Light

Question Paper 5

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 5

Time Allowed: **63 minutes**

Score: **/52**

Percentage: **/100**

1 IGCSE students are investigating the magnification produced by a converging lens.

The apparatus is set up as shown below.

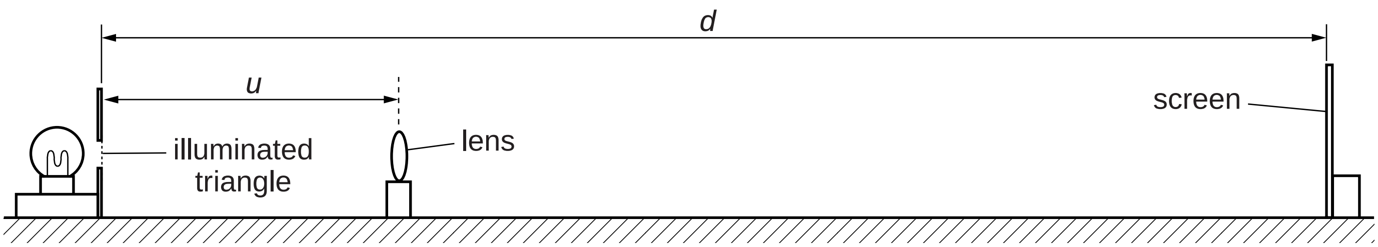

Fig. 5.1

The screen is moved until a sharp image of the object is seen on the screen.

(a) **(i)** On Fig. 5.1, carefully measure u and record the value.

u = ...

(ii) On Fig. 5.1, carefully measure d, the distance between the illuminated triangle and the screen when the image is sharp, and record the value.

d = ...

(iii) Calculate a value m for the magnification, using your answers to **(a)(i)** and **(a)(ii)**, and the equation $m = \frac{d - u}{u}$.

m = ...

[2]

(b) The illuminated triangle is shown in Fig. 5.2. The image of the triangle seen on the screen is shown in Fig. 5.3.

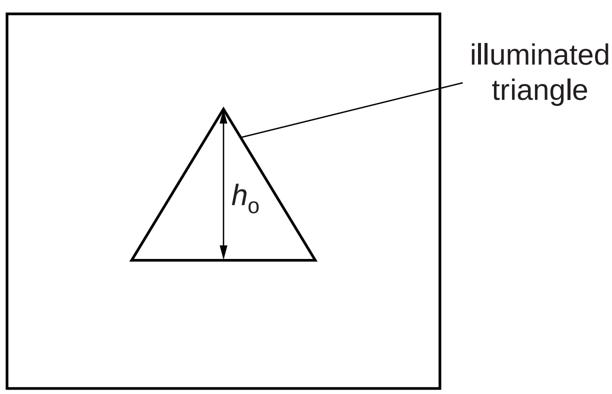

Fig. 5.2

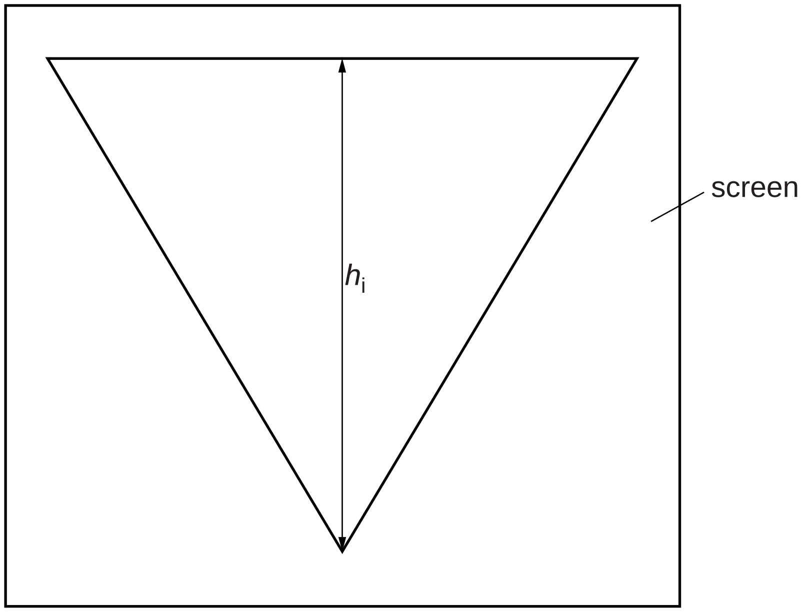

Fig. 5.3

(i) Measure h_o, the height of the illuminated triangle, as shown in Fig. 5.2, and record the value.

h_o = ...

