O Level Combined Physics Structured

Light Test 3.0

Q1

7 Fig. 7.1 shows the position of object R and its corresponding image, P formed on the wall.

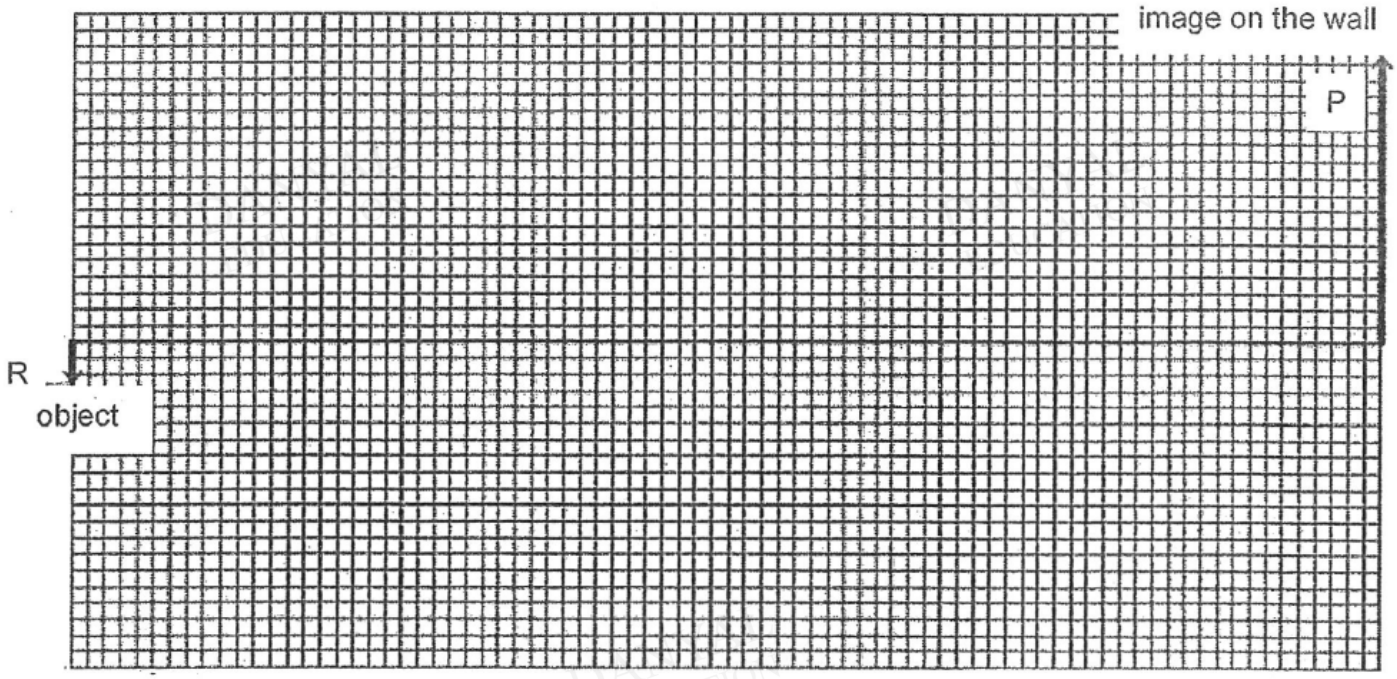


Fig. 7.1 scale : 1 cm represents 12 cm

(a) On Fig. 7.1, draw a light ray from point R to the image on the wall. Locate the position of the lens and label it L. [2]

(b) On Fig. 7.1, draw a second light ray from object **R** to its image. Locate the focal point of the lens and label it **F**. [2]

(c) Hence, determine the focal length of the lens.

focal length = ... [1]

Q2

(a) Fig. 11.1 shows a scale diagram of a converging lens that produces an image I of an object O.

