Light

Question Paper 7

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 7

Time Allowed: **57 minutes**

Score: **/47**

Percentage: **/100**

1 An IGCSE student is investigating reflection of light in a plane mirror.

Fig. 4.1 shows the student's ray trace sheet.

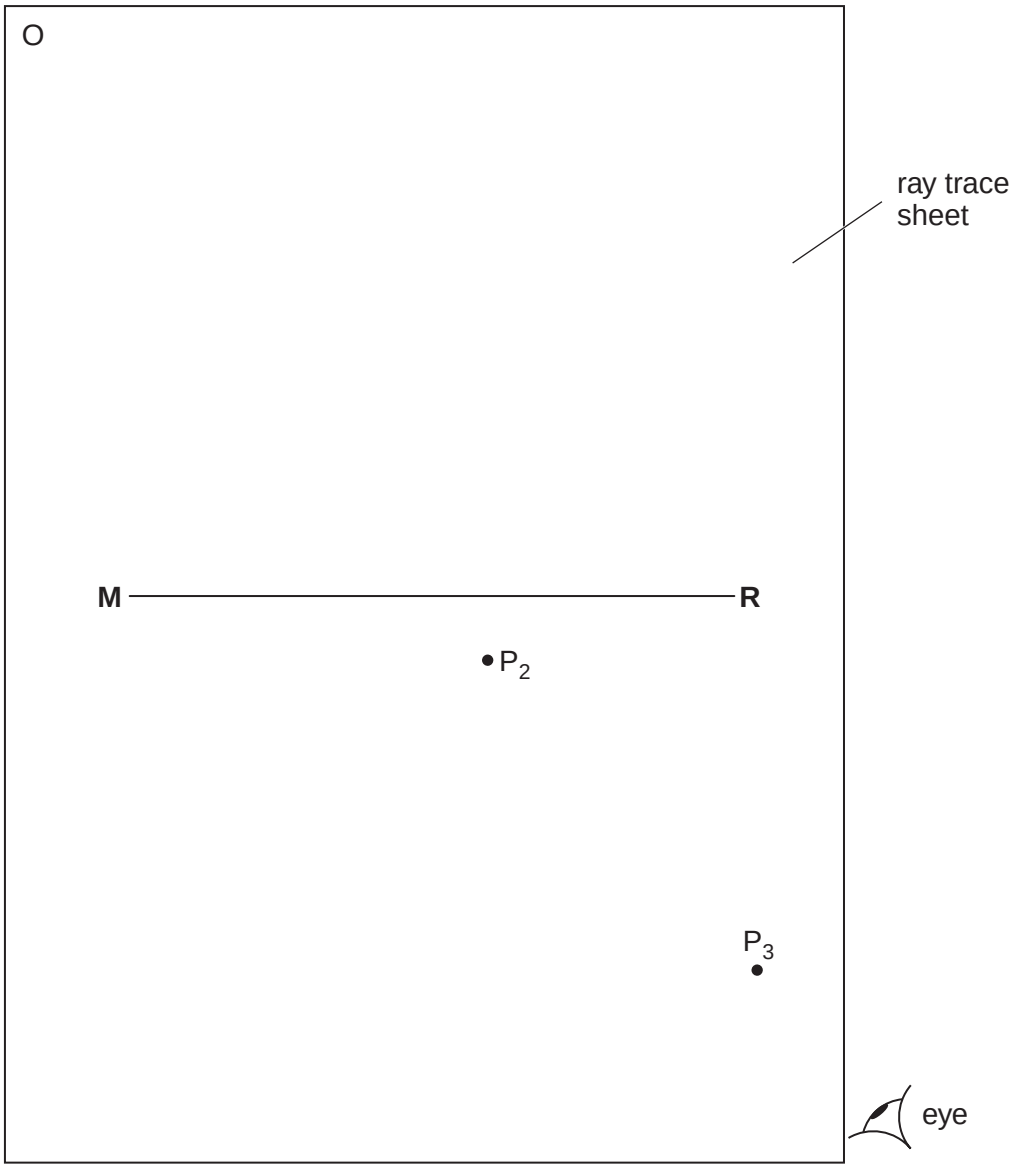


Fig. 4.1

(a) The line **MR** shows the position of a mirror.