(ii) Measure h_i, the height of the image on the screen, as shown in Fig. 5.3, and record the value.

h_i = ...

(iii) Calculate M, another value for the magnification, using your answers to **(b)(i)** and **(b)(ii)**, and the equation $M = \frac{h_i}{h_o}$.

M = ...
[2]

(c) A student says that the values of m and M should be the same.

State whether your findings support this. Justify your answer by reference to your results for m and M.

statement ....

....

justification ....

....

....
[2]

(d) (i) Describe one difficulty the students might have found when measuring the height of the image on the screen.

Suggest a solution for the problem.

difficulty ....

....

solution ....

....
[2]

(ii) Suggest one further precaution which should be taken to make the experiment reliable.

....

....

....[1]

[Total: 9]

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

Fig. 4.1 shows the apparatus used to produce an image on the screen.

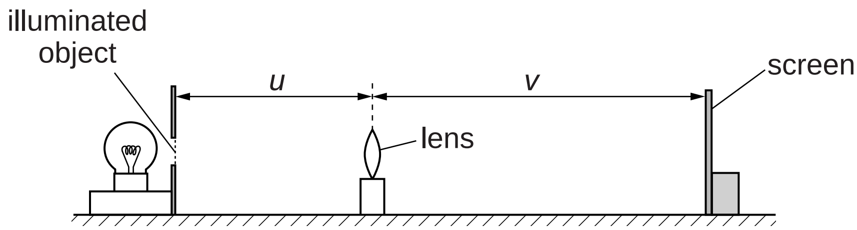

Fig. 4.1

(a) (i) On Fig. 4.1, measure the distance *u* between the illuminated object and the centre of the lens.

u = ...

(ii) On Fig. 4.1, measure the distance *v* between the centre of the lens and the screen.

v = ...
[2]

(b) (i) Calculate *uv*.

uv = ...

(ii) Calculate *u* + *v*.

u + *v* = ...
[1]

(iii) Calculate *x* using the equation $x = \frac{uv}{(u + v)}$.

x = ... [1]

(c) Fig. 4.1 is drawn 1/10th of actual size. The focal length *f* of the lens is given by the equation *f* = 10*x*.

Calculate a value for the focal length *f* of the lens, giving your answer to a suitable number of significant figures for this experiment.

f = ... [2]

(d) A student carrying out this experiment changes the position of the lens and then moves the screen to produce a well-focused image.

She records the distance *v* between the centre of the lens and the screen as $v = 18.2$ cm. She finds it difficult to decide the exact point at which the image is sharpest.

Suggest a range of *v* values for which the image may appear well-focused.

range of *v* values = ... to .... [1]

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

1. ....

....

2. ....

....

[2]

[Total: 9]

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

Fig. 4.1 shows the apparatus.

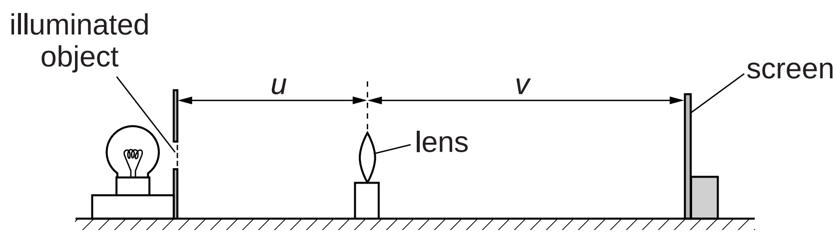

Fig. 4.1

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

u = ... mm

(ii) Measure and record the distance *v*, in mm, from the centre of the lens to the image on the screen.

v = ... mm [1]

(iii) Calculate the value of *uv*.

uv = ...

(iv) Calculate the value of (*u* + *v*).

(*u* + *v*) = ...

(v) Calculate a value f_1 for the focal length of the lens, using the equation $f_1 = \frac{uv}{(u + v)}$.

f_1 = ... [2]

(b) A student does not move the position of the screen or the illuminated object. She moves the lens towards the screen until a smaller, sharply focused image of the object is seen on the screen.

The new values of *u* and *v* are

u = ...42 mm.............

v = ...25 mm.............

(i) Calculate the value of *uv*.

uv = ...

(ii) Calculate the value of (*u* + *v*).

(*u* + *v*) = ...

(iii) Calculate a second value f_2 for the focal length of the lens, using the equation

$$f_2 = \frac{uv}{(u + v)}.$$

f_2 = ...
[1]

(c) A student suggests that f_1 should be equal to f_2.

