Light

Question Paper 9

Level	IGCSE
Subject	Physics
Exam Board	CIE
Topic	Properties of Waves. Including Light and Sound
Sub-Topic	Light
Paper Type	Alternative to Practical
Booklet	Question Paper 9

Time Allowed: **58 minutes**

Score: **/48**

Percentage: **/100**

1 An IGCSE student is determining the focal length of a lens by two different methods.

The set-up for Method 1 is shown in Fig. 4.1.

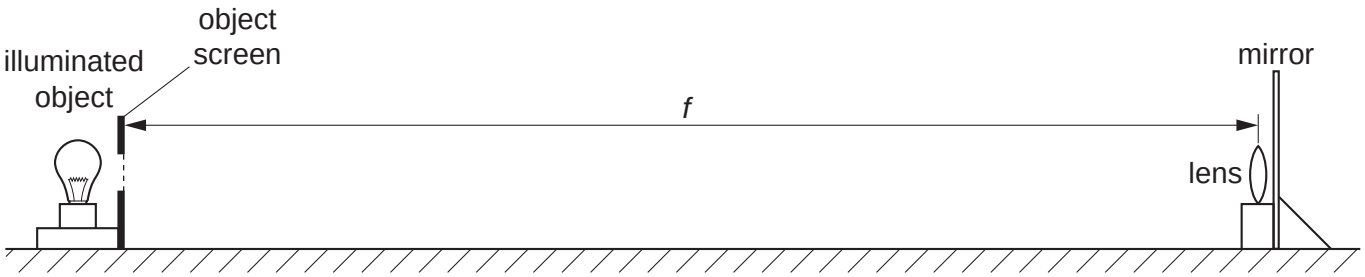


Fig. 4.1

The student moves the lens and the mirror slowly towards the object screen until a sharply focused image is obtained on the object screen as shown in Fig. 4.2.

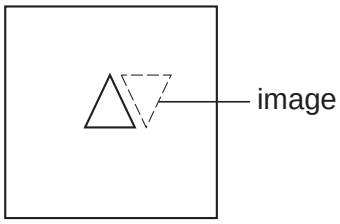


Fig. 4.2

(a) On Fig. 4.1, use your rule to measure the distance *f* between the lens and the object screen. This is the focal length of the lens.

f = ... [2]

(b) For Method 2, the student takes measurements of the diameter *d* and maximum thickness *t* of the lens. Use your rule to take measurements on Fig. 4.3.

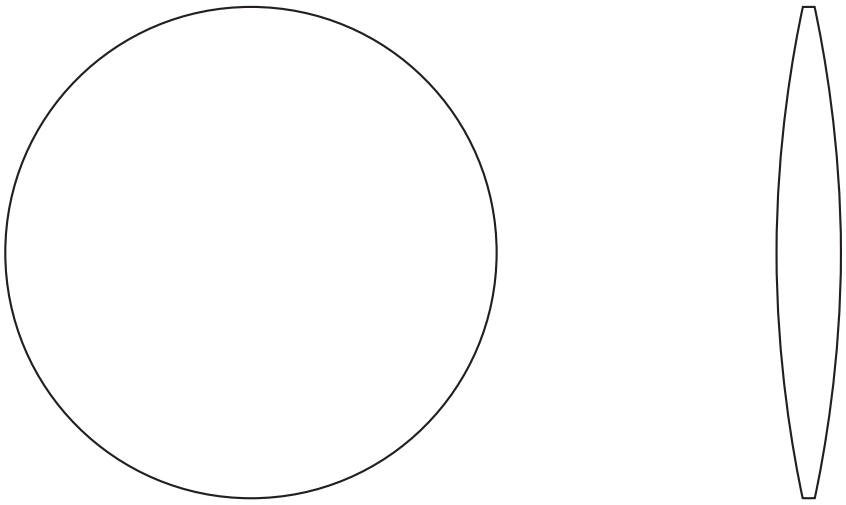


Fig. 4.3

(i) Determine an average value for the diameter d of the lens. Record your readings in the space below.

d = ...

(ii) Measure the maximum thickness t of the lens.

t = ...

(iii) Draw a diagram to show how, in the laboratory you would use two rectangular blocks of wood and a metre rule to measure the thickness of the lens as accurately as possible.