(i) Draw a normal to this line that passes through its centre. Label the normal **NL**. Label the point at which **NL** crosses **MR** with the letter **B**.

[1]

(ii) Draw a line 8 cm long from **B** at an angle of incidence $i = 40°$ to the normal below **MR** and to the left of the normal. Label the end of this line **A**. Record the angle of incidence i in the first row of Table 4.1.

Table 4.1

i / °	r / °
34	33

[2]

(b) Fig. 4.2 shows the mirror which is made of polished metal and has a vertical line drawn on it.

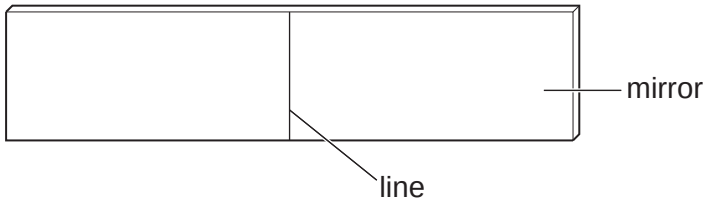


Fig. 4.2

The student places the mirror, with its reflecting face vertical, on **MR**. The lower end of the line on the mirror is at point **B**. He places a pin P_1 at **A**. He views the line on the mirror and the image of pin P_1 from the direction indicated by the eye in Fig. 4.1. He places two pins P_2 and P_3 some distance apart so that pins P_3, P_2, the image of P_1, and the line on the mirror all appear exactly one behind the other. The positions of P_2 and P_3 are shown.

(i) Draw the line joining the positions of P_2 and P_3. Continue the line until it meets the normal.

(ii) Measure, and record in the first row of Table 4.1, the angle of reflection r between the normal and the line passing through P_2 and P_3.

[2]

(c) The student draws a line parallel to **MR** and 2 cm above it. He places the mirror on this line and repeats the procedure without changing the position of pin P_1. His readings for i and r are shown in the table.

In spite of carrying out this experiment with reasonable care, it is possible that the values of the angle of reflection r will not be exactly the same as the values obtained from theory. Suggest two possible causes of this inaccuracy.

1. .....

.....

2. .....

.....[2]

(d) The student was asked to list precautions that should be taken with this experiment in order to obtain readings that are as accurate as possible. Table 4.2 shows the suggestions.

Place a tick (✓) in the second column of the table next to each correctly suggested precaution.

Table 4.2

suggested precaution	
avoid parallax (line of sight) errors when taking readings with the protractor	
carry out the experiment in a darkened room	
draw the lines so that they are as thin as possible	
keep room temperature constant	
place pins P_2 and P_3 as far apart as possible	
use only two or three significant figures for the final answers	

[3]

[Total: 10]

2 An IGCSE student is investigating the reflection of light by a plane mirror.

Fig. 4.1 shows her ray trace sheet.