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

statement ....

justification ....

....
[2]

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

1. ....

....

2. ....

....
[2]

(e) The illuminated object is triangular, as shown in Fig. 4.2.

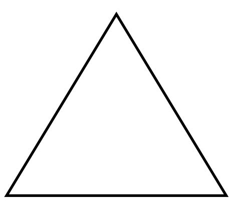

Fig. 4.2

Sketch the image you would see on the screen.

[1]

[Total: 9]

4 An IGCSE class is investigating the reflection of light by a plane mirror.

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

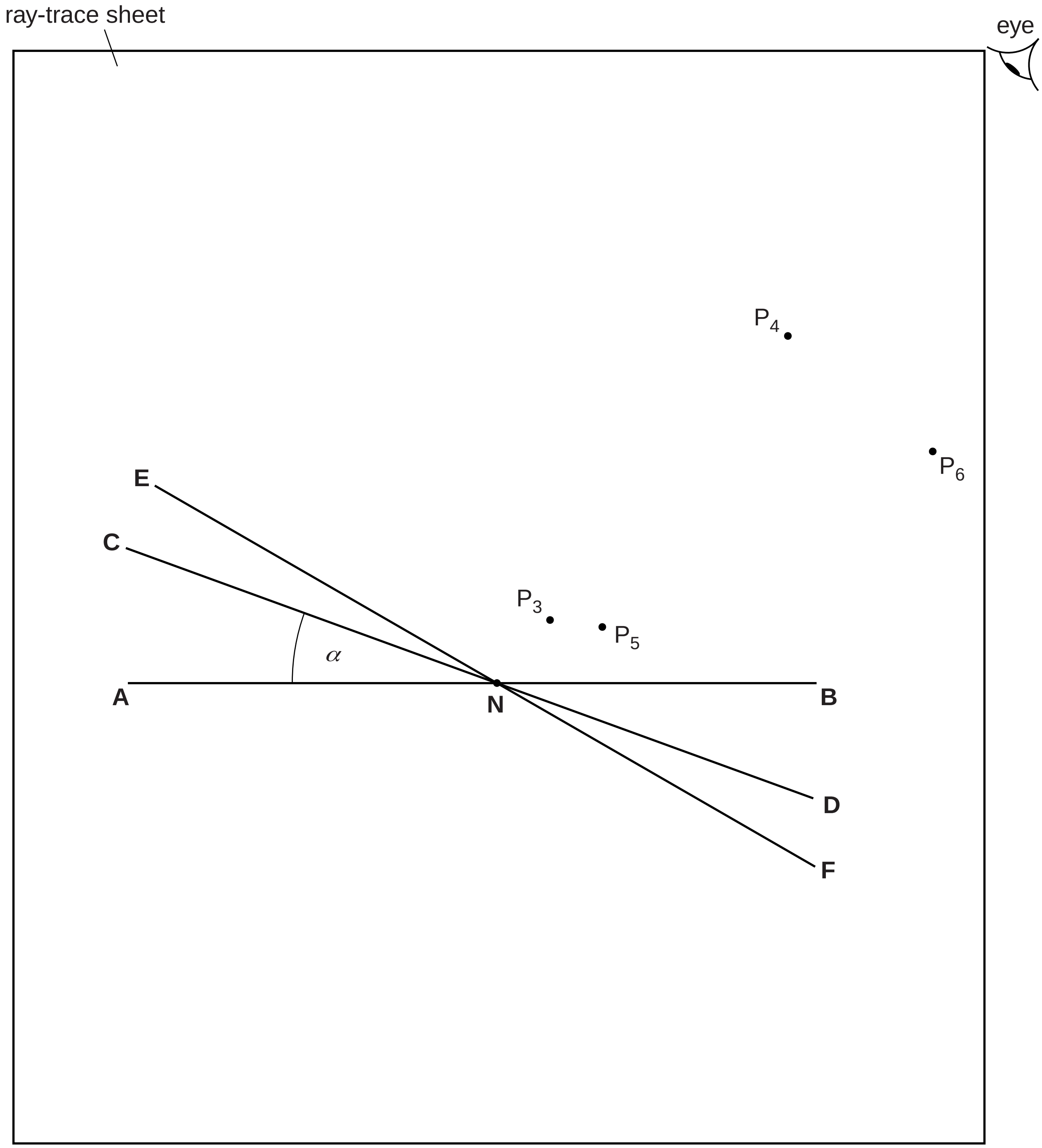

Fig. 4.1

(a) In the first part of the experiment, a plane mirror is to be placed on line **CD**.

