Light

Question Paper 4

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 4

Time Allowed: **54 minutes**

Score: **/45**

Percentage: **/100**

1 The IGCSE class is determining the magnification of an image produced by a lens.

The apparatus is shown in Fig. 4.1.

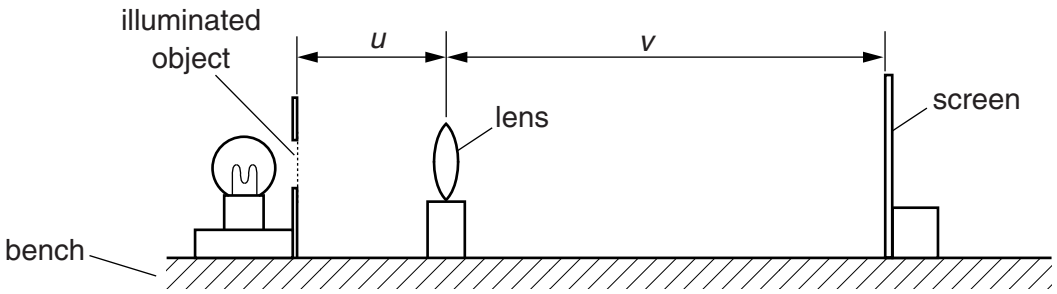


Fig. 4.1

(a) (i) On Fig. 4.1, measure and record in mm the distance *u* from the illuminated object to the centre of the lens.

u = ... mm

(ii) On Fig. 4.1, measure and record in mm the distance *v* from the centre of the lens to the screen.

v = ... mm
[1]

(b) Calculate the ratio $\frac{v}{u}$.

$\frac{v}{u}$ = ... [1]

(c) The diagram is drawn one tenth of actual size.

(i) Calculate the actual distance *U* from the illuminated object to the centre of the lens.

U = ... mm

(ii) Calculate the actual distance *V* from the centre of the lens to the screen.

V = ... mm
[1]

(d) The student measures the height *h* from the top to the bottom of the image on the screen.

h = ... cm

(i) On Fig. 4.2, measure the height x of the illuminated object.

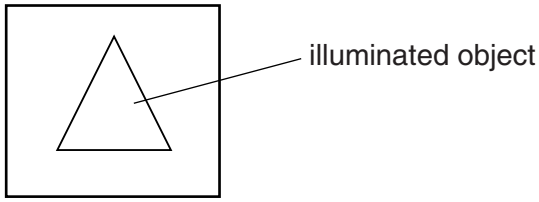


Fig. 4.2 (full size)

x = ...

(ii) Calculate $\frac{h}{x}$.

$\frac{h}{x}$ = ...
[1]

(e) The magnification m of the image is given by the equation $m = \frac{h}{x}$. The student suggests that the ratio $\frac{V}{U}$ also gives the magnification m. State whether the results support this suggestion and justify your answer by reference to the results.

statement .....

justification .....

.....
[2]

(f) State two precautions that you could take in this experiment to obtain reliable results.

1. .....

.....

2. .....

.....
[2]

(g) The image on the screen in this experiment is magnified and dimmer than the object.

State one other difference that you would expect to see between the image and the illuminated object.

.....[1]

(h) Suggest one precaution that you would take in this experiment in order to focus the image as clearly as possible.

.....

.....[1]

[Total: 10]

2 The IGCSE class is investigating refraction of light through a transparent block.

Fig. 4.1 shows a student's ray-trace sheet.

