UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

PHYSICS **5054/03**

Paper 3 Practical Test

May/June 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 **5** printed pages, **3** blank pages and an enclosed Answer Booklet.

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Section A

Answer **all** questions in this section.

1 *In this experiment, you will compare the times of oscillation of two pendulums.*

You have been provided with a 100 g mass hanger suspended from a clamp and stand, two further 100 g masses, a stopwatch and a marker to mark the centre of the oscillation.

(a) Place the marker at the centre of the oscillation. Displace the mass hanger about 5 cm to the side so that it starts to oscillate from side to side. One complete oscillation of the mass hanger is illustrated in Fig. 1.1. Determine the time t_1 for 10 complete oscillations of the mass hanger. Record your results on page 2 of your Answer Booklet.

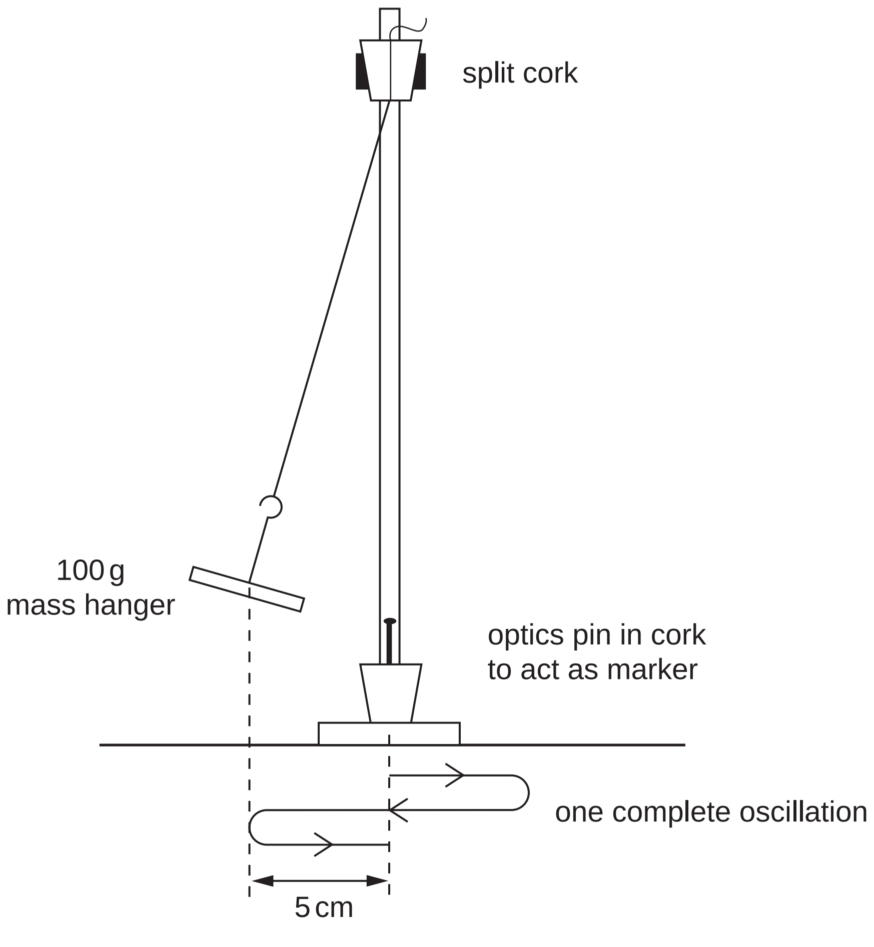

Fig. 1.1

(b) Hence calculate the time T_1 for one complete oscillation.

(c) Without adjusting the length of the string, place the two 100 g masses onto the mass hanger so that a total mass of 300 g is suspended from the clamp and stand. Repeat part **(a)** of the experiment in order to determine the time t_2 for 10 complete oscillations of the 300 g mass. Hence calculate the time T_2 for one complete oscillation of the 300 g mass.

(d) State the likely uncertainty in your measurement of t_1.

(e) Write a conclusion based on your results for t_1, t_2 and the uncertainty.

2 *In this experiment, you will investigate how the resistance of a length of wire depends on its diameter.*

You have been provided with a power supply, a voltmeter, an ammeter, a switch, some connecting leads, two crocodile clips and two lengths of resistance wire that are attached to a metre rule.

(a) On page 3 of your Answer Booklet, draw a diagram of the circuit that has been set up by the Supervisor.

(b) Connect a 1.00 m length of the thinner wire between the two crocodile clips. Close the switch and record the current I in the circuit and the potential difference V across the length of wire. Open the switch after you have taken your readings.

(c) Calculate the resistance R_1 of the length of wire, given that $R_1 = V/I$.

(d) Repeat part **(b)** with a 1.00 m length of the thicker wire connected between the two crocodile clips. Hence calculate the resistance R_2 of the thicker wire, given that $R_2 = V/I$.

(e) The two wires are made of the same material. Write a conclusion that indicates how the resistance of a length of wire is related to its diameter.

