UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER					

PHYSICS **5054/31**

Paper 3 Practical Test **October/November 2012**

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 **all** questions.
For each of the questions in Section A, you will be allowed to work with the apparatus for a maximum of 20 minutes. For the question in Section B, you will be allowed to work with the apparatus for a maximum of 1 hour.

You are expected to record all your observations as soon as these observations are made.
You may lose marks if you do not show your working or if you do not use appropriate units.
An account of the method of carrying out the experiments is **not** required.

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	
3	
4	
Total	

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

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UNIVERSITY *of* CAMBRIDGE
International Examinations

Section A

Answer **all** questions in this section.

1 *In this experiment, you will determine the specific latent heat of fusion of ice.*

You have been provided with

- a supply of ice,
- a cup,
- a supply of water at room temperature,
- a measuring cylinder,
- a plastic spoon,
- a thermometer,
- a stirrer,
- some paper towels.

(a) (i) Measure 80 cm^3 of water from the supply, using the measuring cylinder. This water has a mass m_w = 80 g. Pour the water into the cup. Measure the temperature θ_1 of the water.

θ_1 = ... [1]

(ii) Take a spoonful of ice, pour off excess water and dry the ice with a paper towel. Place the ice into the cup. Stir the mixture and note the temperature when all the ice has melted. Continue adding spoonfuls of dried ice and stirring until the temperature of the water after the ice has melted is below 15 °C. Record the final temperature θ_2 of the water.

θ_2 = ... [1]

(b) (i) Carefully pour the water from the cup into the empty measuring cylinder and determine the final volume of water.

final volume of water = ...

(ii) Calculate the volume of water produced from the melted ice.

volume of water from melted ice = ...

(iii) A volume of 1.0 cm^3 of water has a mass of 1.0 g. Calculate the mass m_i of ice that was added to the water.

m_i = ...
[1]

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(c) **(i)** Calculate the thermal energy (heat) Q_1 lost by the water, initially at room temperature, using the relationship

$$Q_1 = m_w c_w (\theta_1 - \theta_2)$$

where $c_w = 4.2\,J/(g\,°C)$ and $m_w = 80\,g$.

Q_1 = ... J

(ii) Using your value from **(b)(iii)**, calculate the thermal energy Q_2 gained by the water formed from the melted ice, using the relationship

$$Q_2 = m_i c_w \theta_2 .$$

Q_2 = ... J
[1]

(d) Calculate the specific latent heat of fusion L of ice using the relationship

$$L = \frac{(Q_1 - Q_2)}{m_i}.$$

L = ...[1]

[Total: 5]

2 *In this experiment, you will investigate the relationship between the resistance and the cross-sectional area for two resistance wires.*

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You have been provided with a circuit consisting of

- a power supply,
- two lengths of resistance wire of the same material, attached to a metre rule,
- two crocodile clips,
- an ammeter,
- a voltmeter,
- a resistor,
- connecting wires.

A diagram of the circuit is shown in Fig. 2.1.

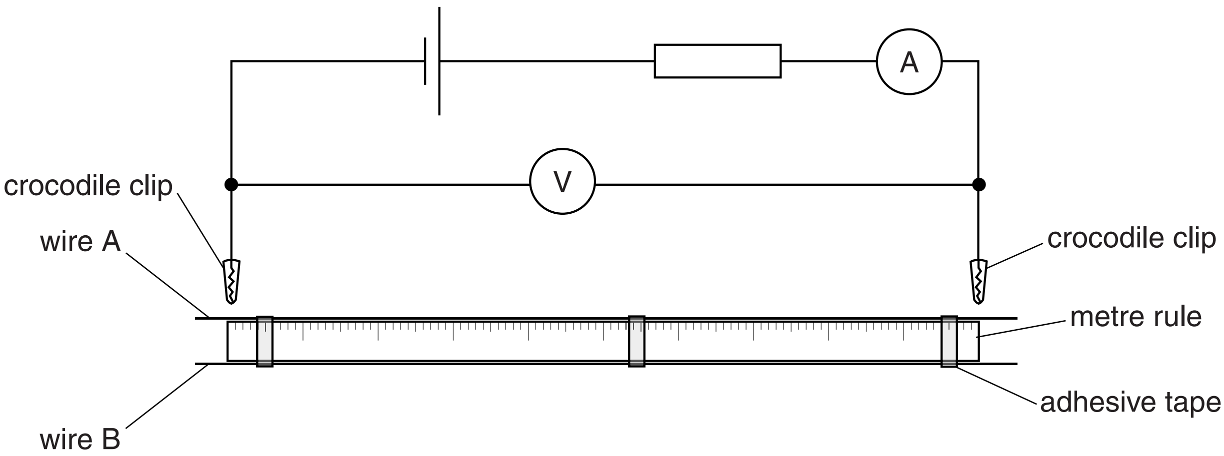

Fig. 2.1

(a) Connect the crocodile clips between two points that are 1.00 m apart on wire A. Measure the current I in the circuit and the potential difference (p.d.) V across the 1.00 m length of wire A. Immediately disconnect the crocodile clips from the wire.

