O Level Combined Physics Structured

Light Test 2.0

Q1

(a) Optic fibres are used to transmit data.

Fig. 6.1 shows a ray of light entering and passing along an optical fibre.

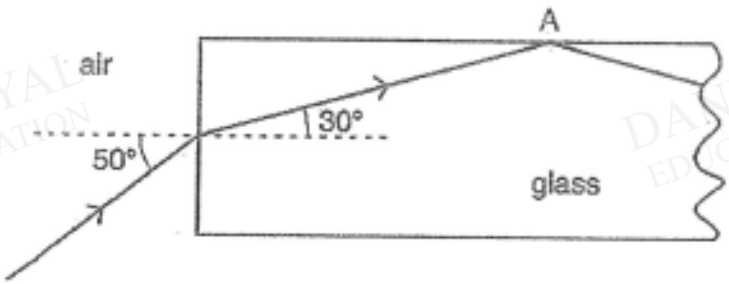

Fig. 6.1 (not to scale)

(i) Calculate the refractive index of the glass in the optical fibre.

refractive index = ... [1]

(ii) Hence, find the critical angle.

critical angle = ... [1]

(iii) Explain why the ray of light is totally internally reflected at A.

.....

.....

.....

.....[2]

(b) Fig. 6.2 shows the virtual image I formed by a magnifying glass which is represented by a straight dotted arrow. The focal point of the lens is represented by F.

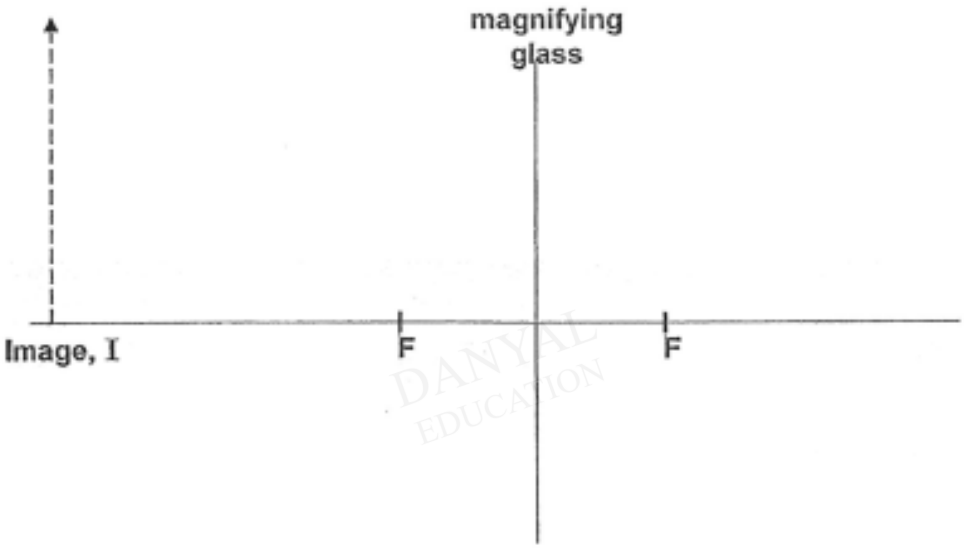

Fig. 6.2 (not to scale)

(i) By means of a ray diagram, complete Fig. 6.2 to determine the position of the object and label it as **O**. [3]

(ii) State all 4 characteristics of the image formed if the object is **moved away** from the lens to a position between F and 2F.

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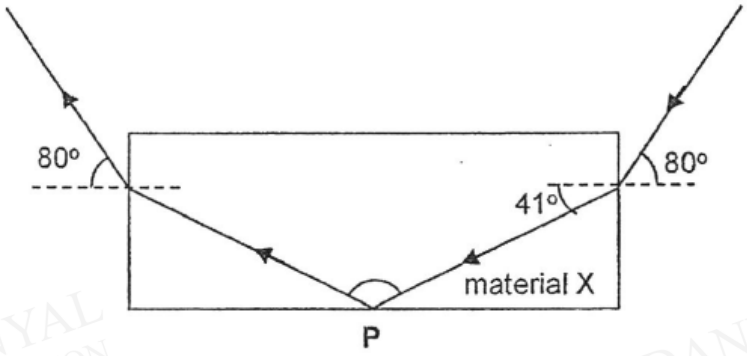
.....[2]

Q2

The diagram shows a narrow ray of light incident at 80° on a rectangular block made of material **X**.



a) Calculate the refractive index of material **X**. [2]

refractive index = ...

b) Calculate the smallest possible angle of incidence at point P for total internal reflection to take place. Leave your answer to the nearest degree. [2]

degree = ... °

Q3

Fig. 6 shows an object and its virtual image formed by a convex lens.