(iv) Theory shows that, for a perfectly formed lens, the focal length is given by the formula

$$f = \frac{d^2}{kt} \qquad \text{where } k = 4.16.$$

Calculate the focal length f of the lens using this formula.

f = ...

[7]

(c) Explain whether your results from Methods 1 and 2 support the theory in part **(b)(iv)**.

.....

.....

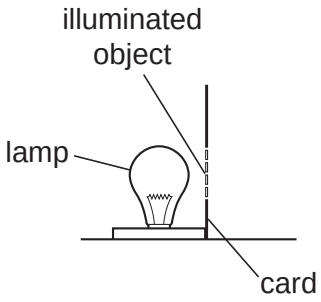
..... [1]

[Total: 10]

2 An IGCSE student is carrying out an optics experiment.

The experiment involves using a lens to focus the image of an illuminated object onto a screen.

(a) Complete the diagram below to show the apparatus you would use. Include a metre rule to measure the distances between the object and the lens and between the lens and the screen. The illuminated object is drawn for you.



[3]

(b) State two precautions that you would take to obtain accurate results in this experiment.

1. .....

.....

2. .....

..... [2]

[Total: 5]

3 A student is determining a quantity called the refractive index of the material of a transparent block.

Fig. 4.1 shows the ray-tracing sheet that the student is producing. **ABCD** is the outline of the transparent block, drawn on the ray-tracing sheet.

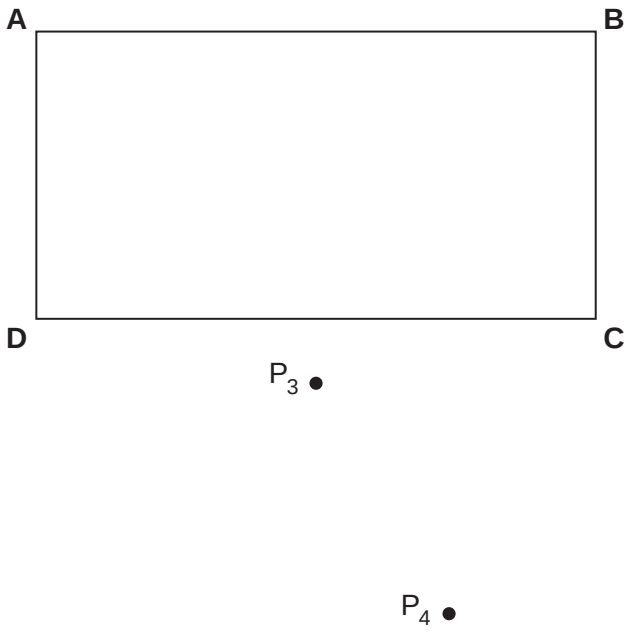


Fig. 4.1

(a) (i) Draw the normal **NN'** to side **AB**, extended to cross side **DC**, so that the normal is 2.0 cm from **A**. Label the point **F** where **NN'** crosses **AB**. Label the point **G** where **NN'** crosses **DC**.

(ii) Draw the line **EF** at an angle of 30° to the normal and to the left of the normal **NN'**. **E** is a point outside the block and above **AB** on the ray-tracing sheet.

[3]

(b) Read the following passage, taken from the student's notebook and then answer the questions that follow.

> I placed two pins P_1 and P_2 on line **EF**.
> I observed the images of P_1 and P_2 through side **CD** of the block so that the images of P_1 and P_2 appeared one behind the other. I placed two more pins P_3 and P_4 between my eye and the block so that P_3, P_4 and the images of P_1 and P_2, seen through the block, appeared one behind the other. I marked the positions of P_1, P_2, P_3 and P_4.

(i) Draw a line joining the positions of P_3 and P_4. Continue the line until it meets **CD**. Label this point **H**.

(ii) Measure and record the length *a* of the line **GH**.

a = ...

(iii) Draw the line **HF**.

(iv) Measure and record the length *b* of the line **HF**.

b = ...[3]

(c) Extend the straight line **EF** through the outline of the block to a point **J**. The point **J** must be at least 5 cm from the block. The line **EJ** crosses the line **CD**. Label this point **K**.

(i) Measure and record the length *c* of the line **GK**.

c = ...

(ii) Measure and record the length *d* of the line **FK**.

d = ...