I = ... [1]

V = ... [1]

(b) Calculate the resistance R_A of wire A, using the relationship

$$R_A = \frac{V}{I}.$$

R_A = ... [1]

(c) Connect the crocodile clips between two points that are 1.00 m apart on wire B. Determine the resistance R_B of wire B, using the method described in **(a)** and **(b)**.

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R_B = ... [1]

(d) The ratio

$$\frac{\text{cross-sectional area of wire A}}{\text{cross-sectional area of wire B}}$$

is given on the card supplied by the Supervisor.

Theory states that

$$\frac{R_B}{R_A} = \frac{\text{cross-sectional area of wire A}}{\text{cross-sectional area of wire B}}.$$

Suggest whether your results support this theory.

....

....

.... [1]

[Total: 5]

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3 *In this experiment, you will investigate the images formed by a converging lens.*

You have been provided with

- a converging lens,
- an illuminated cross-wire object,
- a lens holder,
- a screen,
- a metre rule,
- a set square.

(a) Set up the apparatus as shown in Fig. 3.1.

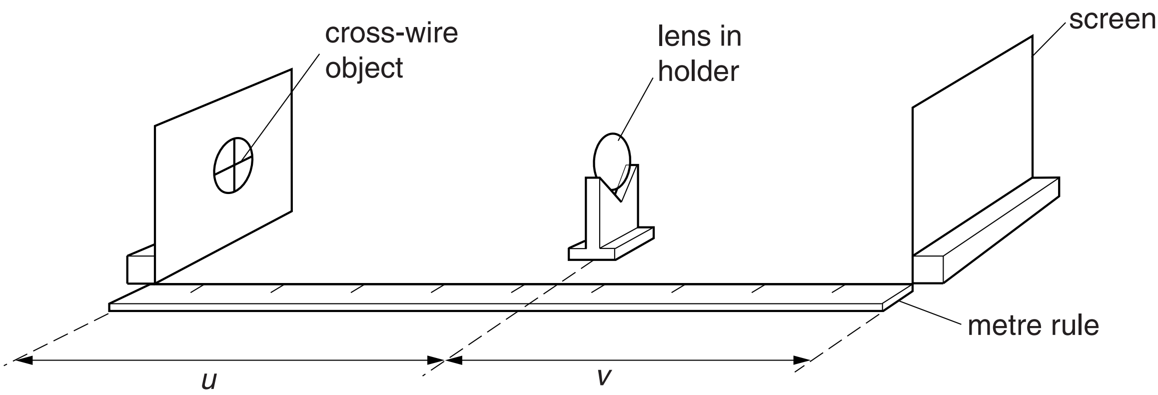

Fig. 3.1

The illuminated object should be at the 0.0 cm end of the rule and the screen should be at the 100.0 cm end.

(i) Adjust the position of the lens to produce an image on the screen that is **smaller** than the object. Describe the technique that you use to obtain an image that is in sharp focus.

....

....

.... [1]

(ii) The distance between the object and the lens is *u* and the distance between the lens and the screen is *v*, as shown in Fig. 3.1. Determine accurate values for *u* and *v* when the image is in sharp focus on the screen.

u = ...

v = ...

[2]

(b) Without moving the position of the object and the screen, adjust the position of the lens until an image is formed on the screen that is **larger** than the object.

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Determine accurate values for *u* and *v* when the image is in sharp focus on the screen.

u = ...

v = ...
[2]

[Total: 5]

Section B

4 *In this experiment, you will determine the mass of a half-metre rule.*

You have been provided with

- a half-metre rule with holes at the 1.0 cm mark and at the 49.0 cm mark,
- a length of thin string that is tied through the hole at the 49.0 cm mark and has a loop at the other end,
- a pivot in the form of a nail,
- a pulley arrangement,
- a stand that is clamped to the bench, which has a boss that holds the nail,
- a 10 g mass hanger with five 10 g slotted masses,
- a plumb-line consisting of a length of thin string with a mass at the end,
- a metre rule,
- a set square,
- a stand, boss and clamp to support the metre rule.

The half-metre rule is suspended from the nail using the hole at the 1.0 cm mark. The plumb-line is also suspended from the nail.

Pass the free end of the string over the pulley and hang the hook on the 10 g mass hanger from the loop in the free end of the string, as shown in Fig. 4.1.

