UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

PHYSICS **5054/03**

Paper 3 Practical Test

October/November 2004

2 hours

Additional Materials: As specified in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

Follow the instructions on the front cover of the Answer Booklet.
Write your answers in the spaces provided in the Answer Booklet.

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.
An account of the method of carrying out the experiments is **not** required.
At the end of the examination, hand in only the Answer Booklet.

This document consists of **6** printed pages, **2** blank pages and an enclosed Answer Booklet.

UNIVERSITY of CAMBRIDGE International Examinations

Section A

Answer **all** questions in this section.

1 *In this experiment, you will determine the weight of a suspended mass by using vector addition.*

You have been provided with a mass suspended from a clamp and stand, a newton meter, a second clamp and stand, a metre rule and a set square.

(a) Attached to your apparatus at point B is a length of string with a loop at the other end, as shown in Fig. 1.1. Pass the hook of the newton meter through the loop. Clamp the newton meter **horizontally**. Adjust the height of the newton meter and the separation of the clamps until the apparatus is set up as shown in Fig. 1.1 and the reading on the newton meter is approximately 0.8 N. Record the newton meter reading R on page 2 of your Answer Booklet.

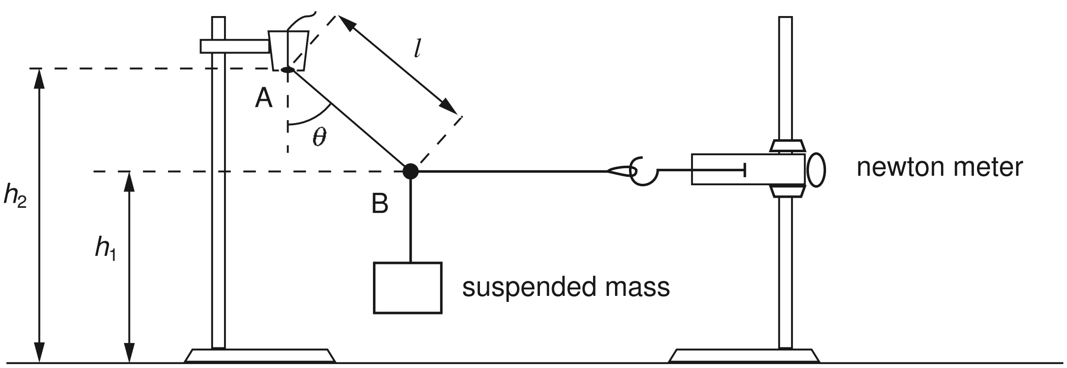

Fig. 1.1

(b) Measure and record the vertical heights h_1 and h_2 shown in Fig. 1.1. Also measure and record the length l between the two points A and B.

(c) Explain, with the aid of a diagram, how you ensured that the heights measured in **(b)** were vertical.

(d) Calculate

(i) the angle θ shown in the diagram, given that $\cos\theta = \dfrac{h_2 - h_1}{l}$,

(ii) the weight W of the suspended mass, given that $W = \dfrac{R}{\tan\theta}$.

2 *In this experiment, you will determine the energy changes that occur when hot and cold water are mixed.*

You have been provided with two 100 cm^3 beakers, a supply of hot water, a supply of water at room temperature, a thermometer, a stirrer and a measuring cylinder.

(a) Using the measuring cylinder, take 50 cm^3 of water out of the room temperature supply and place it in the beaker marked 'for water at room temperature'. On page 3 of your Answer Booklet, record the temperature θ_1 of this water.

(b) The beaker labelled 'for hot water' has a mark on its circumference indicating the position of a volume of 50 cm^3. Using water from the hot water supply, fill the beaker to this mark. Place the thermometer in the beaker and record the temperature θ_2 of the water as soon as the thermometer reading stops rising. As soon as you have taken the temperature, pour the 50 cm^3 of cold water into the hot water and record the temperature θ_3 of the mixture as soon as it stops falling rapidly.

(c) Calculate

(i) the loss in thermal energy of the hot water,

(ii) the gain in thermal energy of the cold water,

given that

change in thermal energy = mass $\times$ specific heat capacity $\times$ temperature change,

where specific heat capacity of water = 4.2 J/(g K) and 1 cm^3 of water has a mass of 1 g.

(d) Explain any difference between the answers that you obtained in part **(c)**.

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

You have been provided with a plane mirror, a converging lens, an optics pin in a cork, a stand and clamp, a half-metre rule, a small quantity of water in a beaker and some paper towels to mop up spillages.

(a) Place the lens on the plane mirror and clamp the cork so that the optics pin is horizontal and about 20 cm above the lens, as shown in Fig. 3.1.

