LEVEL -8

PHYSICS

FINAL TERM REVISION WORKSHEET -2

TOPIC : CHAPTER -13

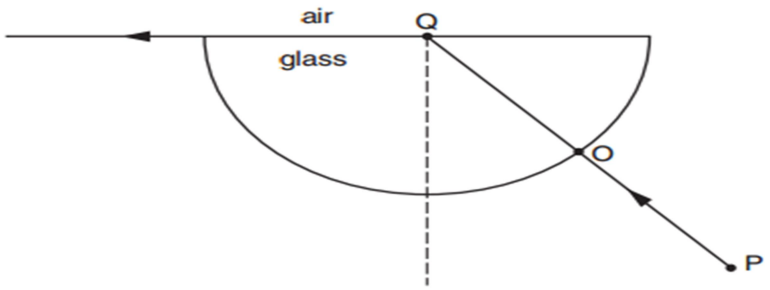
LIGHT

ANSWERS

SECTION B

1.

a) **Figure shows the results of an experiment to find the critical angle for light in a semicircular glass block.**

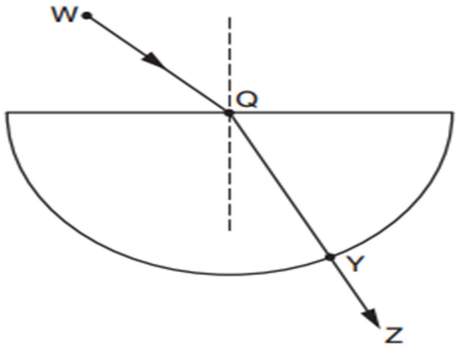


The ray of light PO hits the glass at O at an angle of incidence of 0°. Q is the centre of the straight side of the block.

i. **Measure the critical angle of the glass from Figure.**
Critical angle = 43° ± 1°

ii. **Explain what is meant by the critical angle of the light in the glass.**
Critical angle is the angle of incidence for which the ray is not refracted but reflected back into the medium.

b) **Figure shows another ray passing through the same block.**



The speed of the light between W and Q is 3.0×10^8 m/s. The speed of the light between Q and Y is 2.0×10^8 m/s.

i. State the speed of the light between Y and Z.

Speed = 3×10^8 m/s

ii. Write down an expression, in terms of the speeds of the light, that may be used to find the refractive index of the glass. Determine the value of the refractive index.

$$\text{Refractive index (n)} = \frac{\text{speed of light in vacuum}}{\text{Speed of light in material}}$$

Speed of light in vacuum $=3\times10^8$ m/s

Speed of light in material (between Q and Y) $=2\times 10^8$ m/s

Refractive index $= 3\times10^8$ m/s $\div$ 2×10^8 m/s

$= 1.5$

iii. Explain why there is no change of direction of ray QY as it passes out of the glass.

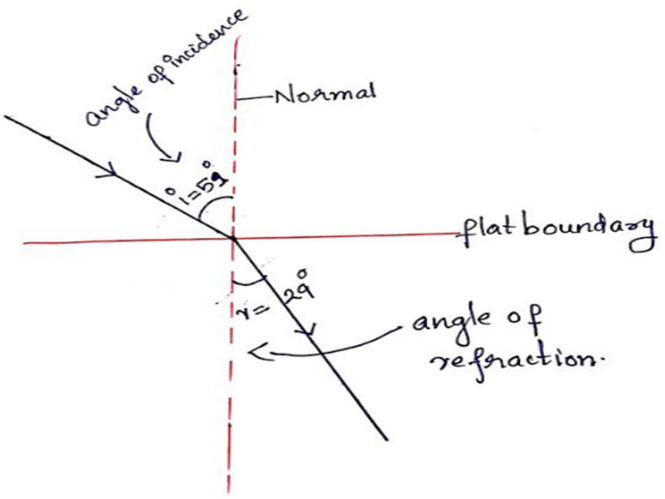
Because angle of incidence is 0° or the ray falls perpendicular to the surface.

iv. What happens to the wavelength of the light as it passes out of the glass?

It increases.

2. a) A ray of light in air travels across a flat boundary into glass. The angle of incidence is 51°. The angle of refraction is 29°.

i) Draw a labeled diagram to illustrate the given information.



ii) Calculate refractive index of glass.

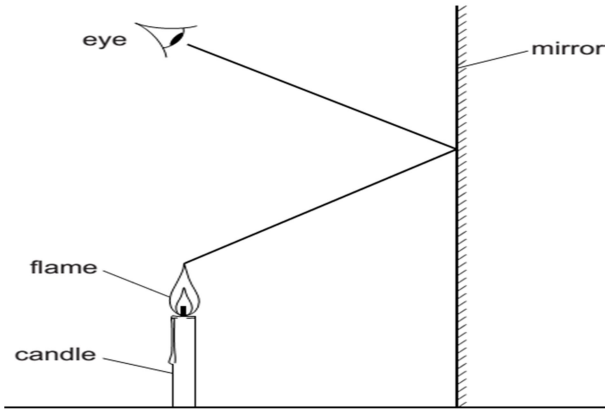
$$\text{Refractive index (n)} = \frac{\sin i}{\sin r}$$

$$= \frac{\sin 51^\circ}{\sin 29^\circ} = 1.602$$

b) A ray of light in glass travels towards a flat boundary with air. The angle of incidence is 51° .This ray does not emerge into the air.
State and explain what happens to this ray.