3 *In this experiment, you will determine the energy changes that occur when ice is added to water at room temperature.*

You have been provided with a 250 cm^3 beaker, a supply of water at room temperature, a thermometer, a stirrer, a supply of ice at 0 °C, a small spoon and a measuring cylinder.

(a) Using the measuring cylinder, take 100 cm^3 of water out of the room temperature supply and place it in the beaker. Measure the initial temperature θ_1 of this water. Record θ_1 on page 4 of your Answer Booklet.

(b) Using the small spoon provided, place a heaped spoonful of crushed ice, as shown in Fig. 3.1, into the beaker.

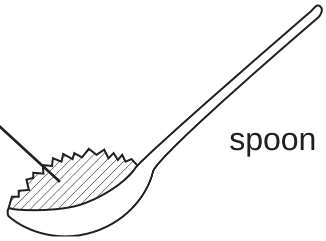

Fig. 3.1

Take care not to transfer water from the melted ice to the beaker. When all the ice in the beaker has melted,

(i) measure and record the final temperature θ_2 of the water,

(ii) measure and record the final volume V_F of water in the beaker,

(iii) hence calculate the volume V_I of water that has formed from the melted ice,

(iv) state the mass m_I of the melted ice, given that 1 cm^3 of water has a mass of 1 g.

(c) Calculate the gain in thermal energy of the ice as it melts using

$$\text{change in thermal energy} = m_I L,$$

where L = specific latent heat of fusion of ice = 336 J/g.

(d) Use the relationship

change in thermal energy on heating or cooling
= mass × specific heat capacity × 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, to calculate

(i) the gain in the thermal energy of the cold water formed from the ice,

(ii) the loss in the thermal energy of the water that was initially at room temperature.

(e) Comment on the answers that you have obtained in parts **(c)** and **(d)**.

Section B

4 *In this experiment, you will investigate the relationship between the separation of an object and a screen and the distance a lens has to be moved in order to form two clear images on the screen.*

You have been provided with a converging lens in a holder, an illuminated cross-wire object, a screen, a metre rule and a set square.

For ease of calculation, all distances should be recorded in metres.

(a) Set up the apparatus as shown in Fig. 4.1 with the screen at the zero end of the metre rule.

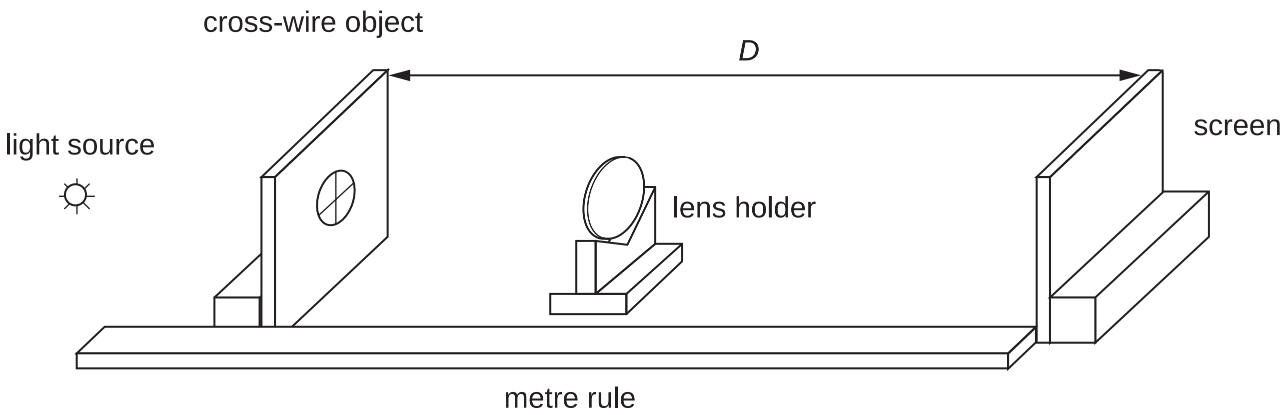

Fig. 4.1

(b) Set the distance D between the object and the screen at 0.800 m (80.0 cm). Adjust the position of the lens until a clear **enlarged** image of the cross-wire is formed on the screen. Measure and record on page 6 of your Answer Booklet the distance x between the centre of the lens and the screen.

(c) Without changing the positions of the cross-wire object and the screen, move the lens towards the screen until a clear **diminished** image of the cross-wire is formed on the screen. Measure and record the distance y between the centre of the lens and the screen. Hence calculate the distance d moved by the lens using $d = x - y$.

(d) Repeat parts **(b)** and **(c)** for a further four values of D that are in the range 0.650 m to 1.000 m. Tabulate all your measurements on page 6 of your Answer Booklet. Your table should also include columns for $(d/D)^2$ and $1/D$.

(e) Using the grid on page 7 of your Answer Booklet, plot a graph of $(d/D)^2$ on the y-axis against $(1/D)/(1/\text{m})$ on the x-axis.

(f) Calculate the slope S of your graph.

(g) Hence calculate a value for the focal length f of the lens, given that $f = -S/4$, where S is the slope of the graph with units of metres.

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