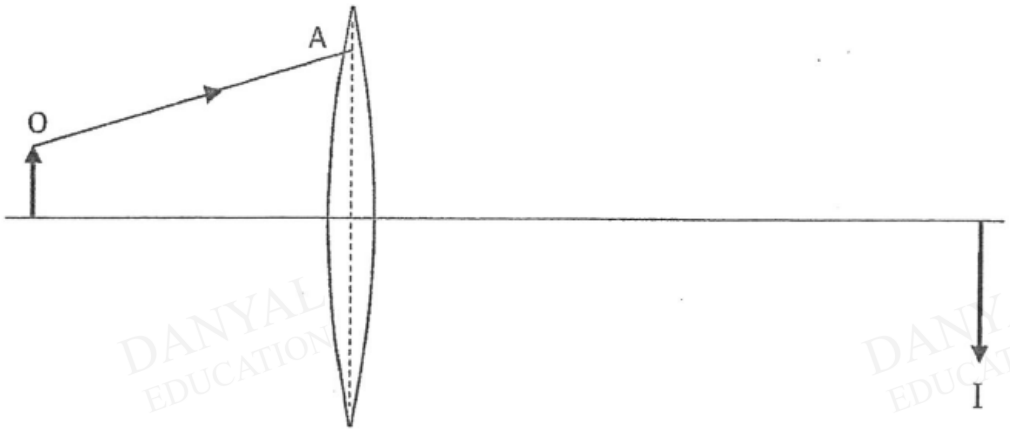


Fig. 11.1

(i) Complete the path of ray OA and indicate clearly in Fig. 11.1 the principal focus and label it F. [2]

(ii) State the focal length of the lens.

focal length = _____cm [1]

(iii) State one application of this set-up.

_____ [1]

(b) Fig. 11.2 shows the path of a light ray passing through a rectangular block.

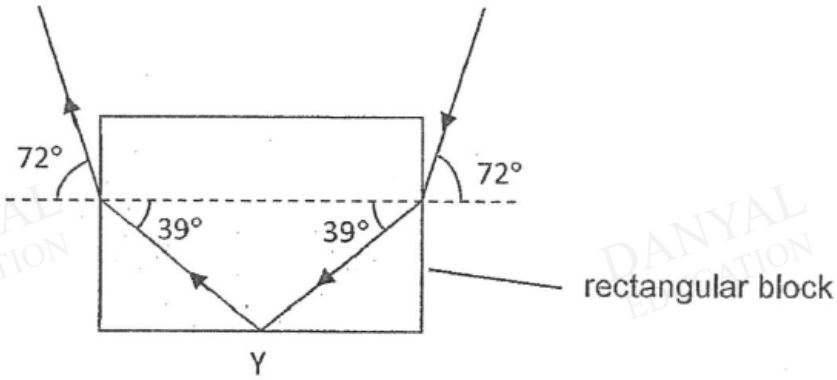


Fig. 11.2

(i) Calculate the refractive index of the rectangular block.

refractive index = _____ [2]

(ii) Calculate the critical angle of the rectangular block.

critical angle = _____° [2]

(iii) Explain why the light ray does **not** exit the rectangular block at Y.

_____

_____

_____

_____ [2]

Q3

Fig 5.1 and **Fig 5.2** show a ray of red light being refracted at a glass surface at different angles of incidence.