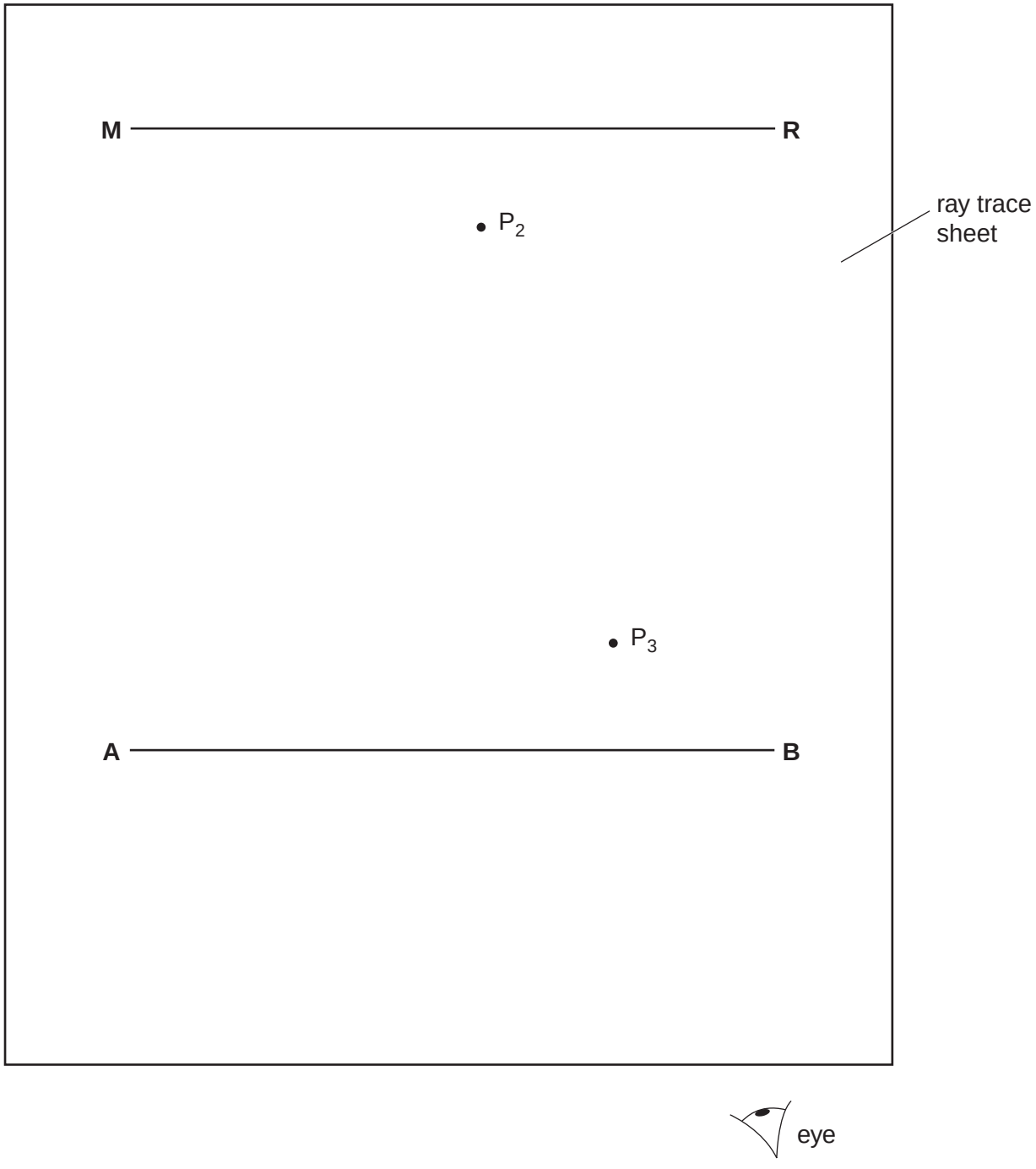


Fig. 4.1

(a) The line **MR** shows the position of a mirror.

(i) Draw a normal to **MR** at its centre. Label the normal **NL** with **N** at the centre of **MR** and **L** on **AB**.

(ii) Mark a point on **AB**, 3.0 cm to the left of **L**. Label this point **C.**

[2]

(b) Fig. 4.2 shows the mirror which is made of polished metal and has a vertical line drawn on it. The lower end of this line is at point **N**.

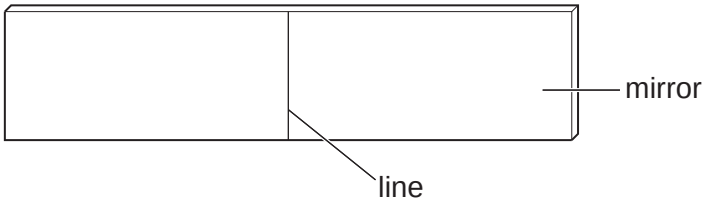


Fig. 4.2

In the experiment, the student places a pin P_1 at **C**. The student views the line on the mirror and the image of pin P_1 from the direction indicated by the eye in Fig. 4.1. She places two pins P_2 and P_3 some distance apart so that the image of P_1, the line on the mirror, and pins P_2 and P_3, all appear exactly one behind the other. The positions of P_2 and P_3 are shown.

(i) Draw the line joining the positions of P_2 and P_3. Continue the line until it meets the normal.

(ii) Draw the line joining point **C** and point **N**.

[1]

(iii) Measure, and record in Table 4.1, the angle of incidence *i* between the normal **NL** and the line **CN**. Measure, and record in the table, the angle of reflection *r* between the normal and the line passing through P_2 and P_3.

(iv) Complete the column headings in the table.

