UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

2231879907

PHYSICS **9702/31**

Paper 31 Advanced Practical Skills 1 **May/June 2010**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

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

Answer **both** questions.
You will be allowed to work with the apparatus for a maximum of one hour for each question.
You are expected to record all your observations as soon as these observations are made, and to plan the presentation of the records so that it is not necessary to make a fair copy of them.
You may lose marks if you do not show your working or if you do not use appropriate units.

Additional answer paper and graph paper should be used only if it becomes necessary to do so.
You are reminded of the need for good English and clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
All questions in this paper carry equal marks.

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1	
2	
Total	

This document consists of **9** printed pages and **3** blank pages.

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1 In this experiment, you will measure the potential difference (p.d.) across a set of resistors in series and the current through the resistors.

(a) Measure and record the e.m.f. of the power supply.

e.m.f. = ... V

(b) (i) Connect the circuit of Fig. 1.1, ensuring that the movable lead is connected between resistors 1 and 2.

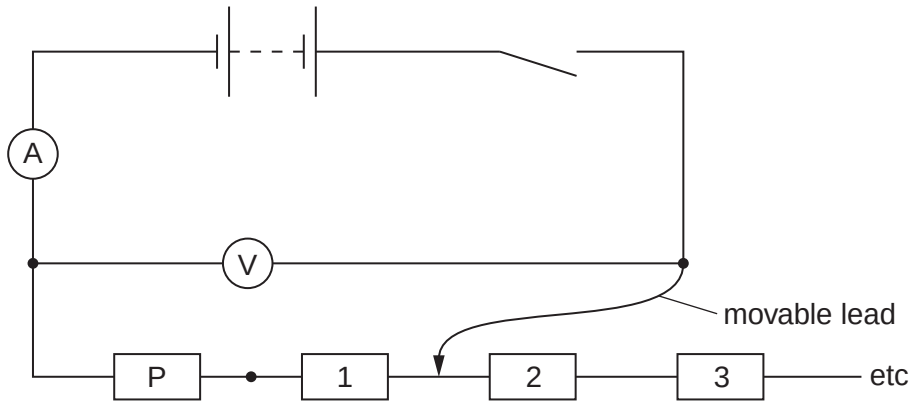


Fig. 1.1

(ii) Close the switch and record the voltmeter reading V and the ammeter reading I.

After recording your results, open the switch.

V = ... V

I = ... A

(iii) Using your answer to **(b)(ii)**, calculate the total resistance R of resistor P in series with resistor 1.

($R = \frac{V}{I}$)

R = ...Ω

(c) By adjusting the movable lead, the resistor P may be connected in series with a number N of other resistors, giving different values of the total resistance R. In **(b)**, $N = 1$.

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Repeat **(b)(ii)**, for different values of N, until you have six sets of readings for N, V and I.
Include values of $\frac{1}{R}$ in your table of results.

(d) **(i)** Plot a graph of I on the y-axis against $\frac{1}{R}$ on the x-axis.

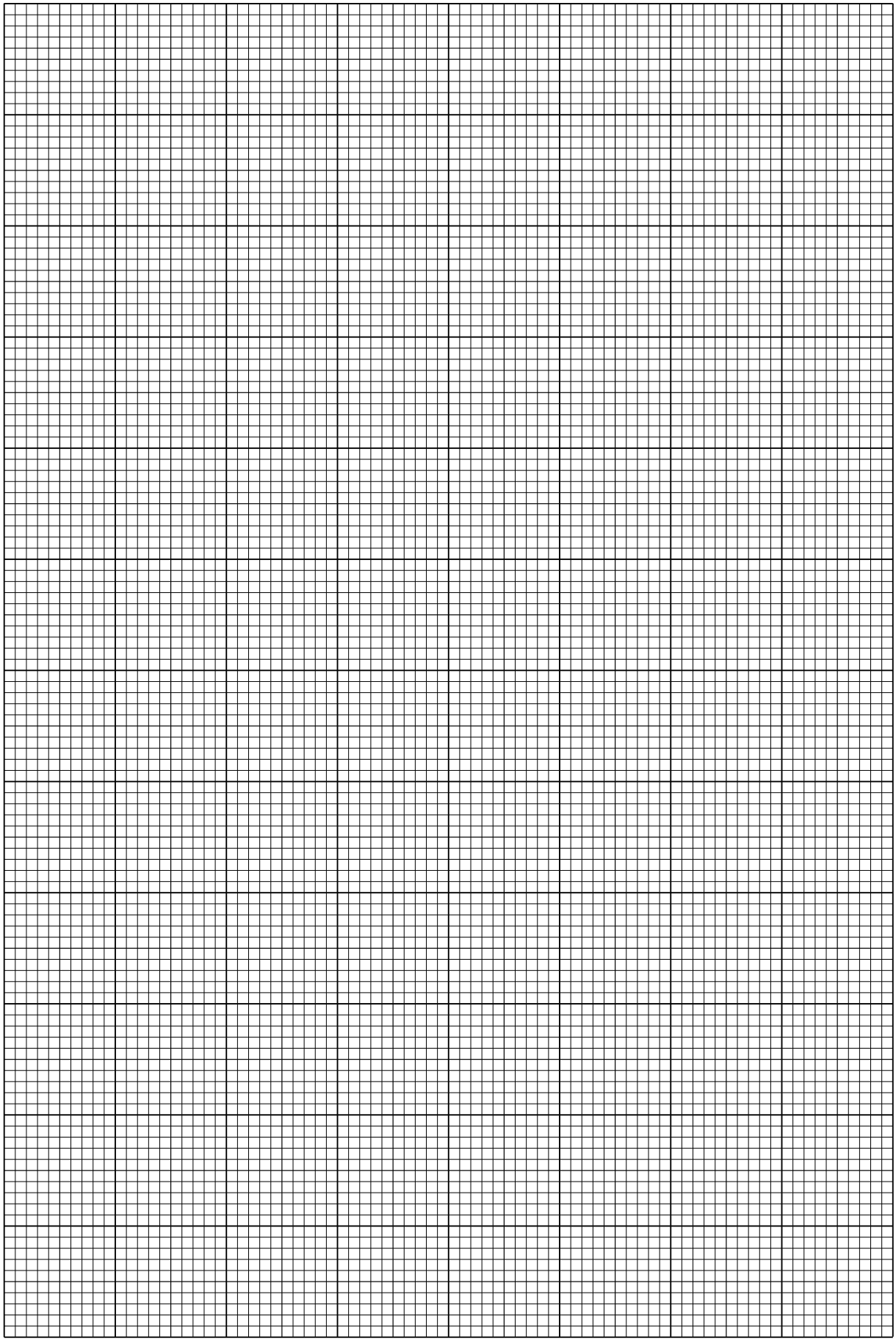
(ii) Draw the line of best fit.