(iii) Calculate the refractive index *n* of the material of the block using the equation

$$n = \frac{cb}{ad}.$$

n = ...[3]

[Total: 9]

4 An IGCSE student is determining the focal length of a converging lens.
The apparatus is shown in Fig. 4.1.

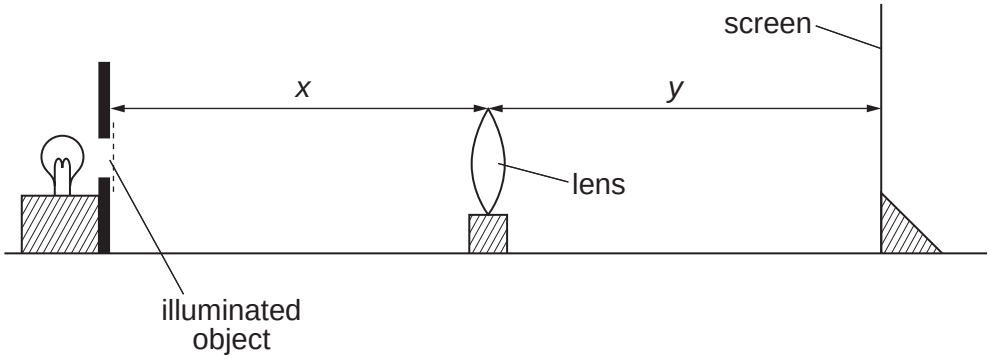


Fig. 4.1

(a) The student places the lens at a distance x = 25.0 cm from the illuminated object. She places the screen close to the lens and then moves it away from the lens until a sharply focused image is formed on the screen. She measures and records the distance y between the lens and the screen.

y = 37.1 cm

Calculate the focal length f of the lens using the equation

$$f = \frac{xy}{(x + y)}.$$

f = ...[2]

(b) She then repeats the procedure with the lens at a distance x = 30.0 cm from the illuminated object.

Fig. 4.1 shows this position of the apparatus. It is a scale diagram.

(i) On Fig. 4.1, measure the distance x_s between the lens and the illuminated object. Also on Fig. 4.1, measure the distance y_s between the lens and the screen.

x_s = ...

y_s = ...

(ii) Calculate the actual distance *y* between the lens and the screen.

y = ...

(iii) Calculate the focal length *f* using the new values of *x* and *y*.

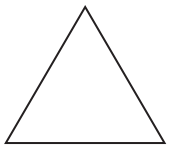
f = ...

(iv) Calculate the average value of *f*. Show your working.

average value of *f* = ...

[7]

(c) The illuminated object has the shape shown below.



Draw a diagram to show the appearance of the focused image in **(b)** on the screen.

[1]

[Total: 10]

5 A student is investigating how the resistance of a wire depends on the length of the wire. The student aims to plot a graph.

The following apparatus is available to the student:

ammeter
voltmeter
power supply
variable resistor
switch
connecting leads
resistance wires of different lengths
metre rule.

Plan an experiment to investigate how the resistance of a wire depends on the length of the wire.

You should

- draw a diagram of the circuit you could use to determine the resistance of each wire
- explain briefly how you would carry out the investigation
- suggest suitable lengths of wire
- state the key variables that you would control
- draw a table, or tables, with column headings to show how you would display your readings. You are not required to enter any readings in the table.

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.....[7]

[Total: 7]

6 **(a)** The IGCSE class has a range of apparatus available. Here is a list of some of the apparatus.

ammeter

barometer

beaker

electronic balance

manometer

measuring cylinder

metre rule

newtonmeter (spring balance)

stopwatch

tape measure

thermometer

voltmeter

Complete Table 5.1 by inserting the name of one piece of apparatus from the list that is the most suitable for measuring each quantity described.

Table 5.1

quantity to be measured	most suitable apparatus
volume of water	
a distance of about 50 m	
the force required to lift a laboratory stool	
the mass of a coin	
the pressure of the laboratory gas supply	

[5]

(b) The IGCSE class is carrying out a lens experiment. This involves using an illuminated object, a screen and a lens.

Firstly, the distance between the illuminated object and the lens is measured with a metre rule. Next, a clearly focused image is obtained on the screen.

(i) Explain briefly how you would avoid a parallax (line-of-sight) error when using the metre rule.

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..... [1]

(ii) State a precaution that you would take to ensure that the image is well focused.

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..... [1]

[Total: 7]