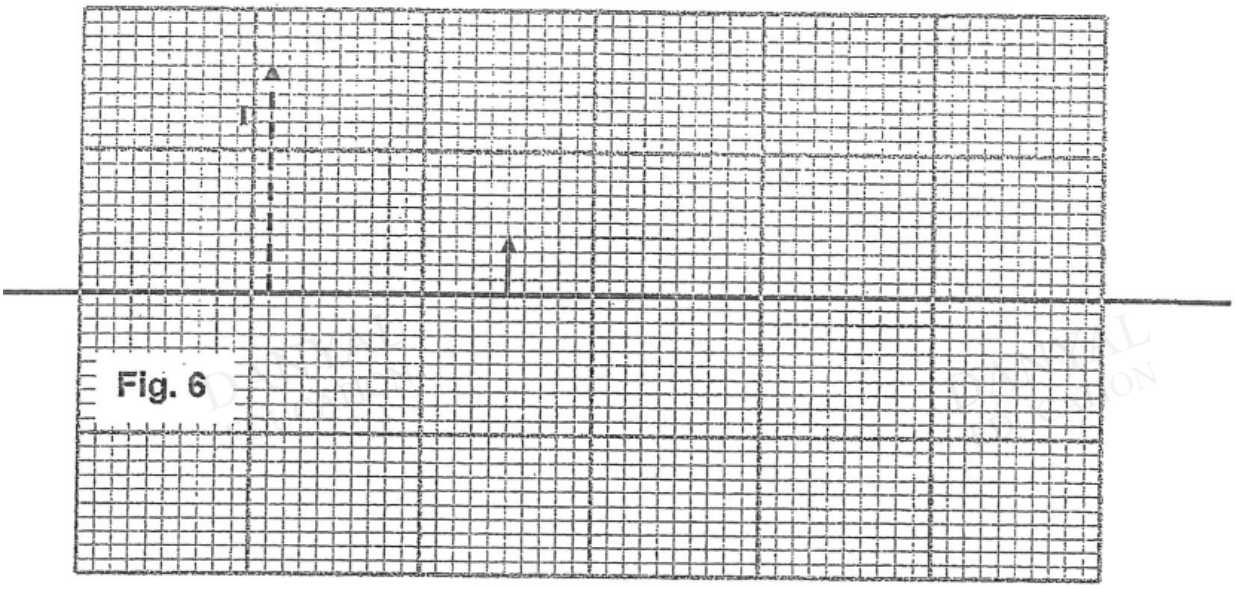


Fig. 6

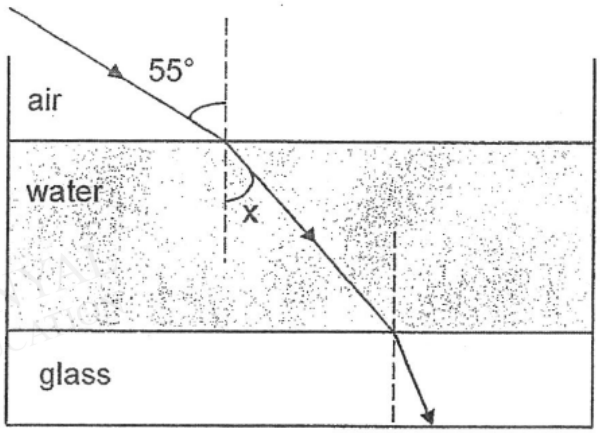
a) The image in **Fig. 6** is a virtual image. Describe one other characteristic of this image. [1]

.....

b) On **Fig 6**, complete the ray diagram to show the position of the lens and principal focus. Mark the position of the principal focus, F. [2]

Q4

The diagram (not drawn to scale) shows a ray of light travelling from air into water and through a piece of glass. The refractive index of water is 1.33.



