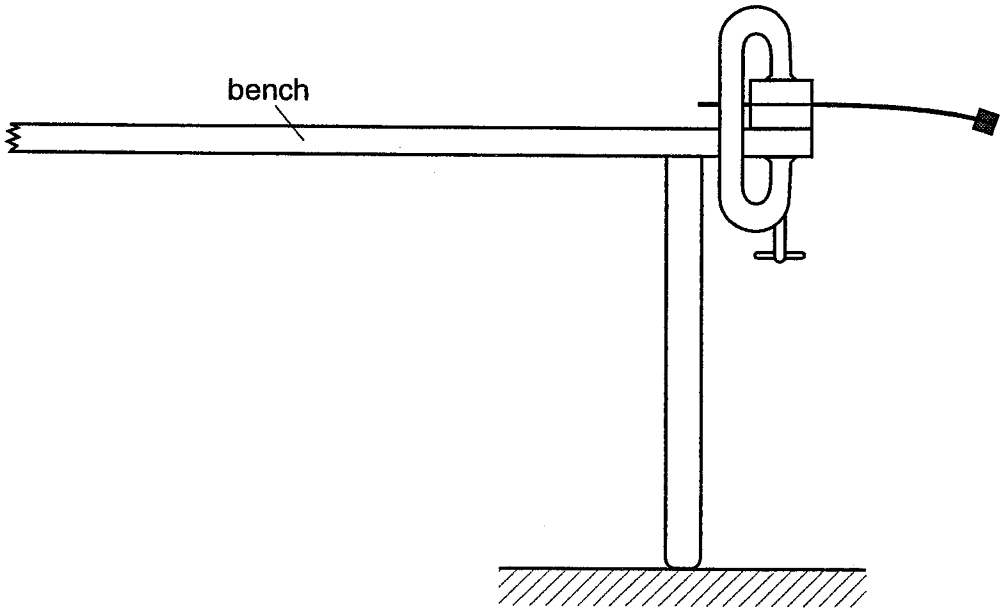

Fig. 1.1

(b) (i) Measure the length l from the centre of one of the masses to the edge of the wooden blocks as shown in Fig. 1.2. You will need to support the masses when you make this measurement.

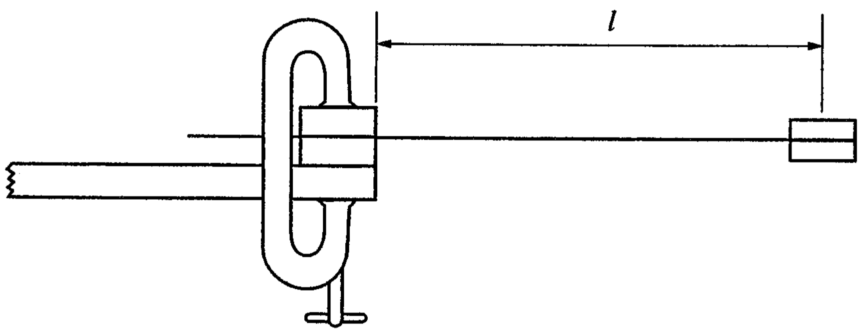

Fig. 1.2

l = ... m

For Examiner's Use

(ii) Gently displace the end of the strip from its equilibrium position and release it so that the strip performs small oscillations in a vertical plane. Make and record measurements to determine the period T of oscillation of the strip.

T = ... s

(iii) Use your answer from **(ii)** to calculate the frequency f of oscillation of the strip.

f = ... Hz

(iv) Justify the number of significant figures which you have given for f.

....

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....

(c) **(i)** Change the value of l and repeat **(b)** **(i)**, **(ii)** and **(iii)** until you have six sets of readings of length l and frequency f for values of l in the range $0.120\,\text{m} < l < 0.260\,\text{m}$.
Include in your table of results, all six values for lg (f/Hz) and lg (l/m).

(ii) Explain why it would be difficult to determine values of f for $l < 10\,\text{cm}$.

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(d) **(i)** Plot a graph of lg (f/Hz) (y-axis) against lg (l/m) (x-axis).

(ii) Determine the gradient and y-intercept of the line of best fit.

gradient = ...

y-intercept = ...

For Examiner's Use

[Turn over

For Examiner's Use

(e) It is thought that f and l are related by a simple power law of the form

$$f = kl^n$$

where n and k are constants.

Use your answers from **(d) (ii)** to determine values for n and k. You need **not** be concerned with the units of these quantities.

n = ...

k = ...

(f) A theoretical treatment of this oscillator shows that

$$k = \sqrt{\frac{Ebd^3}{16\pi^2 M}}$$

where b is the width of the strip, d is the thickness of the strip, M is the mass attached to the end of the strip and E is the Young Modulus. The value of b is written on a card.

(i) Measure the value of d.

d = ...m

(ii) State the name of the instrument used to measure d.

....

(iii) Estimate the percentage uncertainty in the value of d^3.

percentage uncertainty in d^3 = ...%

For Examiner's Use

(g) Determine a value for *E*. Include an appropriate unit.

E = ... unit ....

[Turn over

It is recommended that you spend about 30 minutes on this question.

2 In this question, you will investigate heating effects due to an alternating current (a.c.) and a direct current (d.c.).

(a) Clamp a length of resistance wire above the bench using crocodile clips, two stands, bosses and clamps as shown in Fig. 2.1. You may find it necessary to wrap the wire around the crocodile clips a few times to prevent the wire slipping. The crocodile clips should be gripped firmly by the clamps. Masses should be placed on the bases of the stands so that the wire remains reasonably taut.

