CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

PHYSICS **5054/03**

Paper 3 Practical Test

May/June 2003

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.

UNIVERSITY *of* CAMBRIDGE
Local Examinations Syndicate

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Section A

Answer **all** questions in this section.

1 *In this experiment, you will determine the density of card.*

You have been provided with 10 pieces of thick card and a 30 cm rule.

(a) Determine an average value for the total thickness T of the 10 pieces of card when they are placed on top of each other. Record all your measurements on page 2 of your Answer Booklet.

(b) Determine average values for the length l and the width w of at least three pieces of card.

(c) Find the total mass M of all the cards.

(d) Hence calculate a value for the density of card using the relationship

$$\text{density} = \frac{\text{mass}}{\text{volume}} \, .$$

(e) State which of your measurements causes the greatest uncertainty in your value for the density. Give a reason for your choice.

2 *In this experiment, you will determine the focal length of a lens by taking measurements of the magnified image that it produces.*

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

(a) Set up the apparatus as shown in Fig. 2.1, with the illuminated object at one end of the metre rule and the screen at the other. The object and the screen should be kept in these positions for the rest of the experiment.
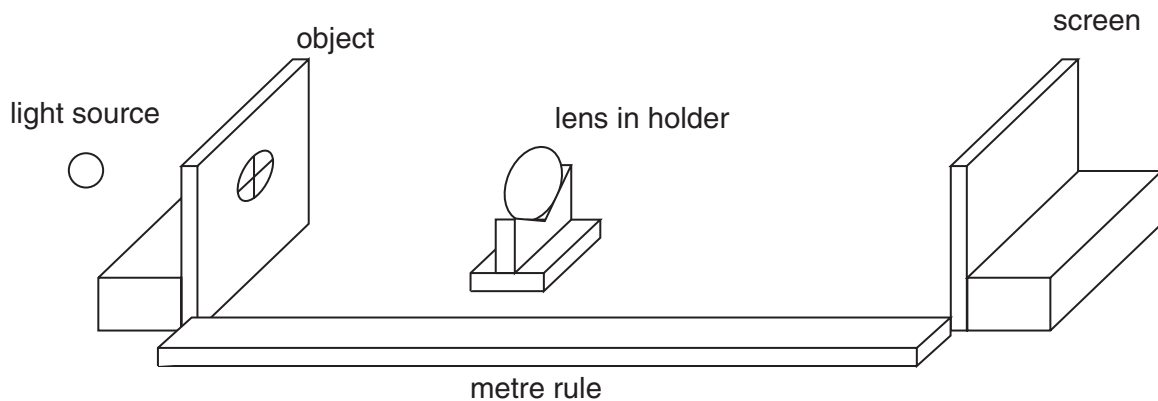

Fig. 2.1

(b) Adjust the position of the lens between the object and the screen until the largest possible magnified and clearly focussed image is formed on the screen. Measure and record on page 3 of your Answer Booklet,

   (i) the height h_O of the object,

  (ii) the height h_I of the image formed on the screen,

 (iii) the image distance v between the lens and the screen.

(c) Calculate

   (i) the linear magnification m, given that

$$m = \frac{h_I}{h_O},$$

  (ii) the focal length f of the lens, given that

$$f = \frac{v}{m+1}.$$

(d) Describe how you would test to see if the image were inverted.

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3 *In this experiment, you will determine the specific heat capacity of water by electrical heating.*

You have been provided with a power supply, a switch, an ammeter, a coil of wire which is at the bottom of a small glass beaker, a card giving the potential difference across the coil, a thermometer, a measuring cylinder, a supply of water, a stopwatch, a stirrer, and a stand, boss and clamp to support the thermometer.

(a) On page 4 of your Answer Booklet, draw a diagram of the circuit that has already been set up by the Supervisor.

(b) Measure 50 cm^3 of water in the measuring cylinder and pour it into the glass beaker that contains the coiled wire. Measure the initial temperature θ_1 of the water in the beaker.