(i) Draw a normal to **AB** at point **N**, towards the top of the page. Label the other end of this normal **L**.

(ii) Two pins P_1 and P_2 are placed on line **LN**. Label suitable positions for P_1 and P_2. [1]

(b) The mirror is placed on line **CD** and the images of P_1 and P_2 are viewed from the direction indicated by the eye in Fig. 4.1.

Two pins P_3 and P_4 are placed so that the images of P_1 and P_2, and the pin P_3 all appear exactly in line with P_4.

(i) Draw a line passing through P_3 and P_4 and reaching **AB**.

(ii) Measure the angle θ between this line and the normal **NL**. Record this value in Table 4.1. [1]

(c) The mirror is then moved to line **EF** and pins P_5 and P_6 are placed in line with the new images.

Repeat steps **(b)(i)** and **(b)(ii)** using the new mirror line and pin positions. [1]

Table 4.1

	α/°	θ/°
mirror on **CD**	20	
mirror on **EF**	30	

[1]

(d) A student suggests that θ should always be equal to 2α.

State whether the experimental results support this idea. Justify your answer with reference to the results.

statement ....

....

justification ....

....

....
[2]

(e) Suggest two precautions that could be taken to ensure accurate results from this experiment.

1. ....

....

2. ....

....
[2]

[Total: 8]

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

The apparatus is shown in Fig. 4.1.

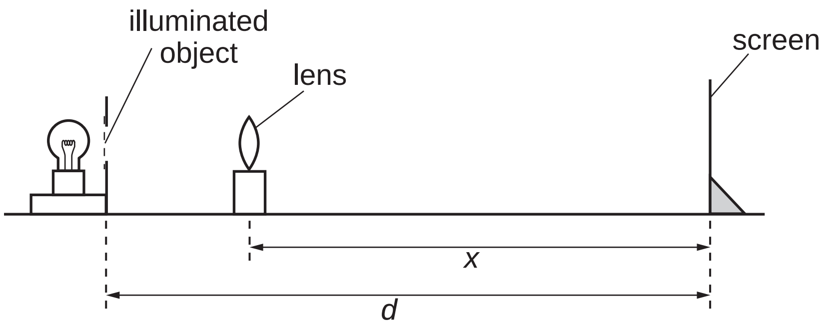

Fig. 4.1

(a) A student places the lens between the object and the screen and close to the object. She moves the lens towards the screen until a clearly focused, **enlarged** image is formed on the screen.

(i) On Fig. 4.1, measure and record the distance *d* between the object and the screen.

d = ...

(ii) On Fig. 4.1, measure and record the distance *x* between the centre of the lens and the screen.

x = ...
[2]

(iii) Fig. 4.1 is drawn one tenth actual size.

1. Calculate the actual distance *D* between the object and the screen.

D = ...

2. Calculate the actual distance *X* between the centre of the lens and the screen.

X = ...
[1]

(b) Without moving the illuminated object or the screen, the student moves the lens towards the screen until a clearly focused, **diminished** image is formed on the screen. She measures the distance *Y* between the centre of the lens and the screen: *Y* = 19.0 cm.

Calculate the focal length *f* of the lens using the equation $f = \frac{XY}{D}$.

f = ... [2]

(c) The student turns the lens through an angle of 180° and repeats the procedure obtaining a value for the focal length $f = 14.7\,\text{cm}$.

Theory suggests that the two values of the focal length *f* should be the same. State whether the results support this theory and justify your answer by reference to the results.

statement ....

justification ....

....
[2]

(d) Briefly describe a precaution that you would take in this experiment in order to obtain a reliable result.

....

....

.... [1]

[Total: 8]

6 The IGCSE class is determining the refractive index of the material of a transparent block.

Fig. 5.1 shows a student's ray-trace sheet.