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

gradient = ...

y-intercept = ...

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(e) The quantities I and R are related by the equation

$$I = \frac{M}{R} + L$$

where M and L are constants.

Using your answers from **(d)(iii)**, determine values for M and L. You should include units where appropriate.

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M = ...

L = ...

You may not need to use all of the materials provided.

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2 In this experiment, you will investigate how the time of swing of a tube depends on its length.

(a) You are provided with two tubes and a string that has a loop at each end.

(i) Pass the string through the shorter tube, as shown in Fig. 2.1a. Pass one loop through the other loop, as shown in Fig. 2.1b, to secure the tube in place, as shown in Fig. 2.1c.

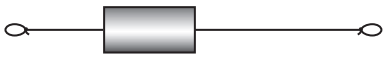


Fig. 2.1a

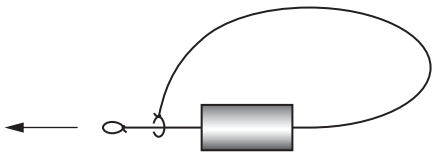


Fig. 2.1b

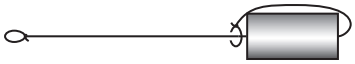


Fig. 2.1c

(ii) Hang the string from the clamp, as shown in Fig. 2.2.

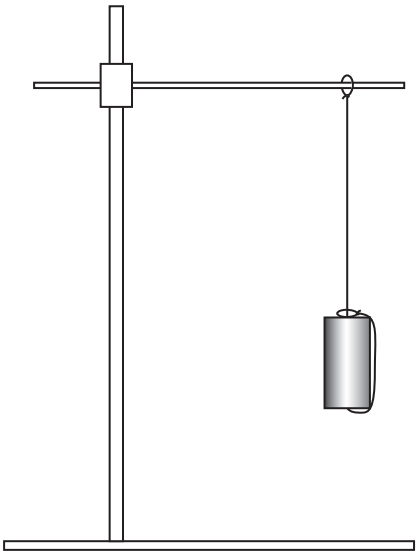


Fig. 2.2

(b) Displace the tube, as shown in Fig. 2.3.
Release the tube.

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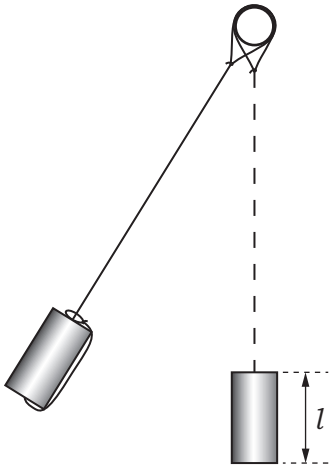


Fig. 2.3

The time the tube takes to return to the release position for the first time is the time period T. This may be determined accurately by measuring the time taken for the tube to complete several swings, backwards and forwards.

Showing all your working, determine an accurate value for the time period T.

T = ... s

(c) **(i)** Using the vernier calipers, measure the length l of the shorter tube, as shown in Fig. 2.3.

l = ...

(ii) Explain how you have made this measurement as accurate as possible.

.....

.....

.....

(iii) Estimate the percentage uncertainty in this measurement of l. Show all your working.

percentage uncertainty = ...

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(d) **(i)** Pass the string through the longer tube so that it rests above the shorter tube, as shown in Fig. 2.4.

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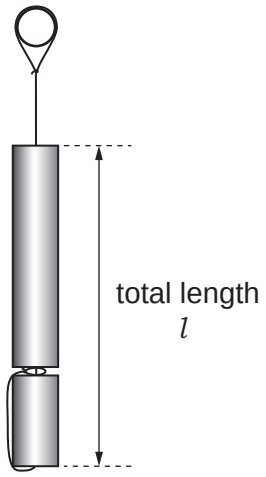


Fig. 2.4

(ii) Repeat **(b)** to determine the new value of T.

new value of T = ...

(iii) Measure the length of the longer tube.

length of the longer tube = ...

(iv) Use your answers to **(c)(i)** and **(d)(iii)** to determine the new value of l (the total length of the two tubes), as shown in Fig. 2.4.

new value of l = ...cm

(e) It is suggested that T and l are related by the equation

$$T^2 = k\,l$$

where k is a constant. By calculating values of k, explain whether your results support this relationship.

.....

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.....

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(f) **(i)** Describe four sources of uncertainty or limitations of the procedure in this experiment.

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1. .....

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2. .....

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3. .....

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4. .....

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(ii) Describe four improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1. .....

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2. .....

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3. .....

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4. .....

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