PHYSICS **5054/03**

Paper 3 Practical Test **May/June 2007**

2 hours

Additional Materials: As listed in the Confidential Instructions

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **6** printed pages, **2** blank pages and **1** Answer Booklet.

[Turn over

Section A

1   *In this experiment you will investigate a diverging lens.*

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

(a) Set up the apparatus as shown in Fig. 1.1. The screen should be 70.0 cm from the object.
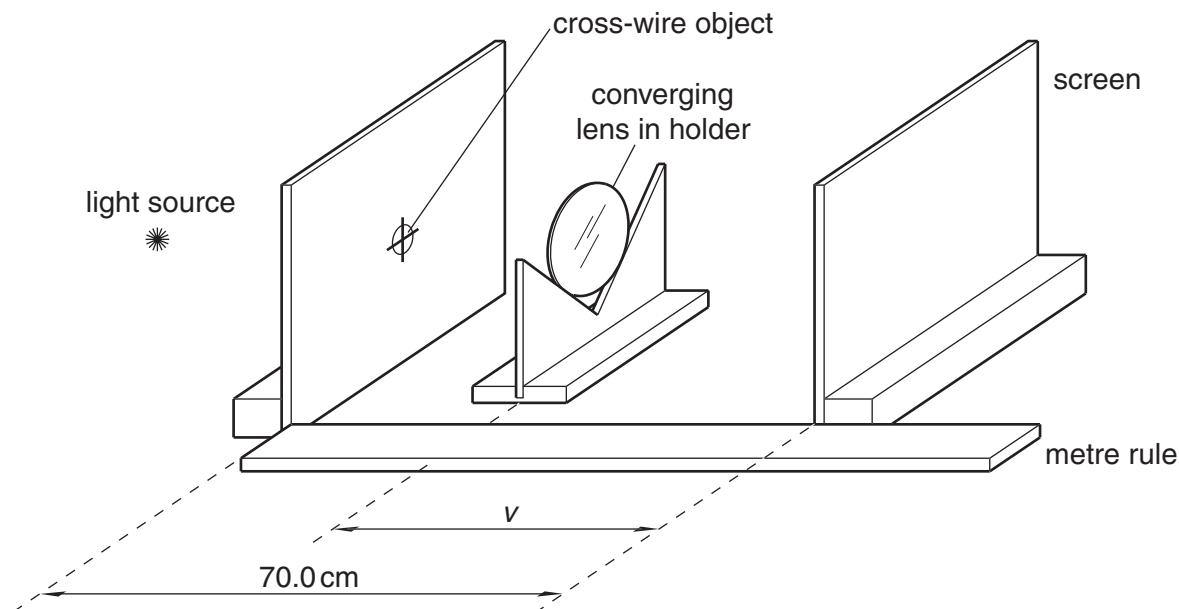

Fig. 1.1

The position of the converging lens should be adjusted until a sharply-focused **magnified** image of the cross-wire object is formed on the screen. Measure the distance *v* between the lens and the screen. Record your measurements on page 2 of your Answer Booklet.   [1]

The distance between the cross-wire object and the converging lens must remain constant for the remainder of the experiment.

(b) Without changing the position of the converging lens, move the screen away from the cross-wire object until it is 100.0 cm from the object. Place the diverging lens between the converging lens and the screen as shown in Fig. 1.2.
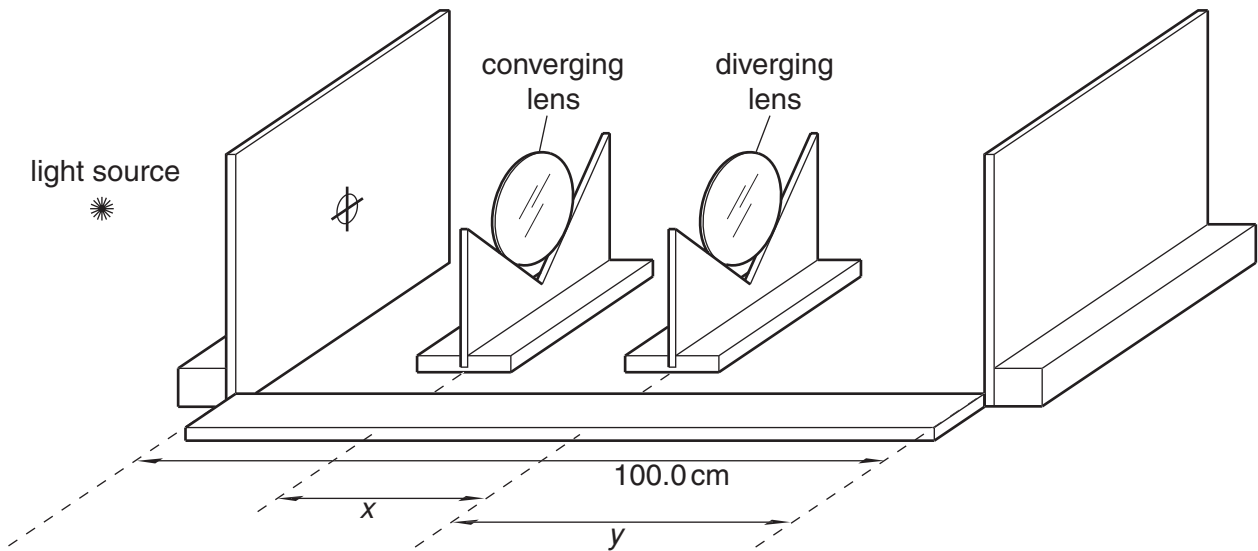
Fig. 1.2

Adjust the position of the **diverging lens** until a sharply-focused image of the cross-wire object is formed on the screen.