Table 4.1

distance of P_1 from the normal /	*i* /	*r* /
3.0		
4.0	23	22
5.0	27	28

[2]

(c) The student repeats the procedure using positions of P_1 that are 4.0 cm and 5.0 cm from the normal. The readings are shown in the table.

In spite of carrying out this experiment with reasonable care, it is possible that the values of the angle of reflection *r* will not be exactly the same as the values obtained from theory. Suggest two possible causes of this inaccuracy.

1. .....

.....

2. .....

.....[2]

(d) Suggest one precaution that you would take in this experiment to ensure that the results are as accurate as possible.

.....

.....[1]

[Total: 8]

3 An IGCSE student is investigating the passage of light through a transparent block using optics pins.

The student's ray trace sheet is shown in Fig. 1.1.

The student places two pins P_1 and P_2 to mark the incident ray. He looks through the block and places two pins P_3 and P_4 to mark the emergent ray so that P_3, P_4 and the images of P_1 and P_2 appear to be exactly one behind the other. He draws the outline of the block. He removes the block and pins and draws in the incident ray and the emergent ray.

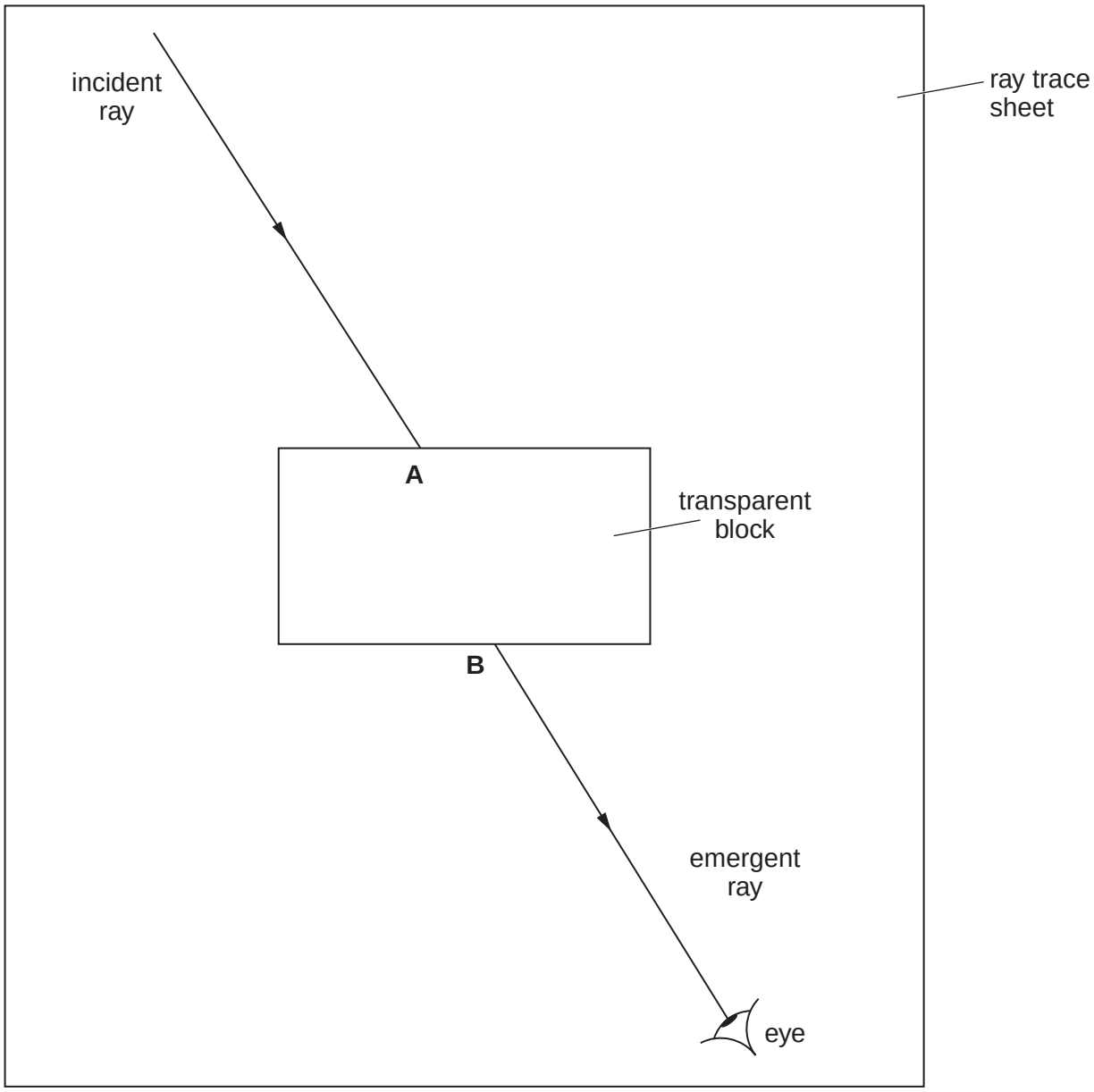


Fig. 1.1

(a) (i) On Fig. 1.1, mark suitable positions for the four pins. Label the pins P_1, P_2, P_3 and P_4.

(ii) Draw the normal at point **A**.