(a) Determine angle x (angle of refraction in water)

angle x = ... ^{0} [2]

(b) If the speed of light in air is 3.0×10^{8} ms^{-1}, what is the speed of light in water?

Speed of light in water = ... m/s [2]

(c) Which of the following, water or glass, has a higher refractive index? Explain your answer with reference to the diagram above.

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.....

..... [2]

Q5

Fig. 11.1 shows a ray of light traveling from air into a rectangular glass block.

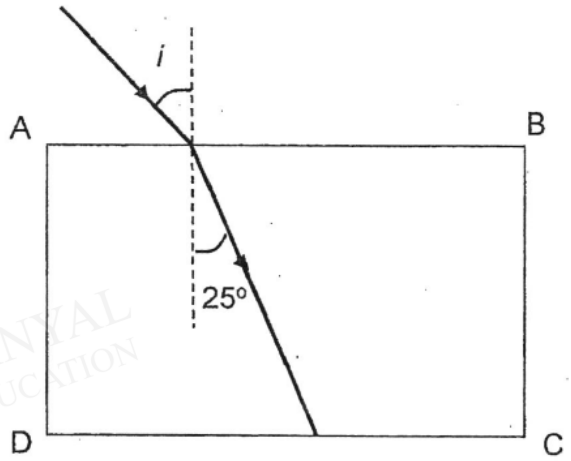

Fig. 11.1

(a) Given that the refractive index is 1.58, calculate the angle of incidence, *i*.

angle of incidence, *i* = ... ^{0} [2]

(b) In Fig. 11.1, draw how the ray emerges from the side CD. [1]

(c) Fig. 11.2 shows the ray of light entering the same glass block but close to one edge of the block and how it travels through the glass block and emerges from the side CD.

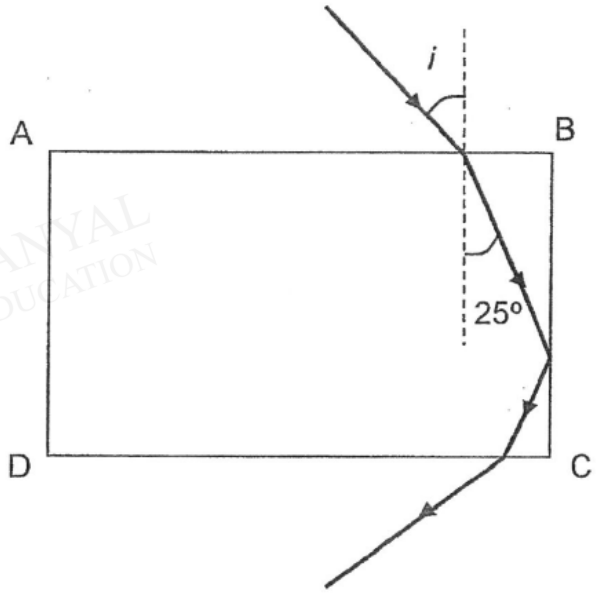

Fig. 11.2

State and explain what has happened to the ray at side BC.

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.....

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..... [2]

(d) Fig. 11.3 shows an object (arrow) placed in front of a converging lens with focal length 10 cm. It is placed 40 cm from the lens.