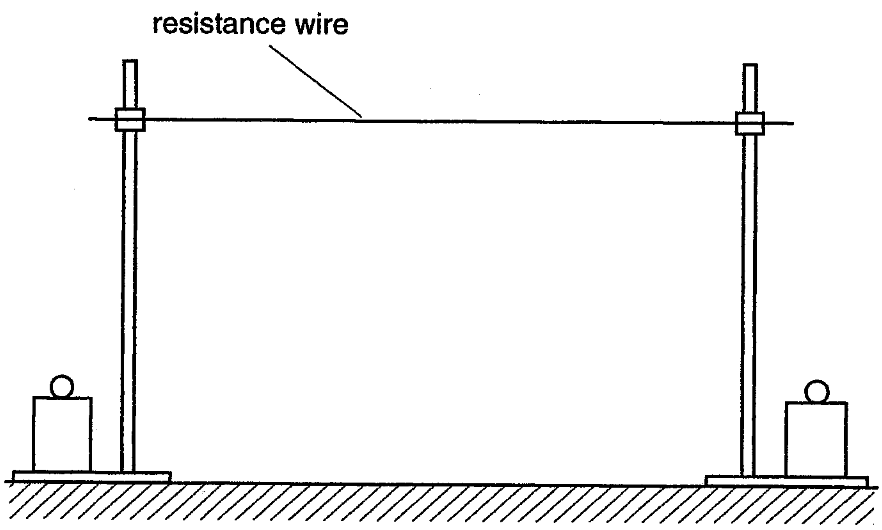

Fig. 2.1

(b) (i) Mount a rule vertically using a channel slotted base and suspend a mass holder from the centre of the wire. The mass holder has a pointer attached so that its position can be determined from the rule. The arrangement should be as shown in Fig. 2.2.

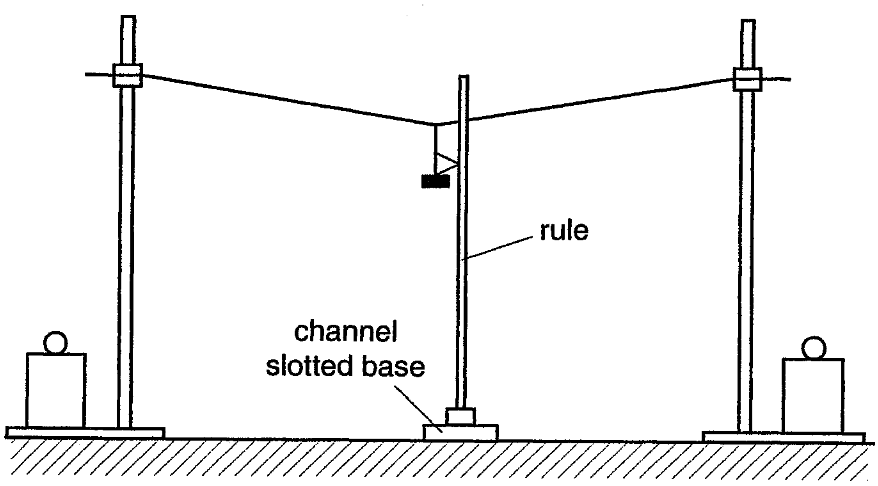

Fig. 2.2

(ii) Record the position of the pointer on the rule.

pointer reading = ... cm

For Examiner's Use

(c) **(i)** Connect the ends of the wire to an alternating current supply. The output of this supply has been fixed, and you should **not** adjust its setting.

(ii) Switch on the power supply. The wire will become quite warm and you should **not** touch it while the supply is on. Note the new pointer reading.

new pointer reading = ... cm

(iii) Switch off the power supply and disconnect the resistance wire from the supply.

(iv) Calculate the change in the pointer reading.

change in pointer reading = ... cm

(d) **(i)** Connect a d.c. power supply, switch and ammeter in series with the wire. The circuit is shown in Fig. 2.3.

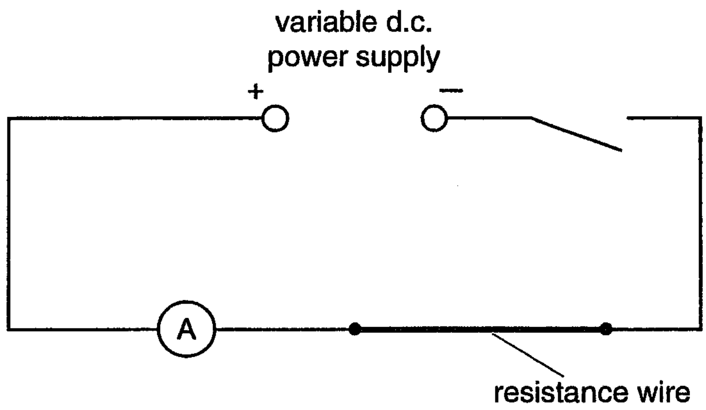

Fig. 2.3

(ii) Record the position of the pointer on the rule.

pointer reading = ... cm

(iii) Close the switch and adjust the current in the wire until the **change** in the pointer reading is the same as in **(c)(iv)**. Record the value of this current.

I = ... A

(iv) Switch off the power supply and disconnect the resistance wire from the supply.

(v) In the first circuit, an a.c. ammeter gives a reading of 3.0 A. This current will give the same heating effect as a direct current of 3.0 A. Calculate the percentage difference between the alternating current and the direct current you have measured in **(iii)**.

percentage difference = ... %

(vi) Suggest why this experiment may not work for currents of more than 20 A.

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[Turn over

For Examiner's Use

(e) In this question, two marks are available for the quality of written communication.

Write an evaluation of the procedure which you have followed to compare the heating effects of alternating and direct currents. You should include some of the limitations of the procedure and suggest ways in which the experiment may be improved, giving reasons for your suggestions.

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Quality of Written Communication

END OF QUESTION PAPER