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

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

2296773611

PHYSICS **9702/36**

Paper 3 Advanced Practical Skills 2 **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.

For Examiner's Use	
1	
2	
Total	

This document consists of **10** printed pages and **2** blank pages.

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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 investigate the potential difference between two points in a circuit.

(a) Assemble the circuit of Fig. 1.1.

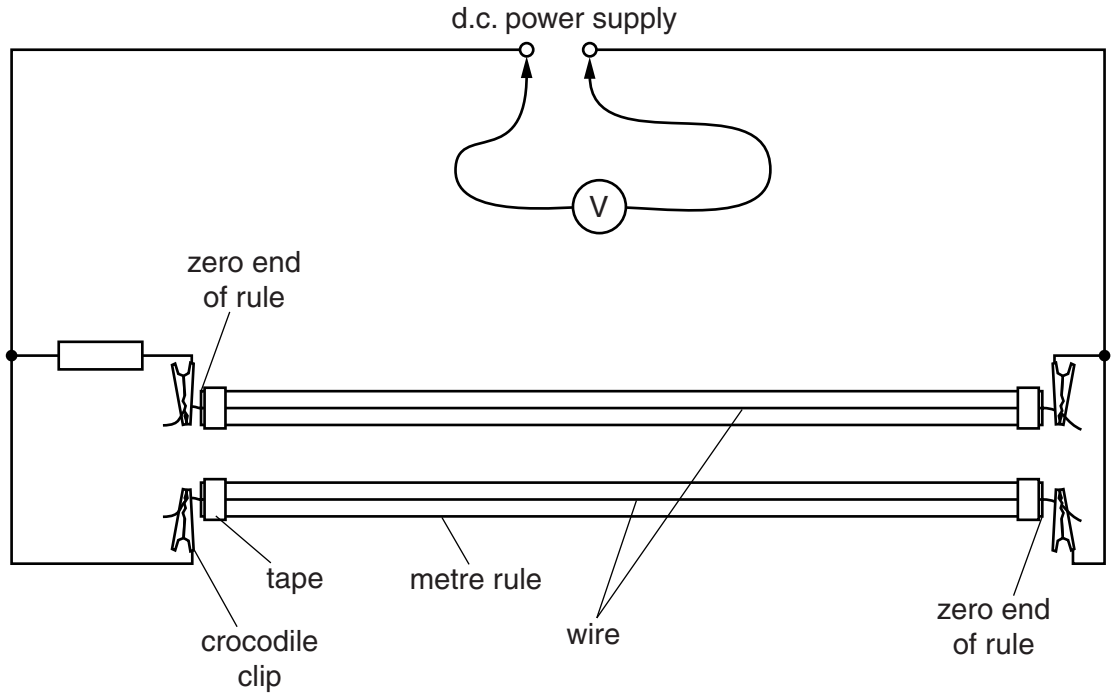

Fig. 1.1

(b) (i) Connect the voltmeter across the power supply.
Record the voltmeter reading *E*.

E = ... [1]

(ii) Disconnect the voltmeter from the power supply.

(c) (i) Position the voltmeter leads on the wires at distance *x* from the zero ends of both rules as shown in Fig. 1.2, where *x* is approximately 20 cm.

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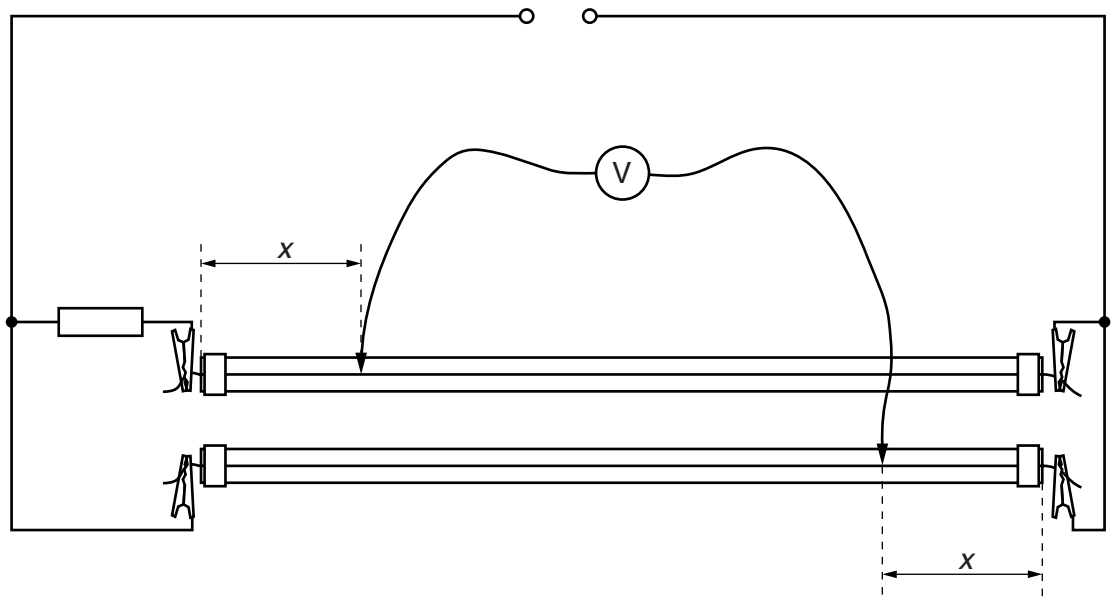