[2]

(b) **(i)** Draw in the line **AB**. Measure and record the angle of refraction *r* between the line **AB** and the normal.

r = ...

(ii) Measure and record the angle of incidence *i* between the incident ray and the normal.

i = ...
[2]

(c) The student does not have a set square or any other means to check that the pins are vertical. Suggest how he can ensure that his P_3 and P_4 positions are as accurate as possible.

.....

.....[1]

[Total: 5]

4 The IGCSE class is investigating the formation of images by a lens.

Fig 4.1 shows the apparatus.

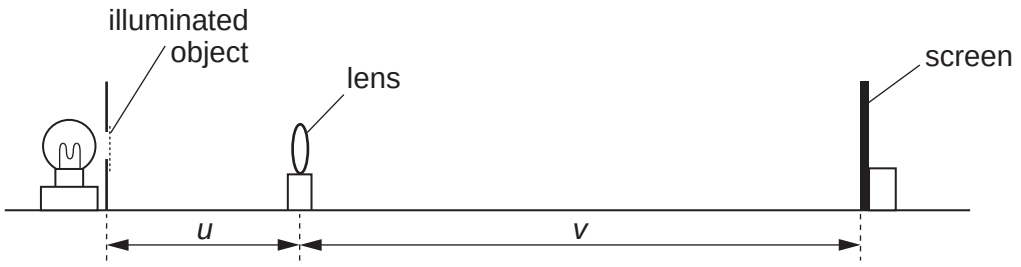


Fig. 4.1

A student places the screen about 1.0 m from the illuminated object. He places the lens between the object and the screen at a distance u = 0.200 m from the object. He adjusts the position of the screen until a clearly focused image is formed on the screen. He records the distance v between the centre of the lens and the screen. He repeats the procedure using different values of u. The readings are shown in Table 4.1.

Table 4.1

u/m	v/m	$\frac{1}{u}/\frac{1}{\text{m}}$	$\frac{1}{v}/\frac{1}{\text{m}}$
0.200	0.596	5.00	1.68
0.300	0.304	3.33	3.29
0.400	0.244	2.50	4.10
0.500	0.214	2.00	4.67
0.600	0.198	1.67	5.05

(a) State and briefly explain one precaution you would take in order to obtain reliable measurements in this experiment.

precaution .....