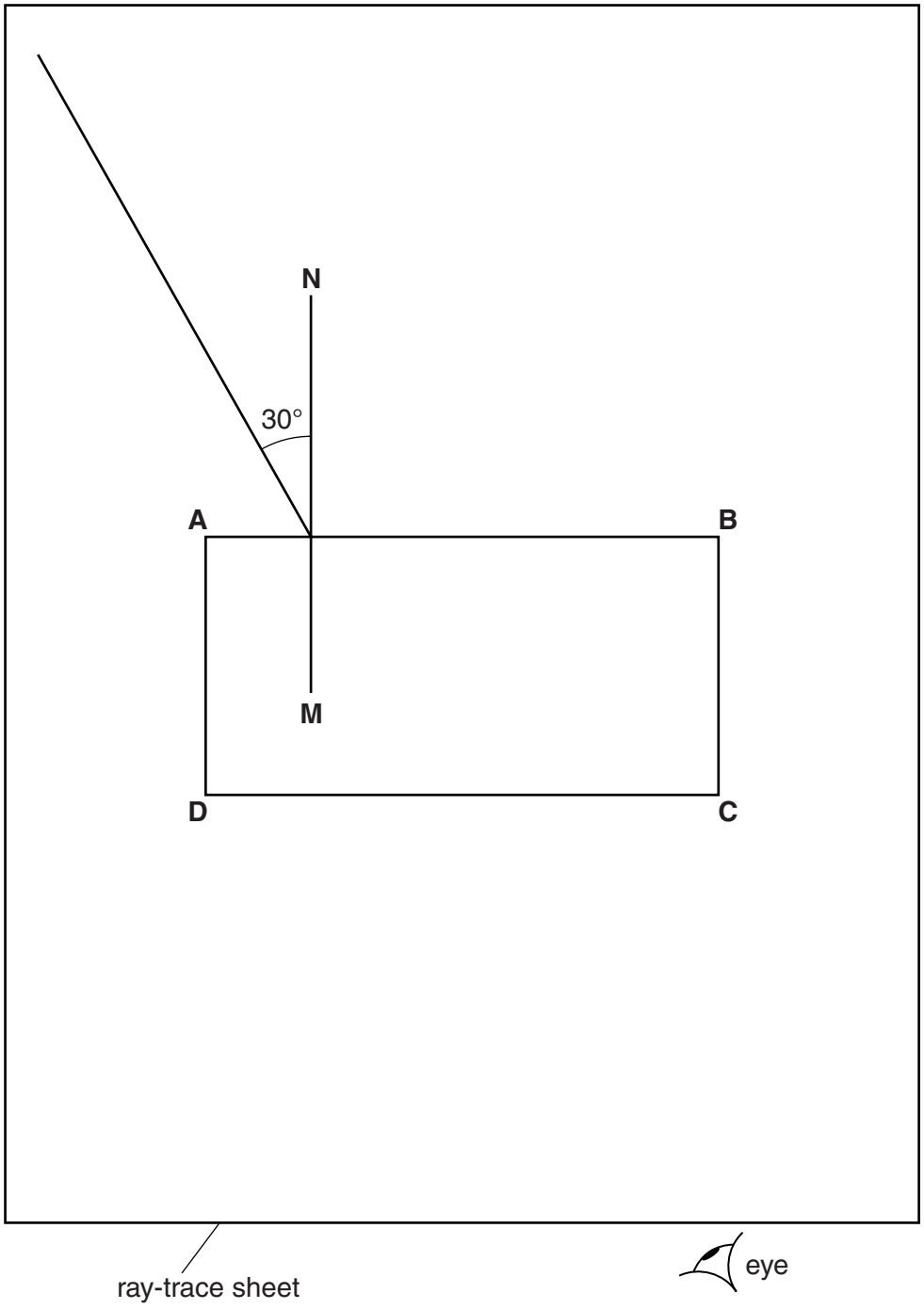


Fig. 4.1

(a) **(i)** On Fig. 4.1, label the point **F** at which the incident ray crosses the normal **NM**. Label the other end of the ray **E**.

(ii) On Fig. 4.1, draw a refracted ray from **F**, at an angle of refraction $r = 20°$, to meet side **CD** of the block. Label the point **G** at which this ray meets side **CD** of the block.

[1]

(b) Predict and draw on Fig. 4.1 the line of the ray that emerges from the block at point **G**. Label the end of your line **H**. [2]

(c) To obtain the correct positions for the emergent ray in this experiment, the student places two pins P_1 and P_2 on line **EF**. He observes the images of P_1 and P_2 through side **CD** of the block so that the images of P_1 and P_2 appear one behind the other.

He places two pins P_3 and P_4 between his eye and the block so that P_3, P_4 and the images of P_1 and P_2, seen through the block, appear one behind the other.

(i) On Fig. 4.1, mark the positions of the pins P_3 and P_4 at a suitable distance apart for this experiment. [1]

(ii) State two precautions that you should take in this experiment to obtain reliable results.

1. .....

.....

2. .....

.....

[2]

(d) The student repeats the experiment with the block turned through 90°, as shown in Fig. 4.2. He measures the angle of refraction *r*.

r = 22° .