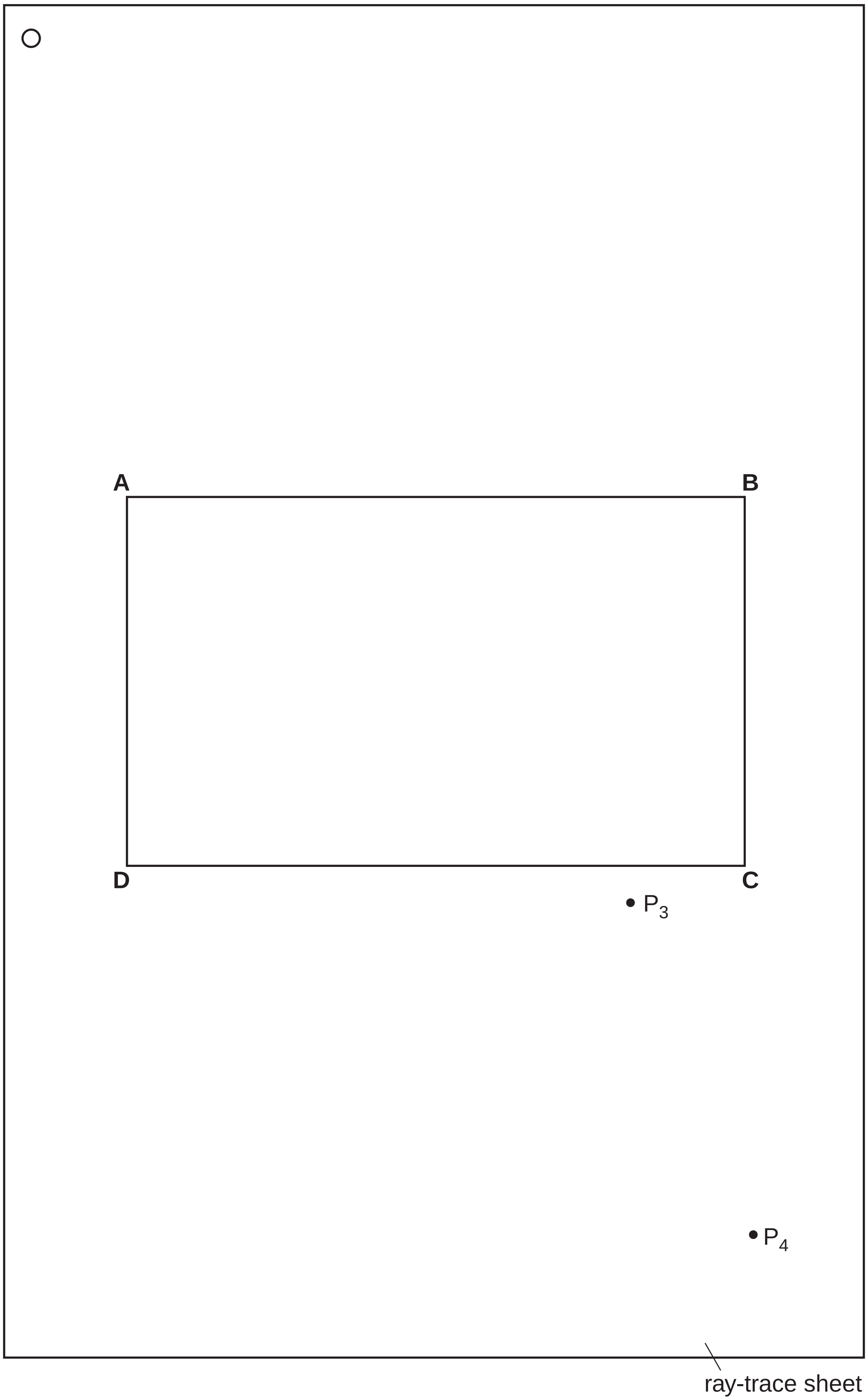

Fig. 5.1

(a) **ABCD** is a transparent block placed, largest face down, on the ray-trace sheet.

(i) On Fig. 5.1, draw a normal at the centre of side **AB**. Label the point **E** where the normal crosses **AB**. Mark a point **N** on the normal 4.0 cm from **E** and outside the outline of the block. [1]

(ii) Draw a line **NF** from **N** to the block. This line must be to the right of the normal and at an angle of 20° to the normal. Mark the point **F** where the line meets **AB**. Measure and record the length *a* of the line **NF**.

a = ... [2]

(b) The student places two pins P_1 and P_2 on the line through **F** and **N**. She 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.

She places two pins P_3 and P_4 between her eye and the block so that P_3 and P_4 and the images of P_1 and P_2, seen through the block, appear one behind the other. The positions of P_3 and P_4 are marked on Fig. 5.1.

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

(ii) Draw the line **GF** and continue it until it meets the normal. Label this point **H**.

(iii) Measure and record the length *b* of the line **FH**.

b = ...

[3]

(iv) Calculate the refractive index *n* of the material of the block, using the equation $n = \frac{b}{a}$.

n = ...[2]

(c) Suggest one precaution that you would take in this experiment to obtain readings that are as accurate as possible.

....

....[1]

[Total: 9]