Fig. 1.2

(ii) Record *x* and record the voltmeter reading *V.*
Include the sign (+ or –) of *V*.

x = ...

V = ...

(iii) By moving both contacts, change *x* until the voltmeter reads zero.
Record *x*.

x = ... [1]

(d) Repeat **(c)(i)** and **(c)(ii)** with different values of x until you have six sets of values of x and V.
Include values of $\frac{V}{E}$ in your table.

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[10]

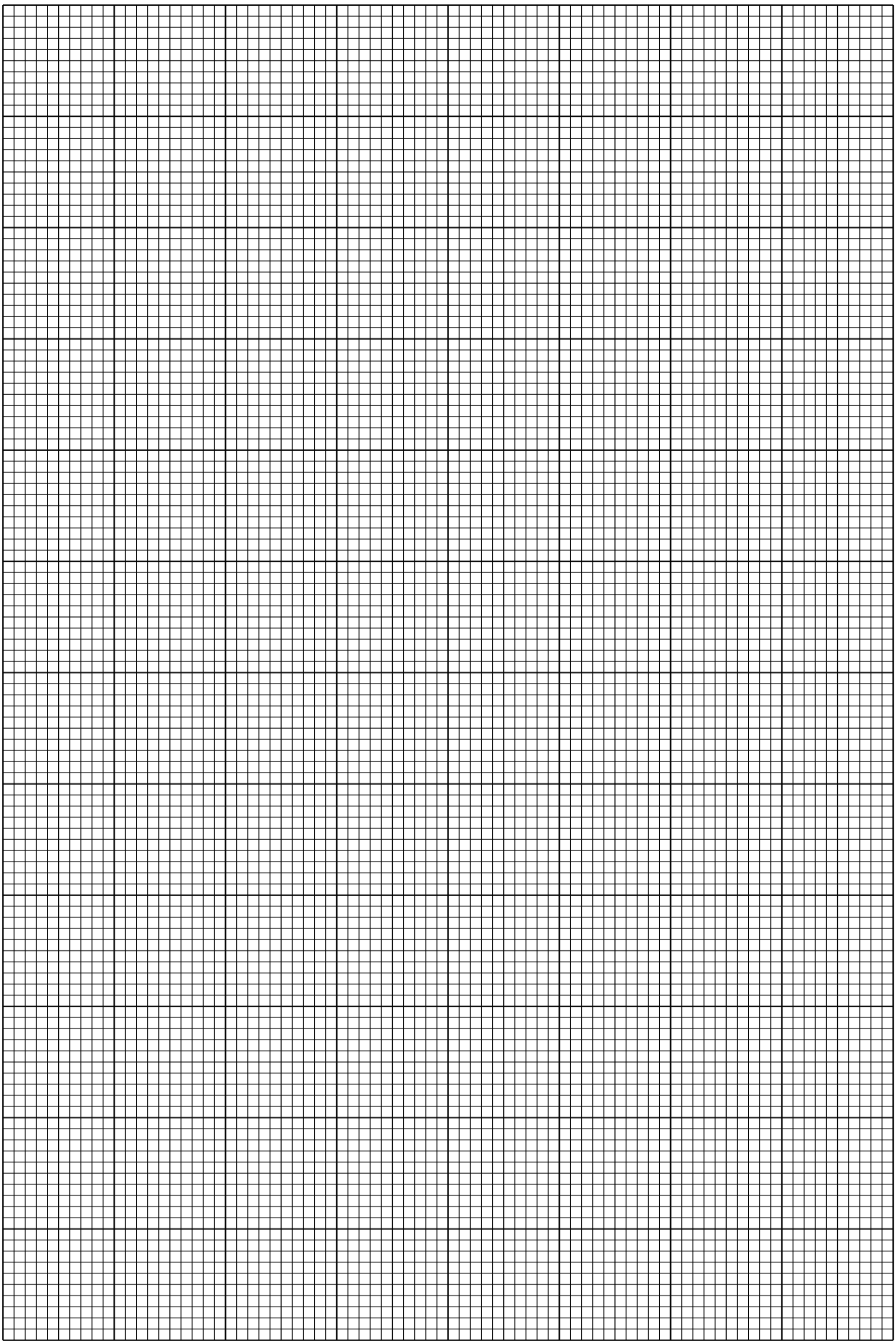
(e) **(i)** Plot a graph of $\frac{V}{E}$ on the y-axis against x on the x-axis. [3]

(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, E and x are related by the equation

$$\frac{V}{E} = ax + b$$

where a and b are constants.

