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

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

4358518461

PHYSICS **9702/31**

Paper 3 Advanced Practical Skills 1 **October/November 2013**

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 the work you hand in.
Write in dark blue or black pen.
You may use a 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 are reminded of the need for good English and clear presentation in your answers.

Electronic calculators may be used.
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.

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.

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1	
2	
Total	

This document consists of **11** printed pages and **1** blank page.

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

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1 In this experiment, you will determine the resistivity of a metal in the form of a wire.

(a) (i) Measure and record the diameter d of the short sample of wire that is attached to the card. You may remove the wire from the card.

d = ...[1]

(ii) Calculate the cross-sectional area A of the wire, in m^2, using the formula

$$A = \frac{\pi d^2}{4}.$$

A = ... m^2

(b) (i) Use the wire attached to the metre rule, one of the voltmeters and one of the resistors to set up the partial circuit shown in Fig. 1.1.

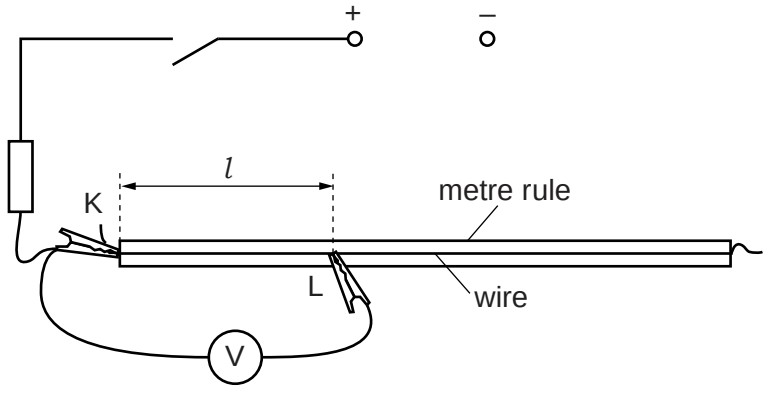


Fig. 1.1

There are two crocodile clips, one labelled K and the other labelled L.
Place K and L so that the distance l between them is approximately 30 cm.

(ii) Measure and record the distance l between K and L.

l = ...m

(iii) Use the other resistor and the other voltmeter to complete the circuit shown in Fig. 1.2.

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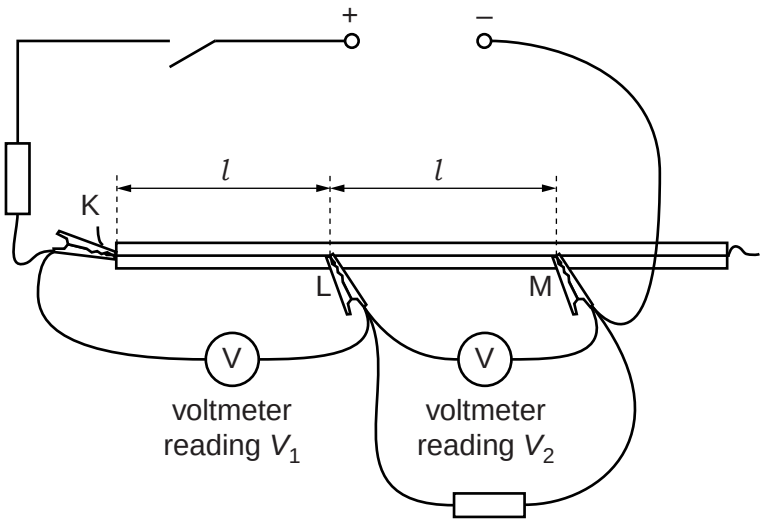


Fig. 1.2

(iv) Place the crocodile clip M at a distance l from L.
The value of l should be the same as in **(b)(ii)**.

(c) (i) Switch on the power supply.

(ii) Record the voltmeter readings V_1 and V_2 as shown in Fig. 1.2.

V_1 = ...V

V_2 = ...V
[1]

(iii) Switch off the power supply.

(d) Change l and repeat **(b)(ii)**, **(b)(iv)** and **(c)** until you have six sets of readings of l, V_1 and V_2. For each set of readings, distances KL and LM should **both** be l.

Include values of $\frac{V_1}{V_2}$ in your table.

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[10]

(e) **(i)** Plot a graph of $\frac{V_1}{V_2}$ on the *y*-axis against l on the *x*-axis. [3]

(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and *y*-intercept of this line.

gradient = ...

y-intercept = ...

[2]

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(f) The quantities V_1, V_2 and l are related by the equation

$$\frac{V_1}{V_2} = Pl + Q$$

where P and Q are constants.