(i) State **one** difference between this image and the initial image formed by the converging lens alone.

(ii) Measure and record the distance x between the two lenses and the distance y between the diverging lens and the screen.

[3]

(c) The focal length f of the diverging lens is given by the equation

$$f = \frac{(v - x)\, y}{x + y - v}.$$

Calculate the value of f. [1]

2 *In this experiment you will make measurements on some microscope slides in order to determine the density of the glass from which they are made. The average mass and thickness of one slide will also be determined.*

You have been provided with a stack of identical microscope slides and a half-metre rule. You should not remove any slides from the stack. You have access to a top-pan balance.

(a) Use the half-metre rule to determine the length l, the width w and the thickness T of the stack of microscope slides. Record your results on page 3 of your Answer Booklet. [2]

(b) Using the top-pan balance, measure the mass M of the stack. Hence determine the density ρ of the stack given that

$$\rho = \frac{M}{lwT} \cdot$$

[1]

(c) **(i)** Count the number N of slides in the stack.

(ii) Determine the average thickness t and the average mass m of one slide, giving your answers to an appropriate number of significant figures.

[2]

3 *In this experiment you will determine the energy lost when a table tennis ball bounces off a surface.*

You have been provided with a table tennis ball, a metre rule, a set square, a cardboard screen, and a stand, clamp and boss.

(a) (i) Clamp the metre rule vertically with the zero end of the rule on the bench and the clamp holding the rule at about 60 cm above the bench. On page 4 of your Answer Booklet, explain, with the aid of a diagram, how you made sure that the metre rule was vertical.

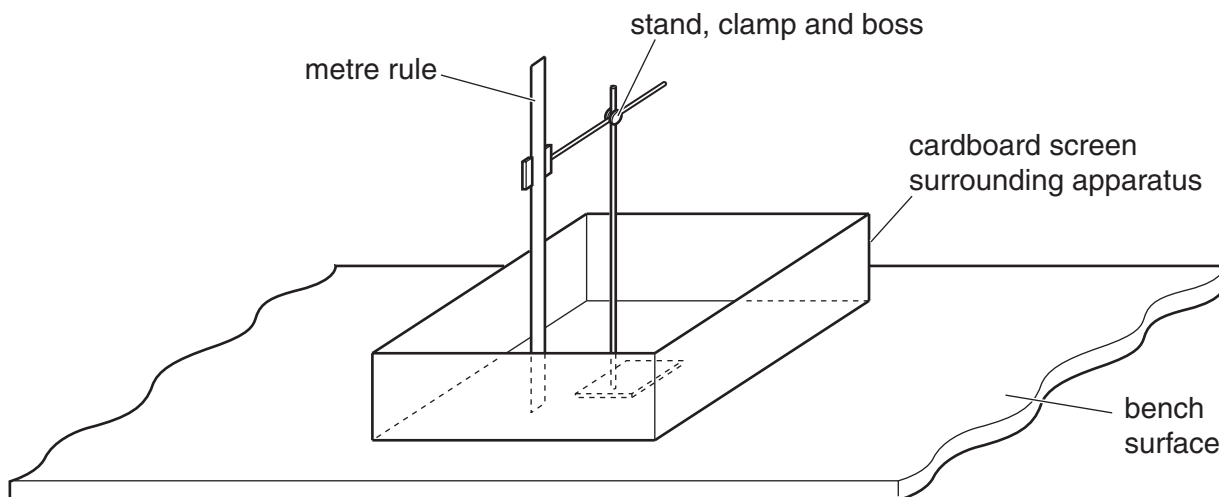**(ii)** Lower the cardboard screen over the apparatus, as shown in Fig. 3.1.

Fig. 3.1

[1]

(b) Hold the table tennis ball close to the rule so that the bottom of the ball is at a height h_1 of 0.50 m above the bench. Release the ball and determine the height h_2 above the bench of the first bounce. In your answer booklet, show how you obtained an accurate value for h_2.   [2]

(c) The gravitational potential energy E of the ball is given by

$$E = mgh,$$

where m is the mass of the ball (which is given on the card), g is the gravitational field strength = 9.8 N/kg, and h is the height of the ball above the bench.

Calculate

(i) the loss of gravitational potential energy as the ball falls to the bench,

(ii) the gain in the gravitational potential energy as the ball rises to the height h_2,

(iii) the loss of energy during the first bounce.

[2]

Section B

4 *In this experiment, you will investigate the current in a circuit when different resistors are used in the circuit.*

You have been provided with an electrical circuit containing a resistor X whose value has been obscured. There is a gap in the circuit between points A and B. You have three extra resistors and some extra connecting leads.

(a) In the space on page 5 of your Answer Booklet, draw a circuit diagram of the circuit that has been set up for you. [1]

(b) Connect points A and B together. Close the switch and measure the current I_0 in the circuit. Open the switch and separate points A and B. [1]

(c) Connect the one of the three extra resistors between points A and B. Record the resistance R of the resistor that you used. Close the switch and record the current I in the circuit. Open the switch and disconnect the resistor from between A and B. [2]

(d) Repeat part **(c)** with

    (i) the other two extra resistors used on their own,

    (ii) all possible series combinations of the extra resistors.

    Tabulate all your values of R and I in the table on page 6 of your Answer Booklet. Include your results from **(c)**. Include units for R and I in your table. [4]

(e) Using the grid on page 7 of your Answer Booklet, plot a graph of I/A on the *y*-axis against R/Ω on the *x*-axis. [4]

(f) Use your graph to determine the value of R that would give a current of 0.5 I_0. Suggest the resistance of the unknown resistor X, explaining your answer. [3]

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