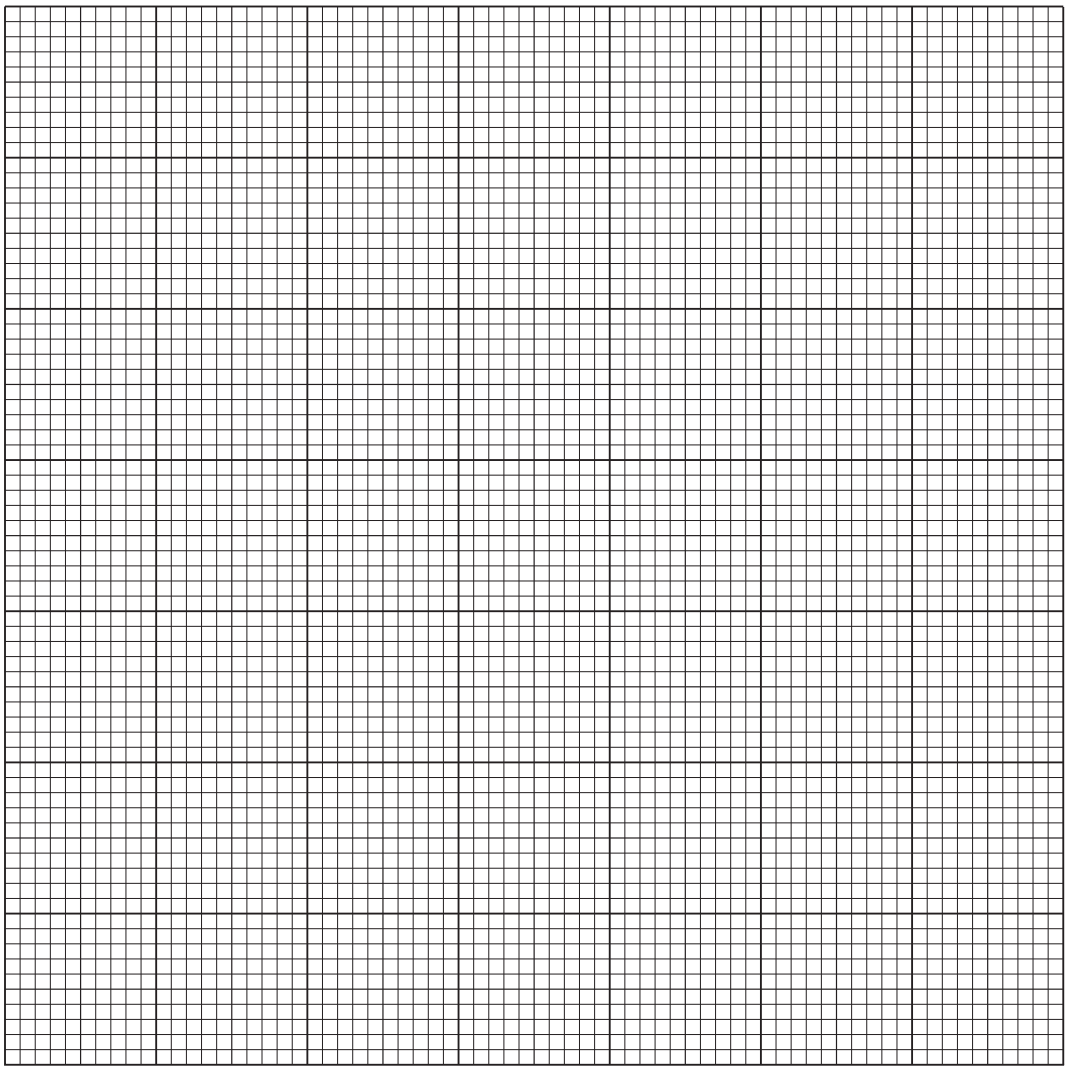
.....

explanation .....

.....

.....[1]

(b) Plot the graph of $\frac{1}{v}/\frac{1}{\text{m}}$ (y-axis) against $\frac{1}{u}/\frac{1}{\text{m}}$ (x-axis). Both axes must start at 0 and extend to 7.0.



[4]

(c) **(i)** Use the graph to find the intercept on the y-axis.

intercept on the y-axis = ...

(ii) Use the graph to find the intercept on the x-axis.

intercept on the x-axis = ...

[2]

[Total: 7]