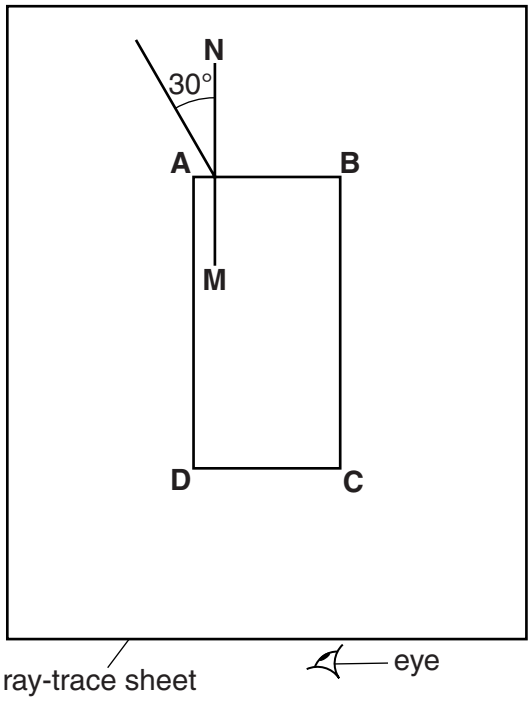


Fig. 4.2

He suggests that the value of *r* should be the same in both experiments because the material of the block has not changed.

State whether the results support this suggestion. Justify your answer by reference to the results.

statement .....

justification .....

.....

[1]

[Total: 7]

3 The IGCSE class is investigating the magnification produced by a converging lens.

The apparatus is set up as shown in Fig. 3.1.

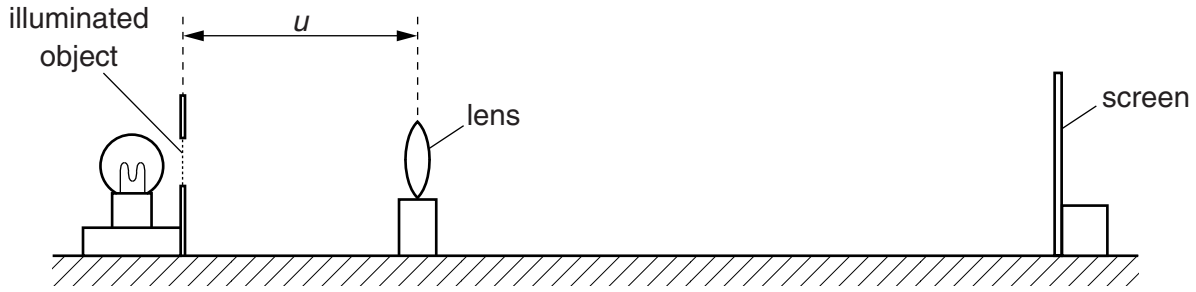


Fig. 3.1

(a) On Fig. 3.2, measure and record the height h_0 of the triangular object.

h_0 = ... cm [1]

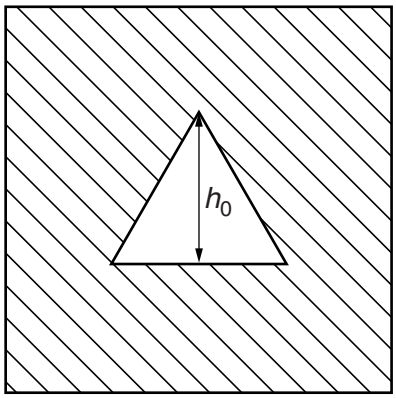


Fig. 3.2

(b) The distance u between the illuminated object and the lens is set to 30.0 cm. The screen is moved until a sharp image of the illuminated object is seen, as shown in Fig. 3.3.

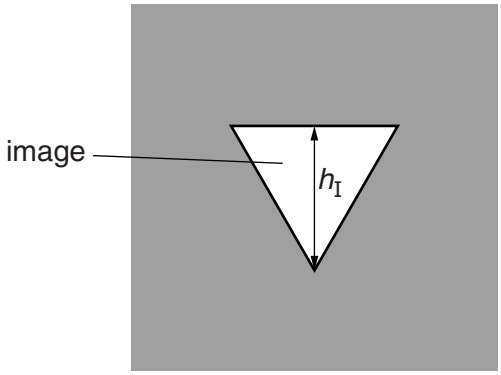


Fig. 3.3

Measure, and record in the first row of Table 3.1, the height h_I of the image.

