Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

8160396230

PHYSICS **5054/31**

Paper 3 Practical Test **May/June 2022**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- 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 should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
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Section A

Answer all the questions in this section.

1 *In this experiment you will estimate the volume of a thermometer.*

You are provided with:

- a thermometer
- a ruler.

(a) Measure and record to the nearest millimetre the length l of the thermometer, and the width w of the thermometer at the 50 °C mark.

l = ... mm

w = ... mm [1]

(b) Calculate the volume V of the thermometer using the equation:

$$V = \frac{\pi}{4} l w^2$$

where $\pi = 3.14$.

V = ... mm^3 [1]

(c) The volume calculated in **(b)** is an estimate of the volume of the thermometer.

Explain why:

(i) the volume calculation is only an estimate

.....

..... [1]

(ii) the volume calculation is close to the actual volume of the thermometer.

.....

..... [1]

(d) The thermometer contains a liquid.

Suggest **one** reason why it is difficult to determine the volume of this liquid.

.....

..... [1]

[Total: 5]

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2 *In this experiment you will investigate a pendulum.*

You are provided with:

- a pendulum
- a stop-watch
- a metre rule
- a stand, weight, boss and clamp.

The supervisor has set up some of the apparatus as shown in Fig. 2.1.

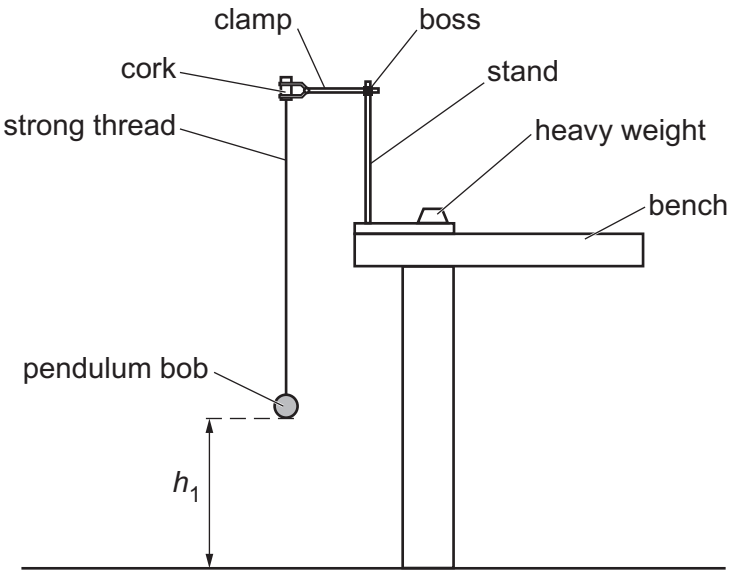


Fig. 2.1 (not to scale)

(a) Measure and record the height h_1 of the **bottom** of the pendulum bob above the floor.

h_1 = ... cm [1]

(b) You are also provided with:

- a second stand, boss and clamp
- a set square.

Keep the string straight and move the pendulum bob to the left. Observe that the height h of the pendulum bob above the floor increases.

Continue to move the pendulum bob until it reaches a new vertical height h_2 above the floor where

$$h_2 = h_1 + 10.0\,\text{cm}.$$

Describe in detail how you use the additional apparatus to ensure that $h_2 = h_1 + 10.0\,\text{cm}$.

.....

.....

..... [2]

(c) Release the pendulum bob from h_2 and observe it swing to the right and then return to its point of release. This is one oscillation.

Determine the **average** time t for one oscillation.

Record your measurements and show your working.

average time t = ... s [1]

(d) A student suggests that the average **vertical** speed v, measured in cm / s, of the pendulum bob as it moves from the point of release to its lowest position is calculated using the equation:

$$v = \frac{10}{(t/4)}$$

Explain whether the student is correct by referring to the distances travelled by the pendulum bob during one oscillation.

.....

..... [1]

[Total: 5]

3 *In this experiment you will investigate a light-emitting diode.*

You are provided with:

- a power supply
- a switch
- a light-emitting diode (LED) in series with a resistor
- a light-dependent resistor (LDR) in series with a resistor
- a voltmeter
- a ruler.

The supervisor has set up the circuit shown in Fig. 3.1.

The LED is connected to long leads so that it can be moved.

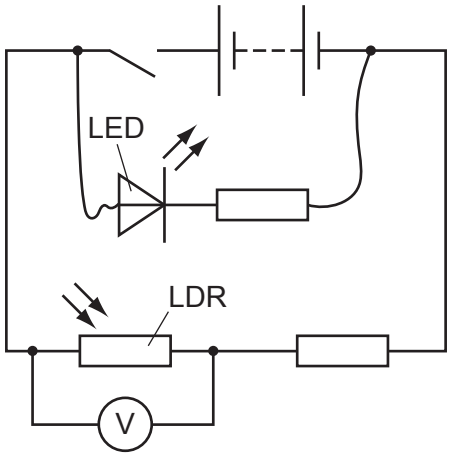


Fig. 3.1

(a) Hold the LED about 30 cm above the LDR.