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(i) Use your answers in **(e)(iii)** to determine values for P and Q.

P = ...m^{-1}

Q = ...

[1]

(ii) The resistivity ρ of the material of the wire, in Ωm, can be found using the relationship

$$\rho = PAR$$

where $R = 10\,\Omega$.

Use your answers in **(a)(ii)** and **(f)(i)** to calculate a value for ρ.

ρ = ...Ωm [1]

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

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2 In this experiment, you will investigate the change in shape of a rubber band when masses are hung from it.

(a) Set up the apparatus as shown in Fig. 2.1.

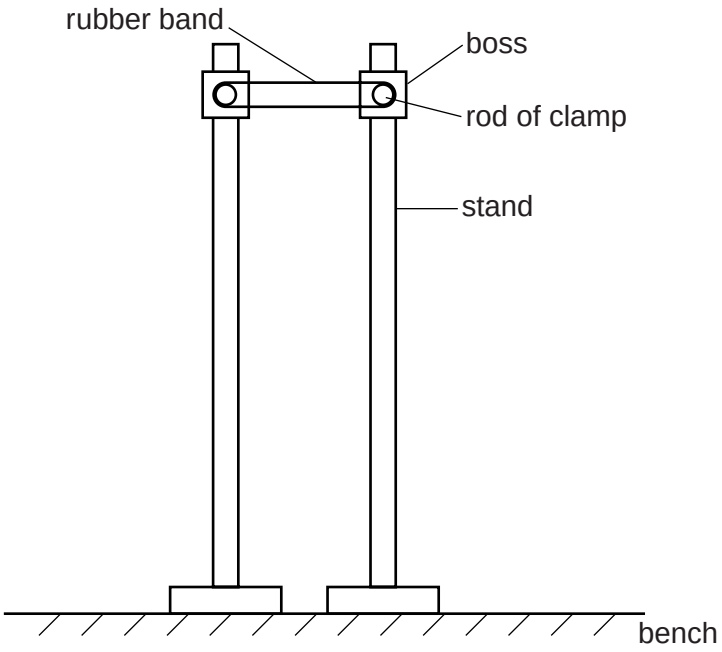


Fig. 2.1

The rods of the two clamps must be at the same height above the bench.

Position the stands so that the rubber band has no slack.

(b) Measure and record the mass *m* of the mass hanger.

m = ...[1]

(c) **(i)** Suspend the mass hanger from the centre of the lower part of the rubber band as shown in Fig. 2.2.

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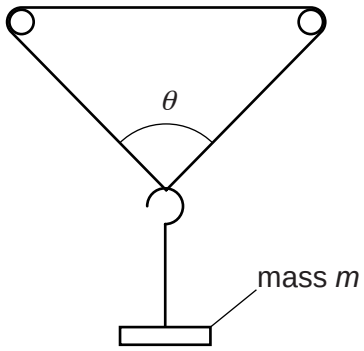


Fig. 2.2

(ii) Measure and record the angle θ as shown in Fig. 2.2.

θ = ...[2]

(iii) Estimate the percentage uncertainty in your value of θ.

percentage uncertainty = ...[1]

(iv) Calculate $\tan \frac{\theta}{2}$.

$\tan \frac{\theta}{2}$ = ...[1]

(v) Calculate $\tan^2 \frac{\theta}{2}$.

$\tan^2 \frac{\theta}{2}$ = ...

(d) (i) Add the slotted mass to the mass hanger.
Measure and record the total mass m of the mass hanger and slotted mass.

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m = ...[1]

(ii) For this total mass, repeat **(c)(i)**, **(c)(ii)**, **(c)(iv)** and **(c)(v)**.

θ = ...

$\tan \frac{\theta}{2}$ = ...

$\tan^2 \frac{\theta}{2}$ = ...
[2]

(e) Remove the slotted mass from the mass hanger.
Measure and record the angle θ.

θ = ...[1]

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[Turn over

(f) It is suggested that the relationship between m and θ is

$$m = \frac{k}{\tan^2 \frac{\theta}{2}}$$

where k is a constant.

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(i) Using your data, calculate two values of k.

first value of k = ...

second value of k = ...
[1]

(ii) Justify the number of significant figures that you have given for your values of k.

.....

.....

.....[1]

(iii) Explain whether your results in **(f)(i)** support the suggested relationship.

.....

.....

.....

.....[1]

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(g) (i) Describe four sources of uncertainty or limitations of the procedure for this experiment.

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1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

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

1. .....

.....

2. .....

.....

3. .....

.....

4. .....

.....

[4]

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