Table 3.1

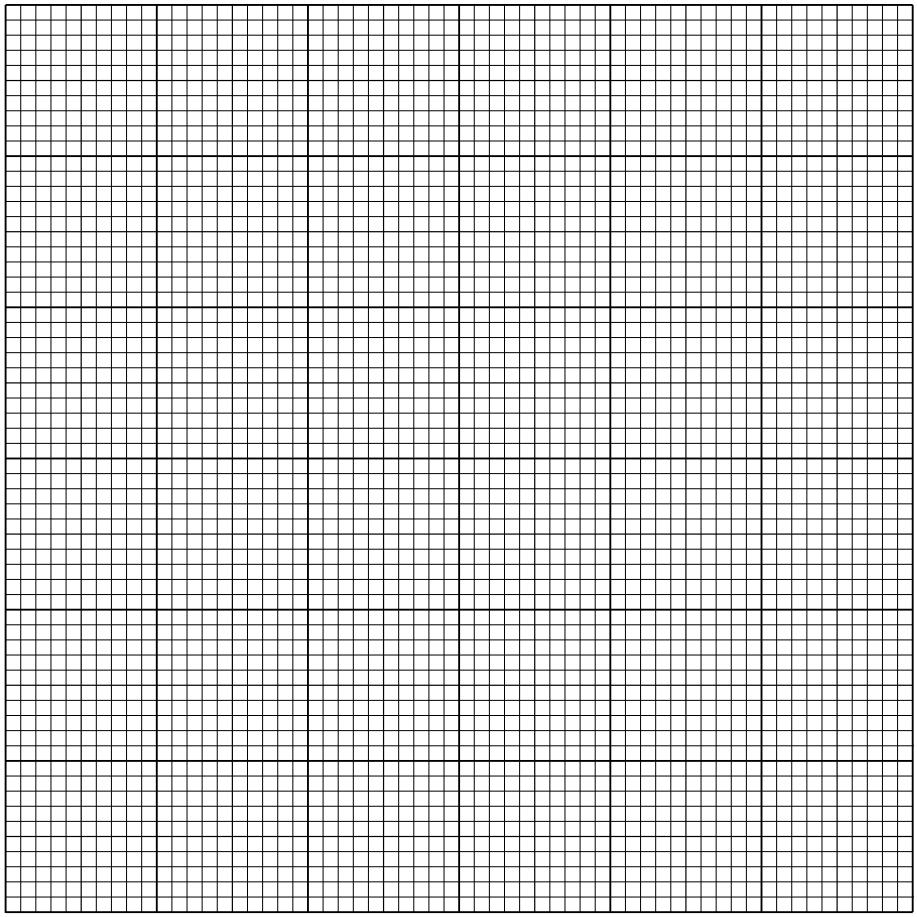
u/cm	h_I/cm	S
30.0		
35.0	1.5	
40.0	1.2	
45.0	1.0	
50.0	0.9	
55.0	0.8	

[2]

(c) The process is repeated for u values of 35.0 cm, 40.0 cm, 45.0 cm, 50.0 cm and 55.0 cm. The h_I values obtained are shown in the table.

Complete Table 3.1 by calculating the values of S, using your result from **(a)** and the equation $S = \frac{h_0}{h_I}$.

(d) Plot a graph of S (y-axis) against u/cm (x-axis).



[5]

(e) **(i)** Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ... [1]

(ii) Calculate the focal length f of the lens, where $f = \frac{1}{G}$ cm.

f = ... [1]

[Total: 10]

4 The IGCSE class is investigating the position of the image in a plane mirror.

A student's ray-trace sheet is shown in Fig. 4.1.