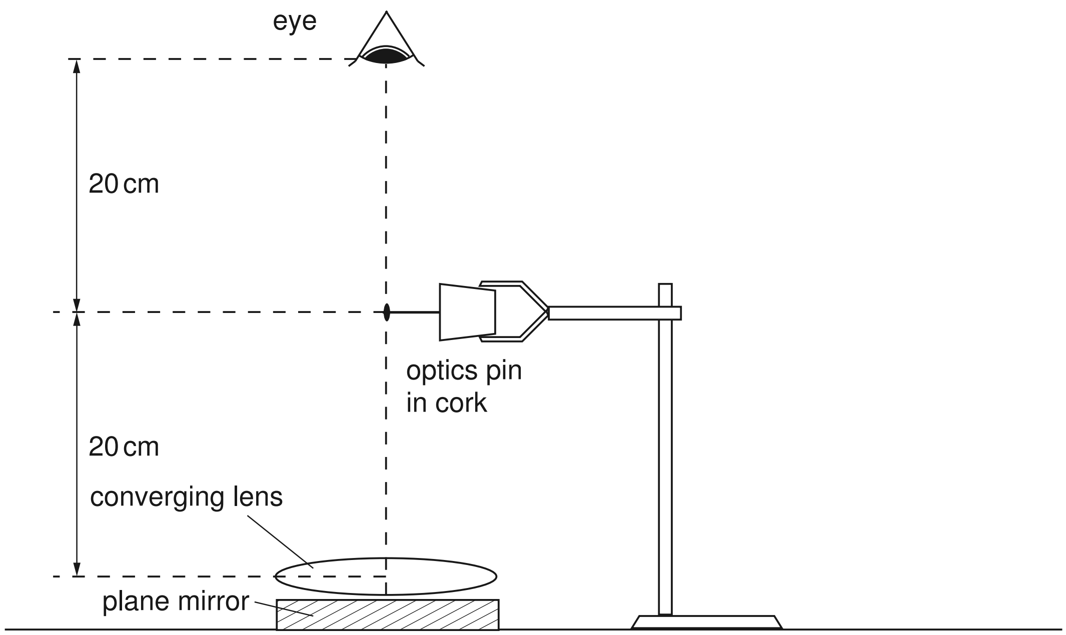

Fig. 3.1

Look vertically down on the apparatus with one eye closed and ensure that you can see an image of the pin formed by the lens and the mirror i.e. the image should be visible by looking through the centre of the lens. By moving the plane mirror and lens, ensure that the head of the pin and the head of the image are in line. This is shown in Fig. 3.2.

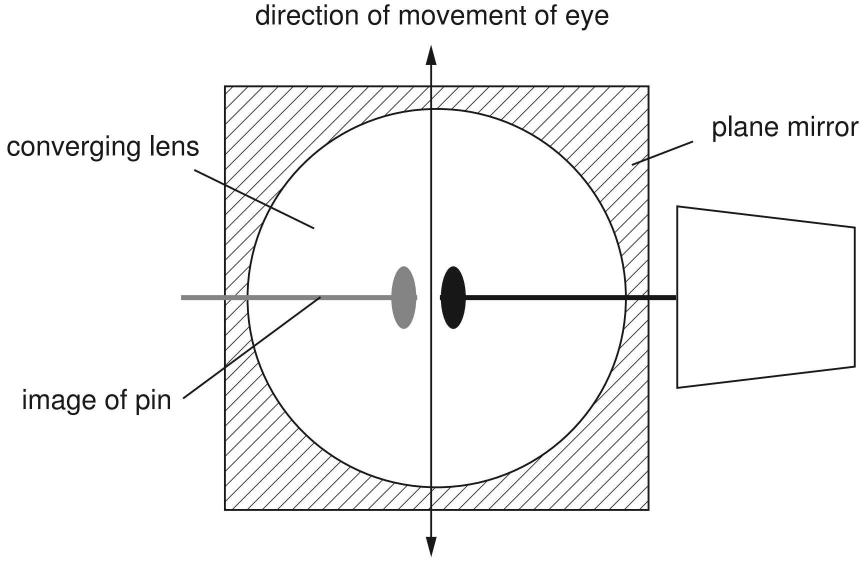

Fig. 3.2

(b) Move your eye slightly in a horizontal plane above the pin, as shown in Fig. 3.2. You should find that the pin and the image appear to separate.

While continuing to look down on the apparatus, slowly lower the pin until you find a position where the pin and its image do not appear to separate when you move your eye. At this stage, measure and record on page 4 of your Answer Booklet the height f_1 of the pin above the centre of the lens. This is the focal length of the lens.

(c) Explain carefully how you ensured that the height f_1 was measured from the **centre** of the lens.

(d) Place a small quantity of water between the lens and the mirror by lifting the lens and replacing it on the mirror after the water has been added. Repeat the experiment, starting with the pin about 30 cm above the lens. Record the height f_2 where the pin and its image do not appear to separate when you move your eye.

(e) Copy into your Answer Booklet the diagram of the lens and mirror shown in Fig. 3.1. Add to the diagram the shape of the water when it is placed between the lens and the mirror. Suggest whether the water will act as a converging lens or a diverging lens.

Section B

4 *In this experiment, you will investigate the relationship between the potential difference across a battery and the current in it.*

You have been provided with three dry cells connected in series to form a 4.5 V battery, a voltmeter, an ammeter, a switch, some connecting leads and three fixed resistors whose values are marked on them.

(a) On page 5 of your Answer Booklet, draw a diagram of the circuit that has been set up by the Supervisor.

(b) Connect the 15 Ω resistor in the gap between points A and B. Close the switch to complete the circuit. Record the potential difference V across the cell and the current I in the circuit. Open the switch as soon as you have taken your readings.

(c) Using the resistors singly and in series combinations between points A and B, obtain a series of readings for the potential difference V across the cell and the corresponding current I in the circuit. Tabulate your results on page 6 of your Answer Booklet. Include in your table a column for values of the resistors used in the gap between A and B. Open the switch as soon as you have taken your readings for each resistance value.

(d) Using the grid on page 7 of your Answer Booklet, plot a graph of V/V on the *y*-axis against I/A on the *x*-axis.

(e) Draw the best fit smooth curve through your points. Draw a tangent to the curve to find the greatest slope S of the graph.

(f) Write down the value for the internal resistance r of the battery, where $r = -S$ and S has units of Ω.

BLANK PAGE

BLANK PAGE