Close the switch.

(i) Read and record the reading on the voltmeter.

voltmeter reading = ... V [1]

(ii) Move the LED down, closer to the LDR.

Determine the distance between the LED and the LDR at which the reading on the voltmeter begins to change from the reading given in **(a)(i)**.

distance = ... cm [1]

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(iii) Continue to move the LED closer to the LDR.

Determine the maximum change from the reading in **(a)(i)** in the voltmeter reading.

Show your working. Give your answer to a suitable number of significant figures.

maximum change in the voltmeter reading = ... V [1]

(b) A student claims that the LED is brighter at the tip, emitting more light in the X direction and less in the Y directions, as shown in Fig. 3.2.

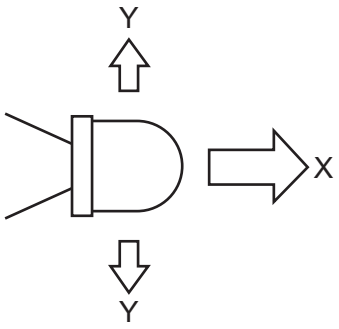


Fig. 3.2

(i) Describe how you use the apparatus in Fig. 3.1 to show whether the student's claim is correct.

.....

.....

..... [1]

(ii) State whether the student's claim is correct.

Justify your answer by taking and recording further readings from the voltmeter.

.....

..... [1]

[Total: 5]

Section B

4 *In this experiment you will investigate the focal length of a lens.*

You are provided with:

- a lens mounted on a slotted mass
- additional slotted masses to change the height of the lens
- an illuminated cross-wire object
- a light source
- a metre rule
- a 30 cm ruler
- a screen.

(a) The supervisor has set up the apparatus as shown in Fig. 4.1. The screen is at the 0 cm end of the rule. The cross-wire object is at the 100.0 cm end of the rule.

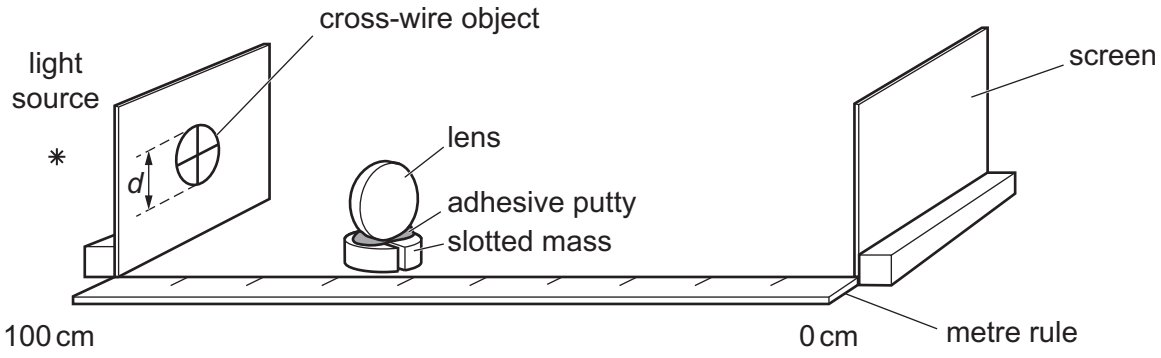


Fig. 4.1

Switch on the light source.

Adjust the position of the lens so that a sharply focused and **enlarged** image of the cross-wire object is seen on the screen.

Describe in detail the technique that you use to adjust the lens.

.....

.....

.....

..... [3]

(b) Measure and record the position of the centre of the lens on the rule and the distance *x* of the centre of the lens from the screen on the answer lines.

position of the centre of the lens = ...

x = ... cm [1]

(c) Measure:

- the length *d* of the vertical wire of the cross-wire object as shown in Fig. 4.1
- the length *D* of the magnified image of this wire.

Record your measurements on the answer lines.

d = ... mm

D = ... mm
[1]

(d) Move the screen to the 8.0 cm mark on the rule. The cross-wire object must stay at the 100.0 cm mark throughout.

Adjust the position of the lens so that the image of the cross-wire on the screen is sharply focused. Measure and record the new position of the lens, the new x and the new D.

Repeat **(b)** and **(c)** to obtain further values for the position of the lens, x and D for screen positions of 16.0 cm, 24.0 cm, 32.0 cm and 40.0 cm on the rule.

Record your measurements in Table 4.1 with appropriate headings and units for each column. Include your measurements of the lens position, x and D from **(b)** and **(c)**.

