CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

PHYSICS **5054/03**

Paper 3 Practical Test

October/November 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 experiment 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 inserted Answer Booklet.

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UNIVERSITY *of* CAMBRIDGE
Local Examinations Syndicate

Section A

Answer **all** questions in this section.

1 *In this experiment, you will determine the energy changes of a toy car as it moves down a ramp.*

You have been provided with a ramp, a toy car, a half-metre rule, a stopwatch and a set square.

(a) The two lines on the ramp are a distance s of 0.90 m apart. Place the front of the car level with the line at the top of the ramp. Release the car and determine an average value for the time t taken for the car to travel to the lower line. Record your measurements and calculations on page 2 of your Answer Booklet.

(b) Calculate the final speed v of the car as it reaches the lower line on the ramp given that

$$v = \frac{2s}{t}.$$

(c) Measure the vertical height h through which the car descends as it moves a distance of 0.90 m along the ramp. Draw a diagram to explain how you did this.

(d) Record the mass m of the car, which is given on the card.

(e) Calculate

(i) the potential energy E_P lost by the car as it descends through the height h, given that

$$E_P = mgh,$$

where $g = 9.8$ N/kg,

(ii) the kinetic energy E_K gained by the car as it moves through the 0.90 m distance, given that

$$E_K = \tfrac{1}{2}mv^2.$$

(f) Comment on the results you have obtained in **(e)**.

2 *In this experiment, you will determine the density of the material from which a metre rule is made.*

You have been provided with a metre rule, a knife edge, a 100 g mass and a small rule with mm graduations.

(a) Balance the metre rule on the knife edge in order to determine the position of the centre of mass of the rule. On page 3 of your Answer Booklet, record the distance d of the centre of mass from the 0.0 cm end of the rule.

(b) Set up the apparatus as shown in Fig. 2.1, with the 100 g mass placed close to the 0.0 cm end of the rule.

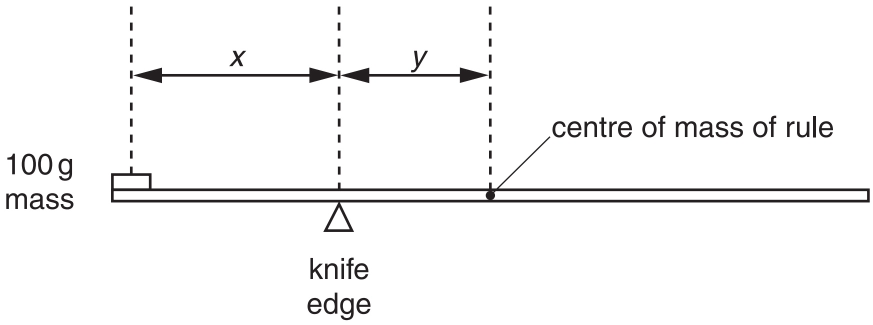

Fig. 2.1

The knife edge should be placed at a point between 0.0 cm and 50.0 cm so that the system balances. Determine the distances x and y, showing clearly how these were obtained.

(c) Calculate the mass m of the metre rule given that $m = \frac{100x}{y}$ grams.

(d) Determine the average width w and the average thickness t of the metre rule. Also record the length l of the metre rule.

(e) Calculate

(i) the volume V of the metre rule given that $V = lwt$,

(ii) the density ρ of the material of the rule given that $\rho = \frac{m}{V}$.

3 *In this experiment, you will investigate the frictional force opposing the motion of a block of wood to which masses have been added.*

You have been provided with a block of wood with a hook at one end, a newton-meter and some 50 g masses.

(a) Place a 50 g mass on top of the block of wood. Pull the block horizontally across the bench at constant speed by means of the newton-meter, as shown in Fig. 3.1.

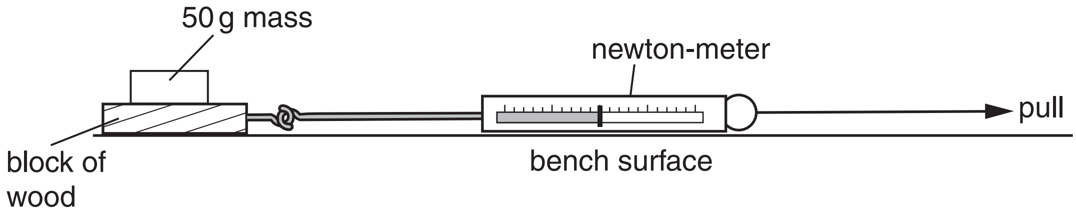

Fig. 3.1

Determine an average value for the force F required to move the block across the bench at constant speed. Record all your measurements on page 4 of your Answer Booklet.

(b) Record the mass M_B of the block, which is given on the card. Also record the total mass M_T of the block with the added mass.

(c) Calculate the total weight W of the block with the added mass given that

$$W = M_T g,$$

where $g = 9.8$ N/kg.

(d) Calculate a value for the coefficient of friction μ between the block and the bench given that

$$\mu = \frac{F}{W}.$$

(e) It is expected that, when different masses are placed on the block, the value of μ will remain constant. Repeat the experiment with two 50 g masses and then with three 50 g masses placed on the block. Comment on the results that you obtain.

Section B

4 *In this experiment, you will investigate the power dissipated in a length of resistance wire.*

You have been provided with a metre rule to which a length of resistance wire has been attached, an ammeter, a voltmeter, a switch, a power supply, a fixed resistor and two crocodile clips.

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

(b) Adjust the positions of the crocodile clips on the wire so that a length l of 80.0 cm of resistance wire is connected in the circuit. Close the switch and record the current I in the circuit and the potential difference V across the length of wire. Open the switch. Take care not to touch the fixed resistor because it may be hot.

(c) Calculate the power P dissipated in the wire given that $P = IV$.

(d) For a range of lengths l of wire, record the current I in the circuit and the corresponding potential difference V across the wire. Tabulate your results on page 6 of your Answer Booklet. Include in your table a column for values of P and your results from **(b)** and **(c)**.

(e) Switch off the circuit.

(f) Using the grid on page 7 of your Answer Booklet, plot a graph of P/W on the y-axis against l/cm on the x-axis.

(g) Draw a smooth curve through your points. Find the length l_M of wire at which the maximum power P_M is dissipated.

(h) Using the value of the resistance of a one metre length of the wire which is given on the card, find the resistance corresponding to the length l_M of wire.

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