5 An IGCSE student is investigating reflection from a plane mirror.

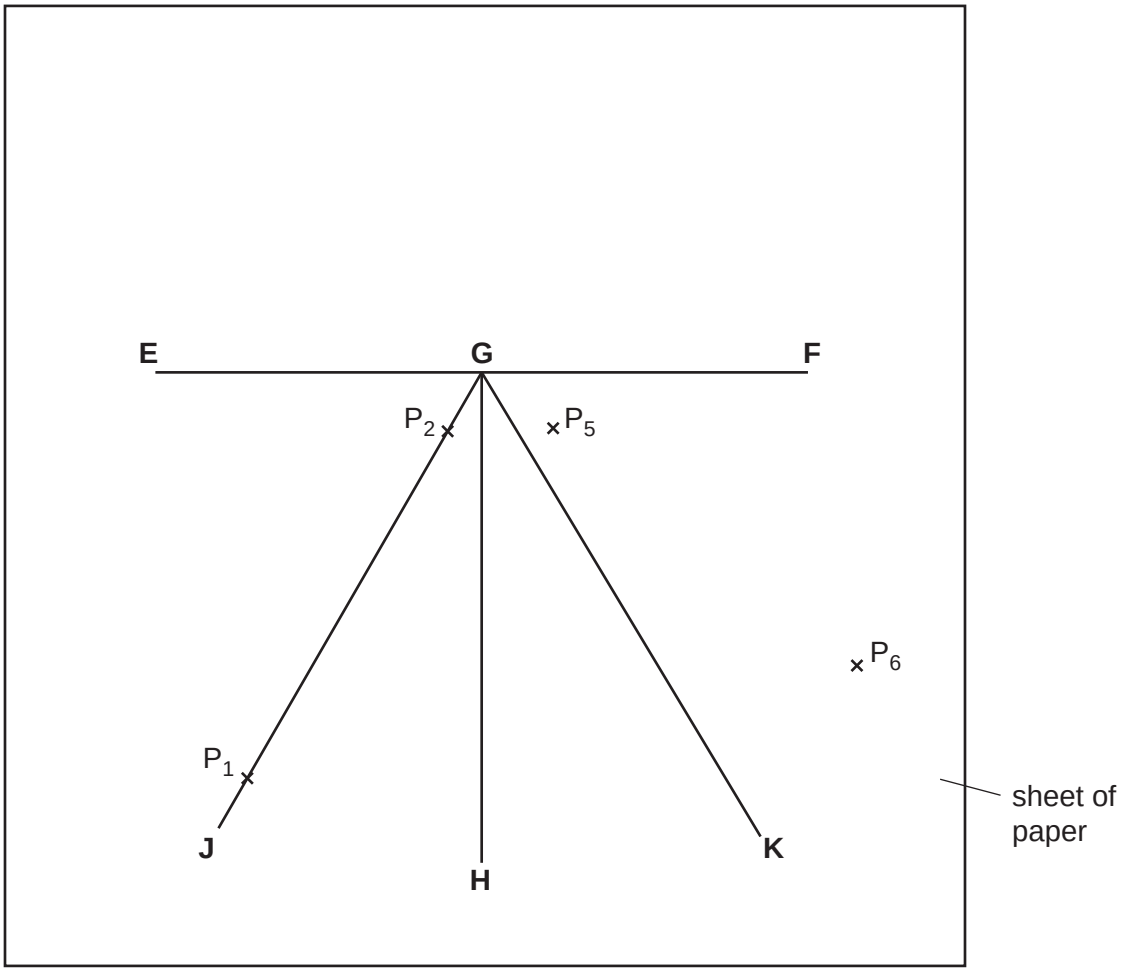


Fig. 4.1

The student is using a sheet of plain paper on a pin board. Fig. 4.1 shows the sheet of paper. The straight line **EF** shows the position of the reflecting surface of a plane mirror standing vertically on the sheet of paper. Line **GH** is a normal to line **EF**. Line **JG** marks an incident ray and line **GK** is the corresponding reflected ray. The student marks the position of the incident ray with two pins (P_1 and P_2) and uses two more pins (P_3 and P_4) to find the direction of the reflected ray.

(a) (i) On Fig. 4.1 mark with two neat crosses, labelled P_3 and P_4, suitable positions for the pins to find the direction of the reflected ray.

(ii) On Fig. 4.1 measure the angle of incidence *i*.

i = ...

(iii) On Fig. 4.1 measure the angle of reflection r_1.

r_1 = ...

[3]

(b) **(i)** On Fig. 4.1 draw a line **E'GF'** such that the angle θ between this line and the line **EGF** is 10°. Start with **E'** below the line **EGF**. The straight line **E'F'** shows a new position of the reflecting surface of the plane mirror standing vertically on the sheet of paper.
The points labelled P_5 and P_6 mark the positions of two pins placed so that P_5, P_6 and the images of P_1 and P_2 appear in line with each other. P_1 and P_2 have not been moved since the original set-up.

(ii) Using a ruler, draw a line joining the points labelled P_5 and P_6, and continue this line to meet the line **E'F'**.

(iii) Measure the angle of reflection r_2 between line **GH** and the line joining the points labelled P_5 and P_6.

r_2 = ...