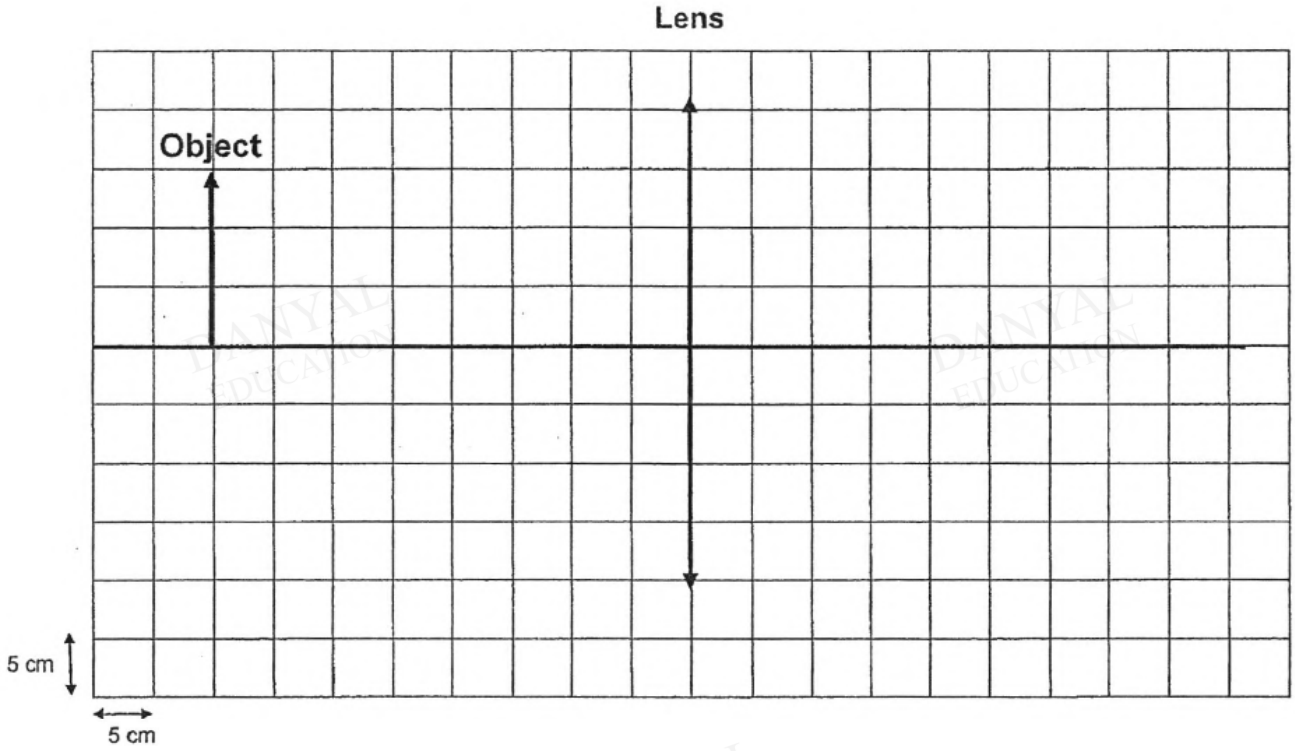


Fig. 11.3

(i) Using two rays of light, draw the ray diagram to find the image of the object. [3]

(ii) State 2 characteristics of the image formed.

1 .....

2 ..... [1]

(iii) The object is slowly moved towards the lens. Without drawing any ray diagram, state **2 changes** that would be observed about the image when the object is placed 15 cm from the lens.

Change 1: .....

Change 2: ..... [1]

Answers

Light Test 2.0

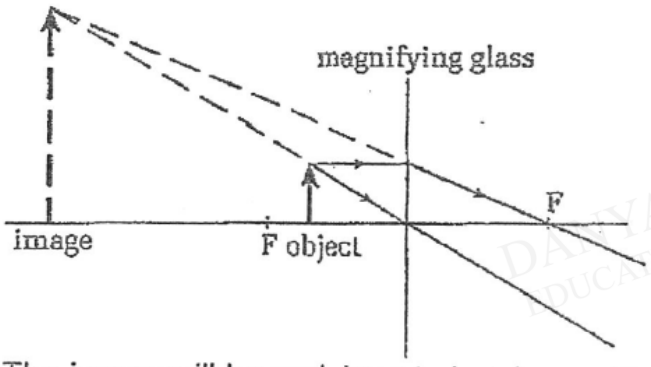
Q1

ai $n = \sin i / \sin r$
$= \sin 50° / \sin 30°$
$= \underline{1.5(3)}$

aii $c = \sin^{-1} 1/n$
$= \sin^{-1} 1/1.5(3)$
$= 41°$

aiii - moving from optically more dense to less dense medium [or moving to lower refractive index (air)
- angle of incidence is greater than the critical angle (of glass)

bi



- correct dotted and solid lines
- 2 arrows before and 2 after lens:
- Ray passing through F and centre of lens
- solid arrow labeled O

bii The image will be real, inverted and magnified. On the other side of the lens.