(c) Switch on the power supply and leave on for a time t of 4.0 minutes. Record the current I in the circuit. Record the potential difference V across the coil, which is given on the card. After 4.0 minutes, switch off the power supply, stir the water and record the highest temperature θ_2 reached by the water.

(d) Calculate the specific heat capacity c of the water, given that

$$c = \frac{IVt}{m(\theta_2 - \theta_1)}$$

where m = mass of water in the beaker = 50 g.

Section B

4   *In this experiment, you will investigate the equilibrium of a balanced metre rule.*

You have been provided with a metre rule with a hole at the 1.0 cm mark, a half-metre rule, a set square, a knife-edge, a clamp and boss supporting a horizontal pivot, a newtonmeter, and a second stand, clamp and boss to support the newtonmeter.

(a)   Balance the metre rule on the knife-edge in order to determine the position of the centre of mass of the metre rule. Record on page 5 of your Answer Booklet the distance l of the centre of mass from the 1.0 cm mark on the metre rule.

(b)   Set up the apparatus as shown in Fig. 4.1, with the newtonmeter supporting the rule at the 80.0 cm mark.
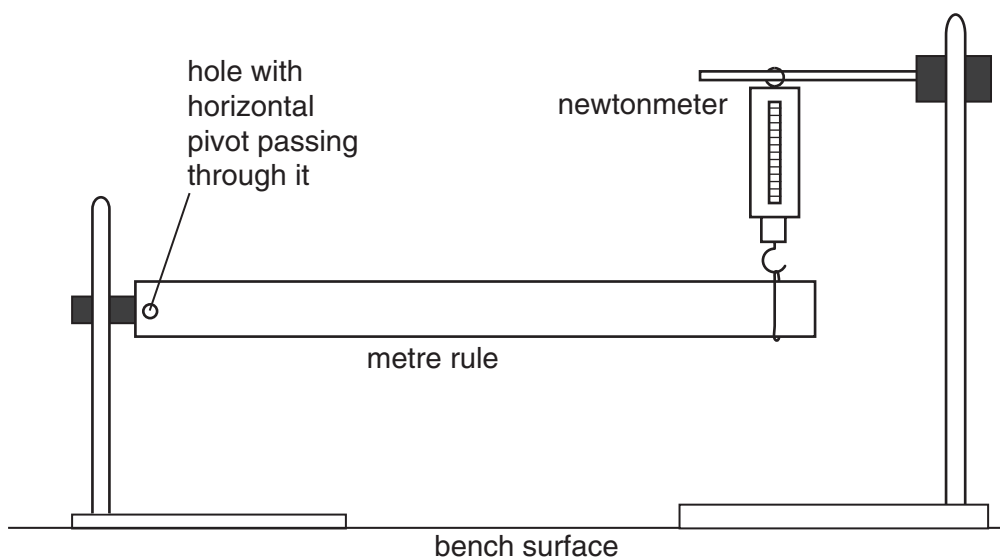

Fig. 4.1

Adjust the height of the pivot and/or the height of the top of the newtonmeter in order to ensure that the metre rule is horizontal. Describe how you checked that the metre rule was horizontal.

(c)   By reading the newtonmeter, record the force F supporting the metre rule at the 80.0 cm mark. Also record the distance d from the pivot to the point at which the rule is supported by the newtonmeter.

(d)   For a range of distances d, record the corresponding force F required to support the rule horizontally. You will need to adjust the height of the pivot and/or the height of the top of newtonmeter in order to maintain the metre rule in a horizontal position. Tabulate your results on page 6 of your Answer Booklet. Include in your table the readings you obtained in **(c)** and a column for values of $1/d$.

(e)   Using the grid on page 7 of your Answer Booklet, plot a graph of F/N on the *y*-axis against $(1/d)/(1/\text{cm})$ on the *x*-axis.

(f)   Find the gradient G of your graph.

(g)   Determine the weight W of the metre rule. This is given by $W = G/l$ where l is the measurement in cm obtained in **(a)** and G is the gradient with unit N cm.

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