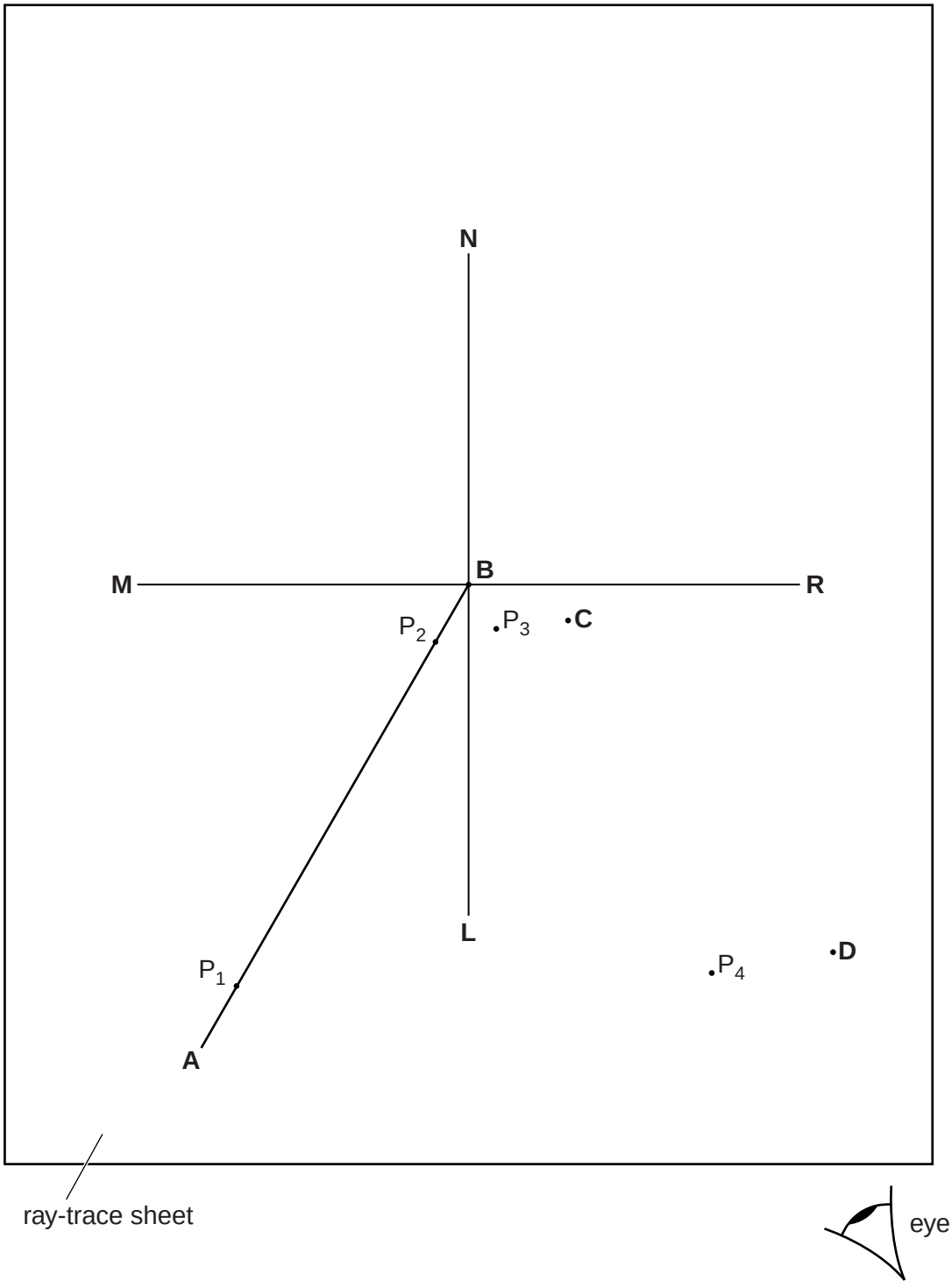


Fig. 4.1

The line **MR** shows the position of a plane mirror. **NL** is the normal at the centre of the mirror.

AB marks the position of an incident ray.

The student pushes two pins, P_1 and P_2 into this line. She views the images of pins P_1 and P_2 from the direction indicated by the eye in Fig. 4.1.

She places two pins P_3 and P_4 some distance apart so that pins P_4 and P_3, and the images of P_2 and of P_1, all appear exactly one behind the other. The positions of P_3 and P_4 are labelled.

(a) Draw in the line joining the positions of P_3 and P_4. Continue the line until it crosses **MR** and extends at least 8.0 cm beyond **MR**. [1]

(b) The student repeats the procedure without moving pin P_1 but using a different angle of incidence. On Fig. 4.1, the new positions of pins P_3 and P_4 are marked **C** and **D**.

(i) Draw in the line joining the positions **C** and **D**. Continue the line until it extends at least 8.0 cm beyond **MR**.

(ii) Label with a **Y** the point where the two lines beyond **MR** cross. [1]

(c) **(i)** Draw a line from P_1 to **MR** that meets **MR** at a right angle. Measure and record the length *a* of this line.

a = ...

(ii) Draw a line from the point labelled **Y** to **MR** that meets **MR** at a right angle. Measure and record the length *b* of this line.

b = ...
[2]

(d) A student suggests that the length of *a* should equal the length of *b*.

State whether your results support this suggestion. Justify your statement by reference to your results.

statement .....

justification .....

.....

.....
[2]

(e) Suggest a precaution that you would take, when placing the pins, in order to obtain reliable results.

.....

.....[1]

[Total: 7]

5 The IGCSE class is determining the focal length of a lens.

The apparatus is shown in Fig. 5.1.