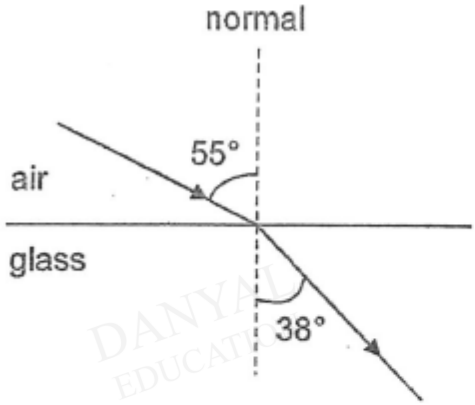


Fig 5.1

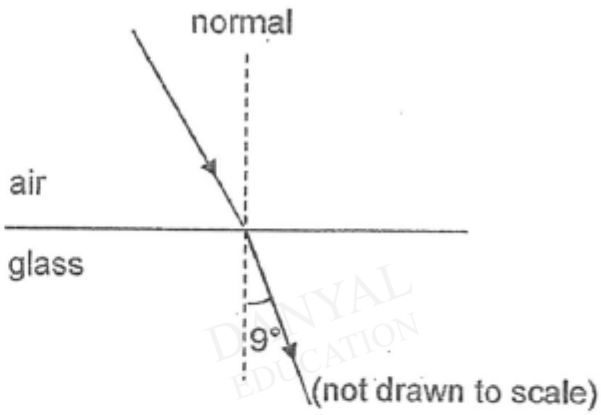


Fig 5.2

(a) Calculate the angle of incidence in **Fig 5.2**.

Angle of incidence = ... [3]

(b) State the angle of incidence at which the angle of refraction is zero.

..... [1]

Q4

Fig. 6.1 below shows a thin converging lens being used to produce an image **X'** of an object **X**.

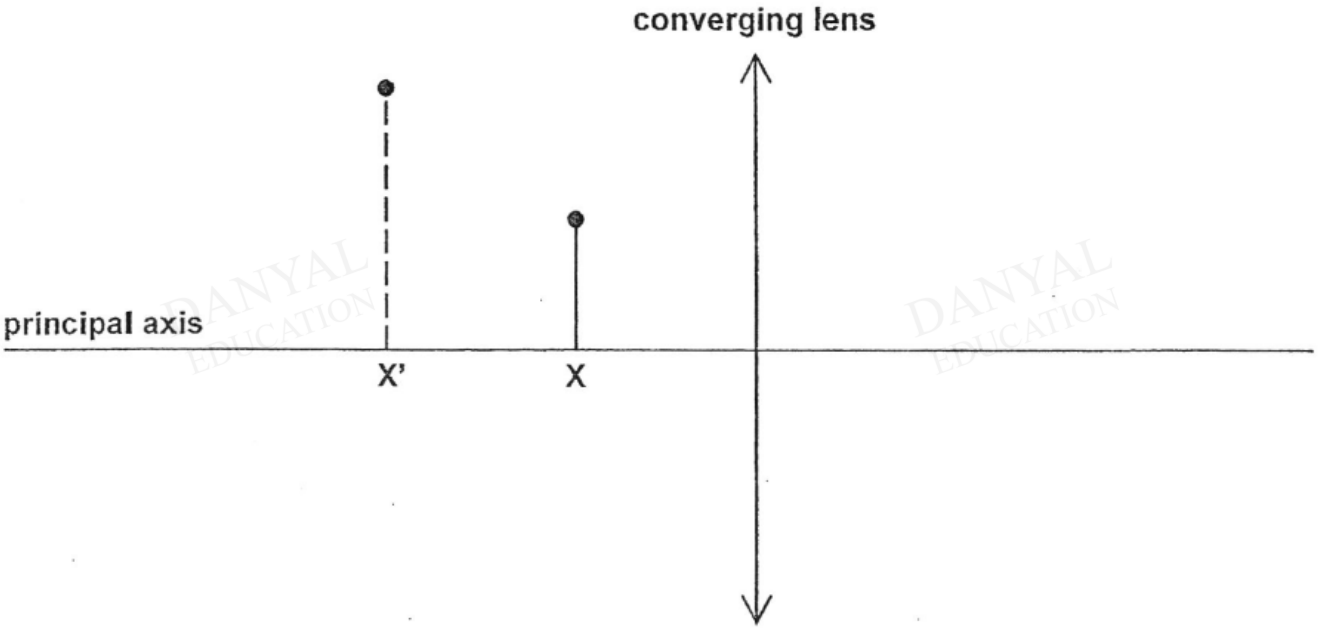


Fig. 6.1

Complete the diagram to locate the position of the principal focus **F**.
Indicate the principal focus **F** clearly on **Fig. 6.1**. [2]

Q5

Fig. 12.1 shows the path of a light ray in a glass prism, **ABC**. The refractive index of the glass prism is 1.81.