(iv) Calculate the angle α through which the reflected ray has moved.

α = ...

(v) Calculate the difference between 2θ and α.
θ is the angle between the two positions of the mirror.

difference between 2θ and α = ...
[3]

(c) Theory suggests that if the mirror is moved through an angle θ then the reflected ray will move through an angle of 2θ.
State whether your result supports the theory and justify your answer by reference to the result.

Statement .....

Justification .....

.....[2]

6 The IGCSE class is investigating refraction and reflection of light in a transparent block.

The block rests on a pin board covered with a sheet of plain paper. Some of the lines and labels that a student draws are shown in Fig. 4.1.

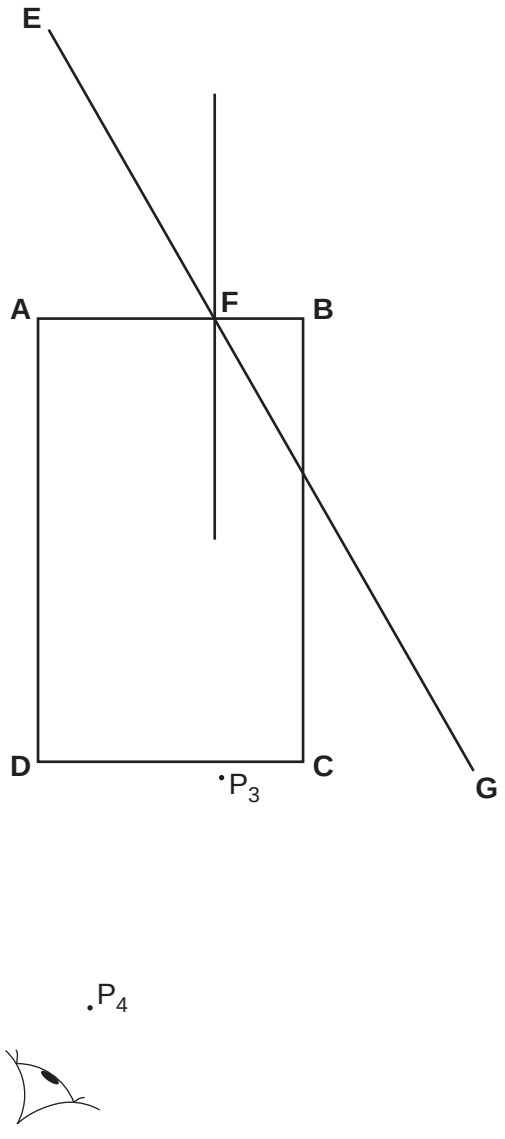


Fig. 4.1

(a) The student places the transparent block **ABCD** on the sheet of plain paper. The student draws a line around the block and then draws a normal to side **AB**.
On Fig. 4.1 label the normal **NN'**.

[1]

(b) Line **EF** shows an incident ray that is at an angle of incidence $i = 30°$ to the normal. The student continues the line to a point **G**.
Draw two neat crosses on line **EF** and label them P_1 and P_2 to show suitable positions for two pins that are to be used to trace the direction of the incident ray. [1]

(c) The student observes the images of P_1 and P_2 through side **CD** of the block from the direction indicated in Fig. 4.1 so that the images of P_1 and P_2 appear one behind the other. She then places two pins P_3 and P_4 between her eye and the block so that P_3, P_4 and the images of P_1 and P_2, seen through the block, appear in line. The positions of P_3 and P_4 are marked.

(i) Draw a line joining the positions of P_3 and P_4. Continue the line so that it crosses **CD** and extends beyond **BC** to cross line **EFG**. Label the end of the line **H**.

(ii) Measure the smaller angle θ between **EFG** and the line joining the positions of P_3, P_4 and **H**.

θ = ...

(iii) Calculate the difference $(\theta - 2i)$. Show your working.

$(\theta - 2i)$ = ...
[4]

(d) The student repeats the experiment using an angle of incidence $i = 40°$ to the normal and obtains a value of $\theta = 82°$.

Calculate the difference $(\theta - 2i)$.

$(\theta - 2i)$ = ...[1]

(e) Theory suggests that $\theta = 2i$. State whether the two results in parts **(c)** and **(d)** support the theory and justify your answer by reference to the results.

Statement .....

Justification .....

.....[2]