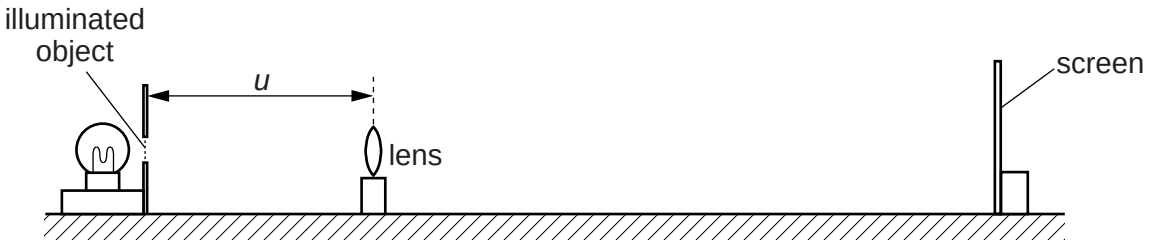


Fig. 5.1

A student places the lens a distance u = 25.0 cm from an illuminated object of height 1.5 cm. She moves the screen until a sharply focused image of the object is seen on the screen.

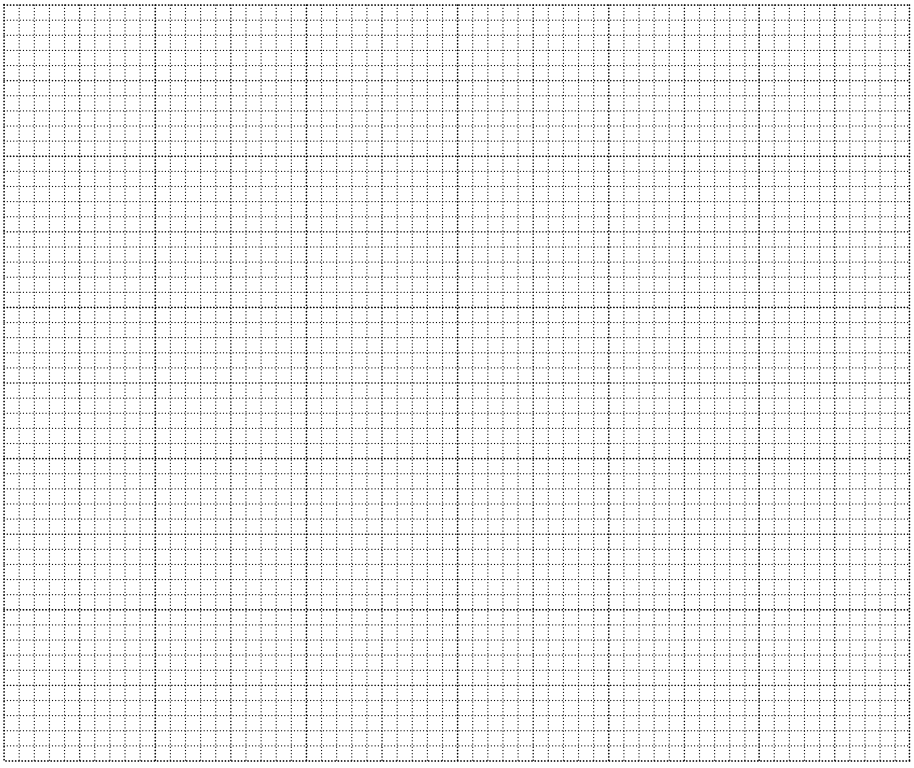
She measures the height h of the image on the screen. She calculates $\frac{1}{h}$.

She repeats the procedure using a range of u values. Her results are shown in Table 5.1.

Table 5.1

u/cm	h/cm	$\frac{1}{h} \Big/ \frac{1}{\text{cm}}$
25.0	2.2	0.45
30.0	1.5	0.67
35.0	1.1	0.91
40.0	0.9	1.1
45.0	0.8	1.3

(a) Plot a graph of u/cm (y-axis) against $\frac{1}{h}\Big/\frac{1}{\text{cm}}$ (x-axis). You do not need to begin the axes at the origin (0,0).



[5]

(b) Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ...[2]

(c) Calculate the focal length f of the lens, using the equation $f = \frac{G}{1.5}$ cm. Give your answer to a suitable number of significant figures for this experiment.

f = ...[2]

(d) State two precautions that you would take in this experiment in order to obtain reliable results.

1. .....

.....

2. .....

.....

[2]

[Total: 11]