Use your answers from **(e)(iii)** to determine the values of a and b.
Give appropriate units.

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a = ...

b = ...

[2]

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

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2 In this experiment, you will investigate the transfer of energy in a collision between rolling spheres.

(a) You are provided with three spheres as shown in Fig. 2.1.

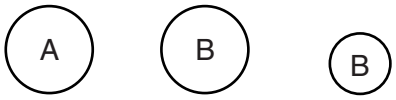

Fig. 2.1

(i) Measure and record the mass m_A of the sphere labelled A.

m_A = ... g [1]

(ii) Measure and record the mass m_B of the **smaller** of the two spheres labelled B.

m_B = ... g

(iii) Calculate the value of R, where

$$R = \left(\frac{2m_A}{m_A + m_B}\right)^2.$$

R = ... [1]

(iv) Justify the number of significant figures you have given for your value of R.

.....

.....

.....[1]

(b) You are provided with a track mounted on a board.
Place the **smaller** sphere B on the track at the lowest point.
Measure and record the height h_0 of the bottom of the sphere above the bench, as shown in Fig. 2.2.

h_0 = ... [1]

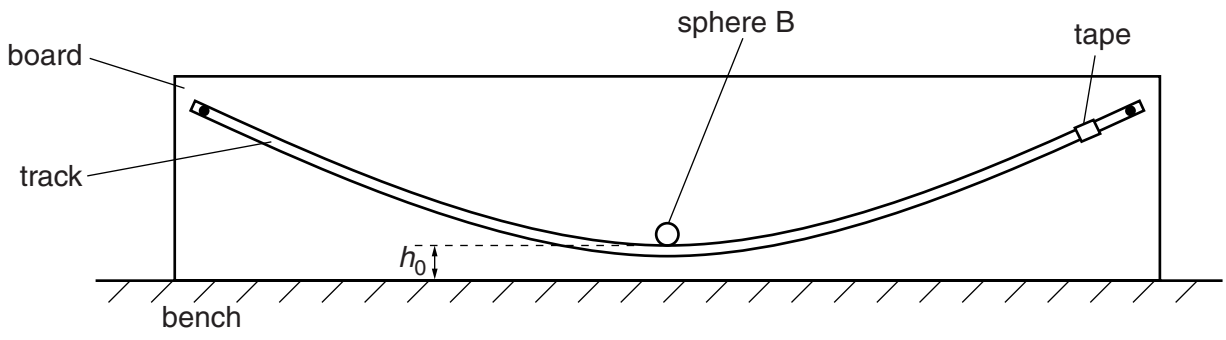

Fig. 2.2

(c) Place sphere A on the track and resting against the tape, then release it so that it collides with sphere B.
Take measurements to find the maximum height h_B reached by sphere B after the collision, as shown in Fig. 2.3.

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h_B = ... [2]

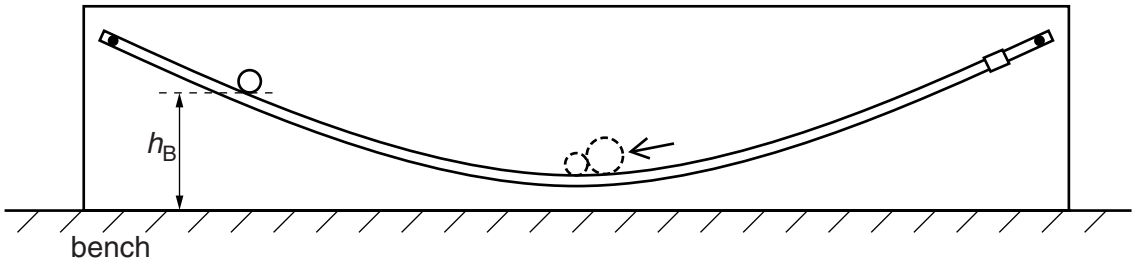

Fig. 2.3

(d) Estimate the percentage uncertainty in your value of h_B.

percentage uncertainty = ... [1]

(e) Copy the value of m_A from **(a)(i)**.
Repeat steps **(a)(ii)**, **(a)(iii)** and **(c)** using sphere A and the **larger** of the two spheres labelled B.

m_A = ... g

m_B = ... g

R = ...

h_B = ...
[3]

(f) It is suggested that the relationship between h_B and R is

$$h_B - h_0 = kR$$

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) Explain whether your results support the suggested relationship.

.....

.....

.....

..... [1]

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

For Examiner's Use

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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