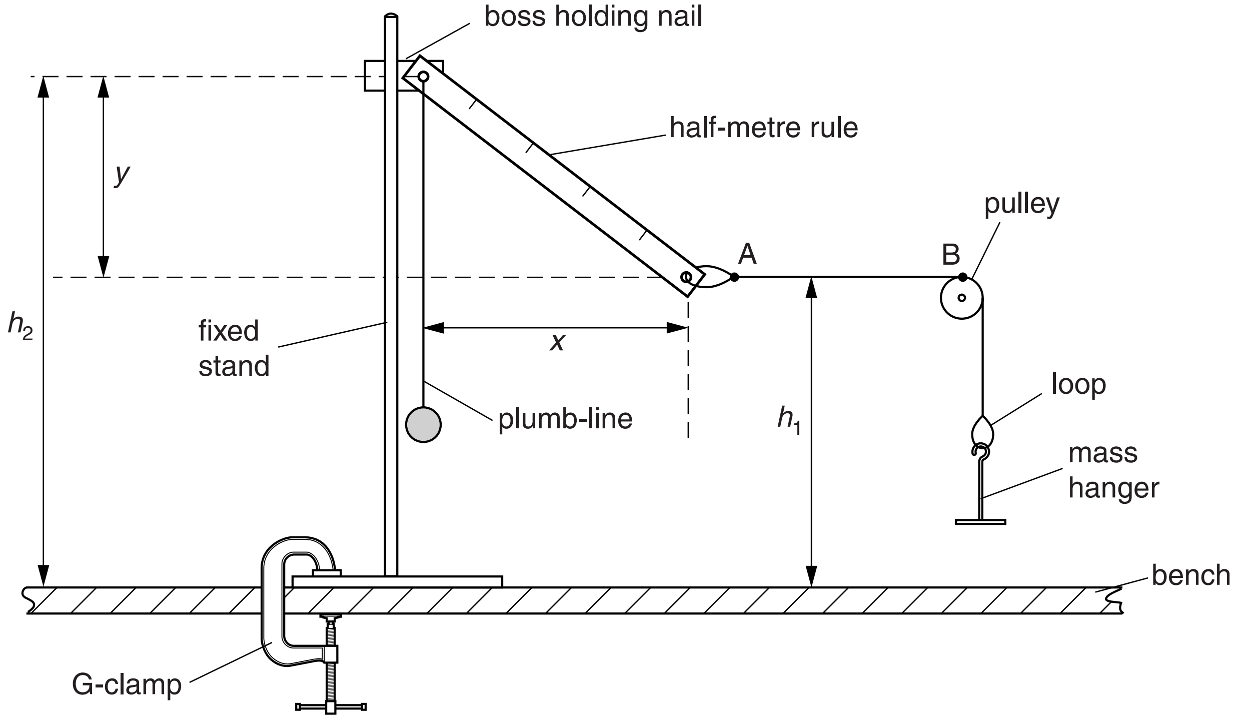

Fig. 4.1

Adjust the height of the pulley and the distance of the pulley from the fixed stand until the section of the string labelled AB is horizontal.

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(a) Explain how you made sure that the string AB was horizontal. You may add to Fig. 4.1 if you wish.

....

....

.... [1]

(b) Measure and record

(i) the height h_1 of the string AB above the bench,

h_1 = ...

(ii) the height h_2 of the centre of the nail above the bench,

h_2 = ...

(iii) the horizontal distance x between the centres of the two holes in the half-metre rule, as shown in Fig. 4.1 (the plumb-line will help you to do this).

x = ...
[2]

(c) Calculate

(i) a value for the vertical distance y between the centres of the two holes as shown in Fig. 4.1,

y = ...

(ii) a value for $\tan\theta$, where θ is the angle between the rule and the vertical, using the relationship

$$\tan\theta = \frac{x}{y}.$$

$\tan\theta$ = ...
[1]

(d) Repeat **(b)** and **(c)** for a range of values of the total mass m suspended from the string. In each case ensure that the section AB of the string is horizontal. Record your results in Fig. 4.2. Include column headings for m, h_1, h_2, x, y and $\tan\theta$. Also include your results for $m = 10\,\text{g}$ from **(b)** and **(c)**.

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Fig. 4.2 [4]

(e) Using the grid opposite, plot a graph of $\tan\theta$ on the y-axis against m/g on the x-axis. Draw the straight line of best fit through your points. [4]

(f) Determine

(i) the gradient of the line of best fit,

gradient = ... [2]

(ii) the mass M of the half-metre rule using the relationship

$$M = \frac{2}{\text{gradient}} \,.$$

M = ... [1]

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[Total: 15]

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