Q2

a) $n = \sin i / \sin r \rightarrow n = \sin 80° / \sin 41°$ [1] = 1.50 [1]

b) $n = 1/\sin c \rightarrow 1.50 = 1/\sin c \rightarrow c = 41.8°$ [1] Smallest angle = 42° (nearest degree)

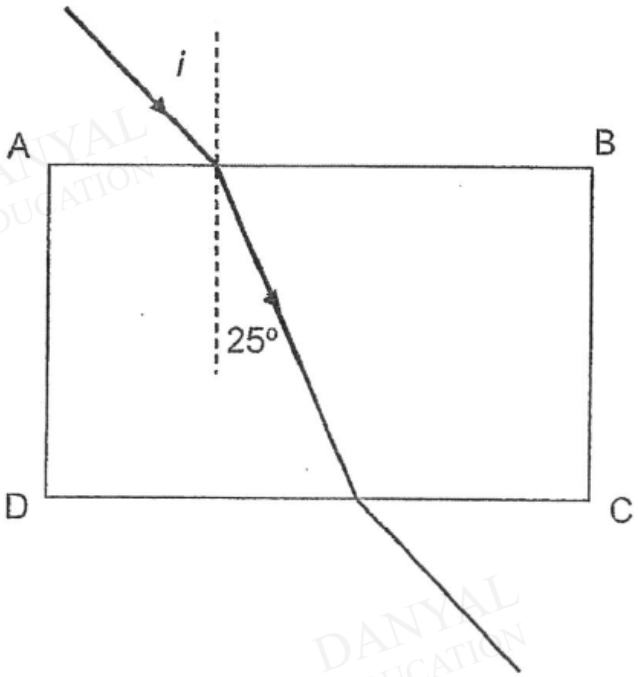
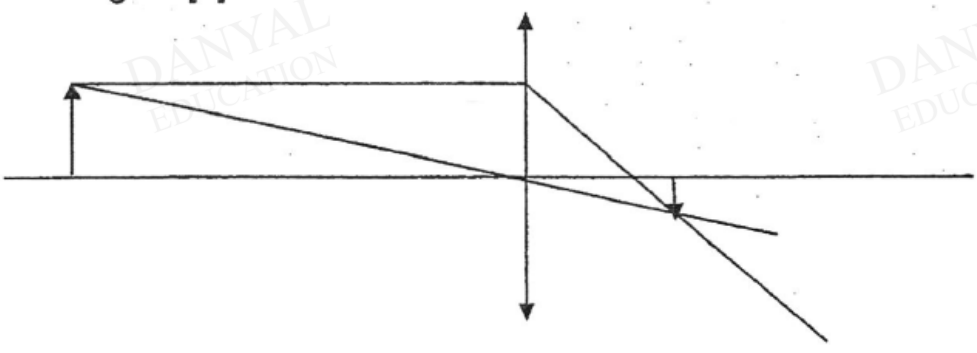
Q3

a) Upright / magnified

Q4

(a)	Refractive index, n = $\frac{\sin i}{\sin r}$ $1.33 = \frac{\sin 55}{\sin x}$ $x = 38.0^0$	 [1] [1]
(b)	Refractive index, n = $\frac{C}{v}$ $1.33 = \frac{3.0x10^8}{v}$ V = 2.26 x 10^8 m/s or 2.3 x 10^8 m/s	 [1] [1]
(c)	Glass has a higher refractive index than water. This is can be seen when light ray travels from water to glass, the ray bends towards the normal.	[1] [1]

Q5

(a)	1.58 = sin i°/sin 25 r = $\sin^{-1}$(1.58 x sin 25°) = 41.9°	1 1
(b)		1
(c)	The ray undergoes total internal reflection. The angle of incidence must be greater than the critical angle.	1 1
(d)	(i) Ray through centre of lens –[1] Ray parallel to principal axis and passing through focal point – [1] Image – [1] 	3
	(ii) The image is real, inverted and diminished. (any 2)	½ (each)
	(iii) Change 1 – It is magnified Change 2 – It gets further away from the lens.	½ (each)