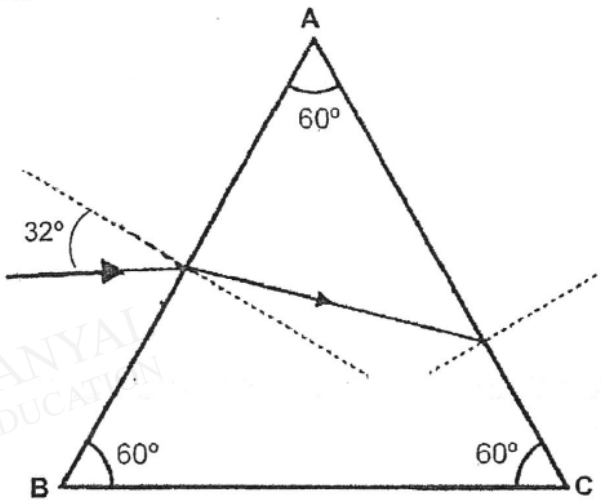


Fig. 12.2

(a) Calculate the angle of refraction of the light ray on surface **AB**.

angle of refraction = ... ° [2]

(b) Find the speed of light in the glass prism.

speed = ... m / s [2]

(c) Explain why the light ray bends in such a manner at the surface **AB**.

.....

.....

..... [2]

(d) The ray exits the prism through surface **AC**. Sketch the possible path of the emergent ray.

[1]

(e) Calculate the critical angle of the glass prism

critical angle = ... ° [1]

(f) Explain why the light ray exits the prism through surface **AC** instead of going through total internal reflection.

.....

.....

.....

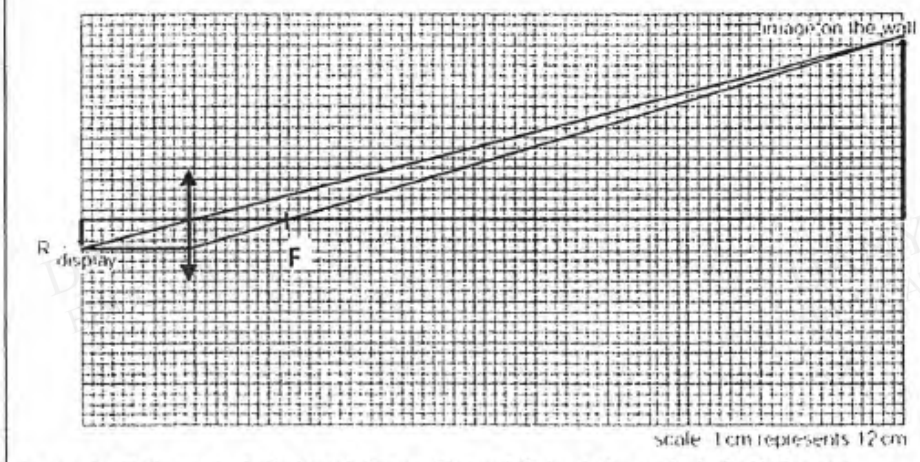
.....

..... [2]