In a separate column of Table 4.1, calculate the magnification m of the lens using the equation

$$m = \frac{D}{d}\ .$$

Use the value of d you recorded in **(c)**.

Table 4.1

screen position on rule / cm				m
0				
8.0				
16.0				
24.0				
32.0				
40.0				

[4]

(e) On the grid on page 11, plot a graph of m on the y-axis against x on the x-axis. [4]

(f) **(i)** Calculate the focal length f of the lens using the equation:

$$f = x - 0.01\ x^2$$

where x is your value of x recorded in **(b)**.

Show your working.

f = ... cm [1]

(ii) A student claims that the focal length f of the lens is 15.0 cm.

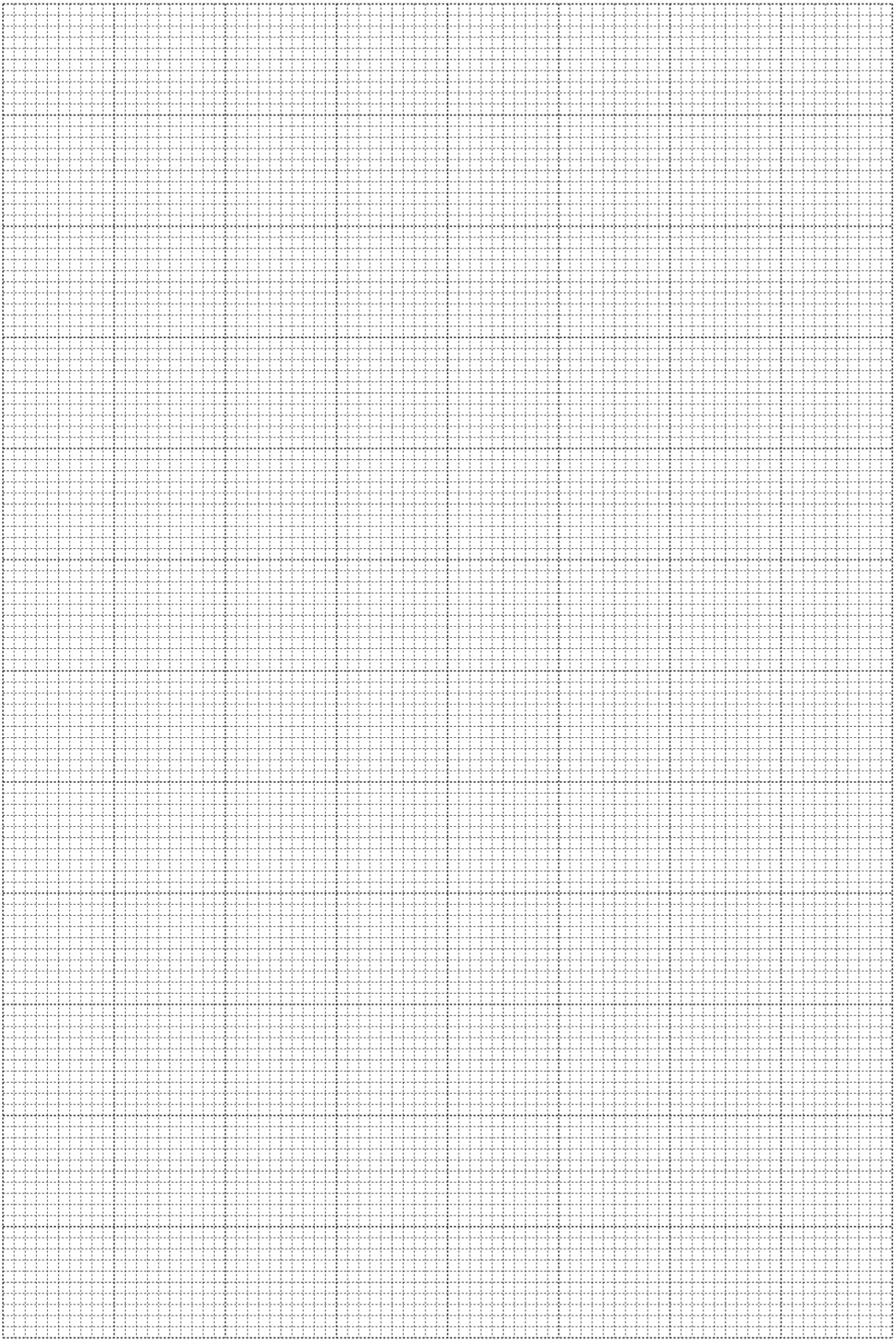
Use your value of f calculated in **(f)(i)** to explain whether the student's claim is correct.

.....

..... [1]

[Total: 15]

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