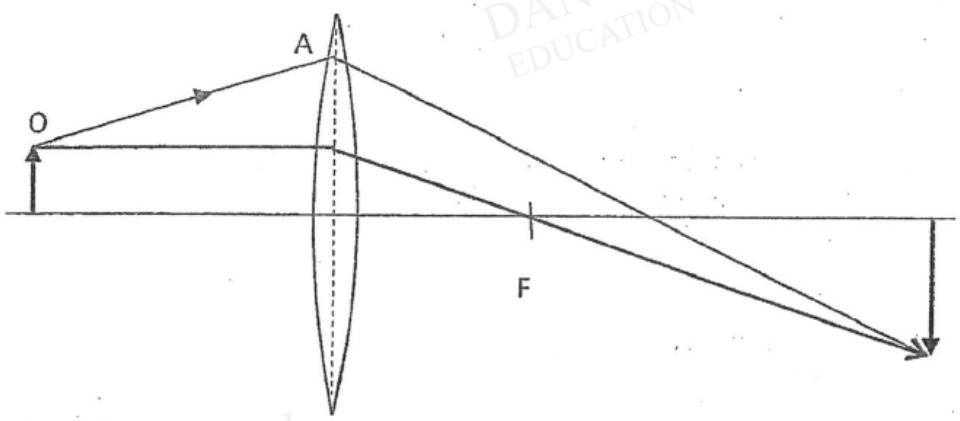
Answers

Light Test 3.0

Q1

(a),(b)	 Lens is 2.1 cm(+/- 0.1cm) from R and F is 1.6 cm(+/- 0.1) from L	B2 (drawing) B2 (drawing),
(c)	Focal length = 1.6 x 12 = 19.2 cm (Use candidate's answer)	A1

Q2

(ai)  [1] ray from A [1] F	
(ii) focal length = 2.3 cm	[1]
(iii) projector	[1]
(bi) n = sin 72° / sin 39° = 1.51	[1] [1]
(ii) 1.51 = 1/sin c c = 41.5°	[1] [1]
(iii) The angle of incidence at Y is larger than critical angle and light is travelling from an optically denser medium to optically less dense medium. Hence, total internal reflection occurs at Y.	[1] [1]

Q3

(a)	refractive index $= \frac{\sin i}{\sin r}$ $= \frac{\sin 55°}{\sin 38°}$ $= 1.33$ $1.33 = \frac{\sin i}{\sin 9°}$ $\angle i = 12.0°$	1 1 1
(b)	0°	1

Q4

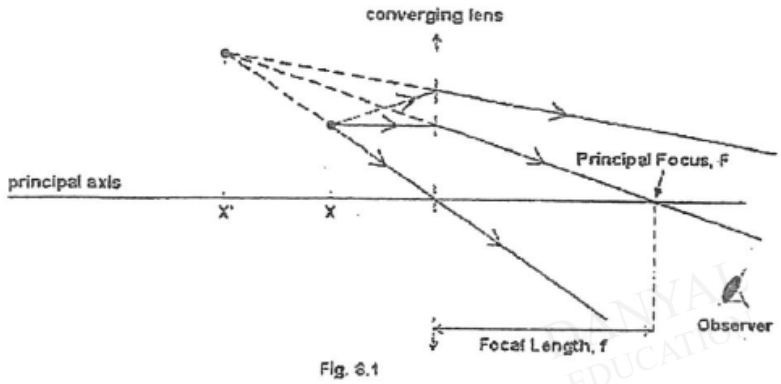


Fig. 8.1

Completing the existing ray with correct dotted and solid portions and direction. Principal Focus F correctly positioned using two light rays with correct dotted and solid portions and directions, and labelled.	[1] [1]

Q5

5a	n = sin i / sin r 1.81 = sin 32° / sin r sin r = sin 32° / 1.81 r = $\sin^{-1}$ (0.292773074) = 17.0°	[1] [1]
5b	n = c / v 1.81 = 3.00 x 10^8 m/s / v v = 1.66 x 10^8 m/s	[1] [1]
5c	When light travels from air (the less dense medium) to glass (the denser medium), it slows down and bends towards the normal.	[1] [1]
5d	Light ray is drawn with directional arrow and bending away from normal. No indication of angle is needed.	[1]
5e	n = 1 / sin c c = $\sin^{-1}$ (1/1.81) = 33.5°	[1]
5f	In order to go through total internal reflection, the light ray needs to be incident from the denser medium and angle of incidence needs to be larger than critical angle. Although the light ray is incident from the denser medium, the angle of incidence at surface AC is smaller than critical angle. Hence, the ray goes through refraction instead of total internal reflection.	[1] [1]