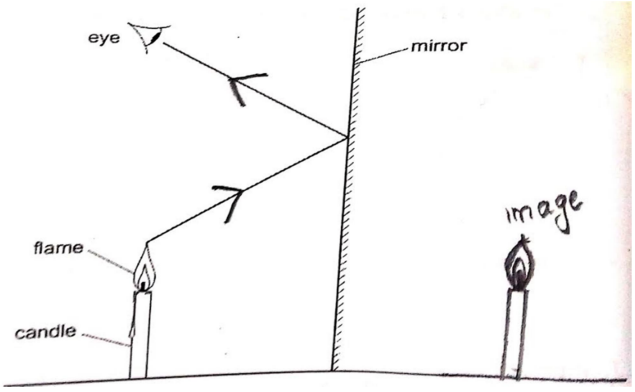
The ray undergoes total internal reflection. Because the angle of incidence is greater than the critical angle.

3. A student looks into a vertical mirror to see the reflection of a burning candle.
Figure shows one ray of light being reflected by the mirror.



(a) On the ray in Figure mark arrows to indicate the direction of travel of the light.

(b) On Figure carefully mark the position of the image of the candle flame.



(c) The candle is moved further from the mirror. State what, if anything, happens to

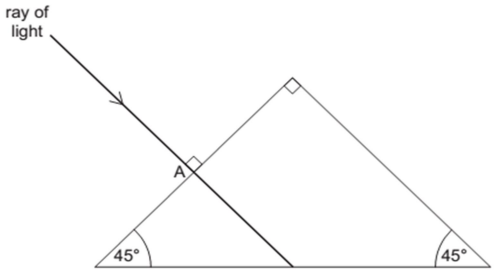
(i) The position of the image.

The position of the image changes.

(ii) The size of the image.

No change in the size of the image.

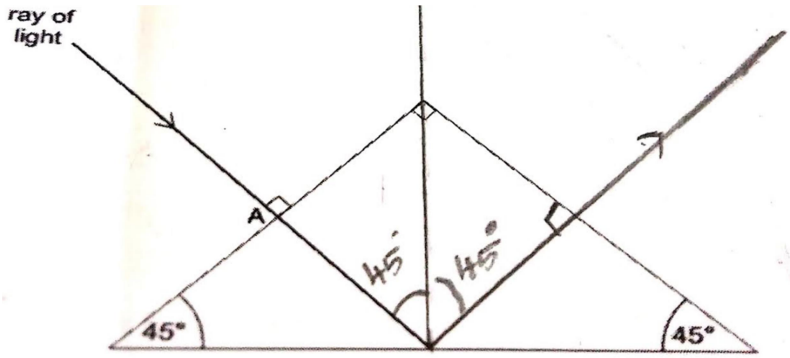
4. a) **A ray of light passes through one surface of a glass prism at right angles to the surface, as shown in Figure.**



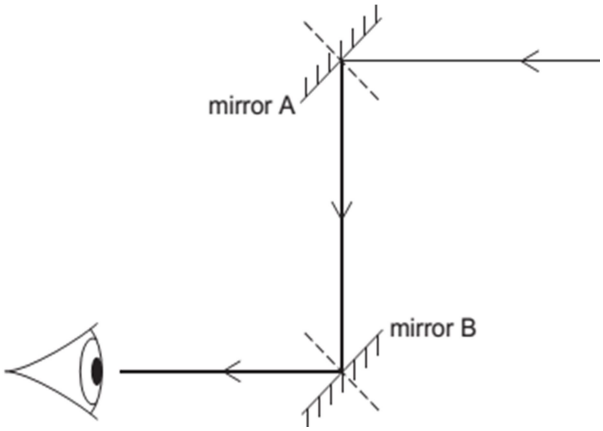
(i) State why the ray is not deviated as it passes through the surface into the glass at A.

Because the ray falls along the normal or angle of incidence is zero.

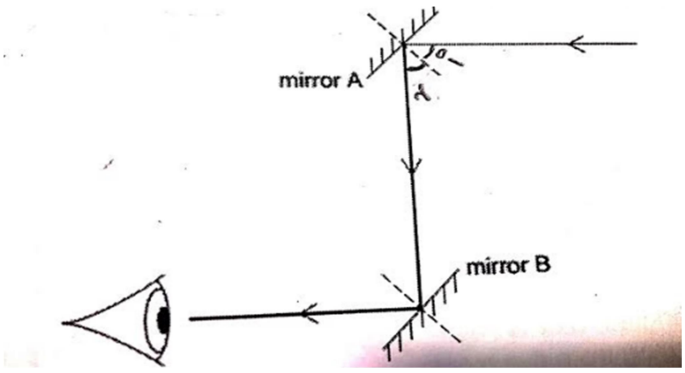
(ii) On Figure use a ruler to help you draw the rest of the path of the ray, until it has emerged again into the air.



(b) Fig. shows a periscope that uses two plane mirrors.



(i) On Fig. clearly mark the angle of incidence i and the angle of reflection r at mirror A.

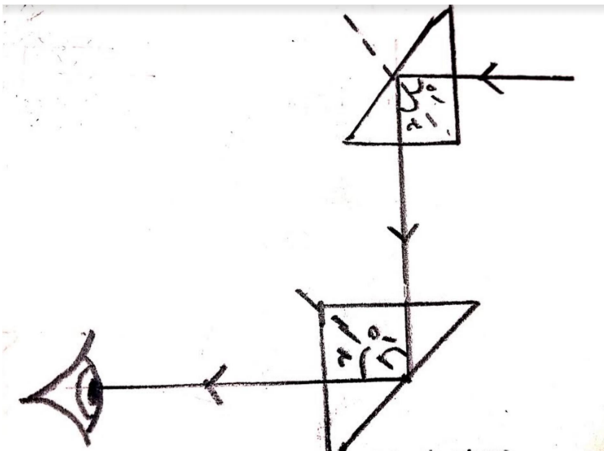


(ii) State the equation linking i and r.

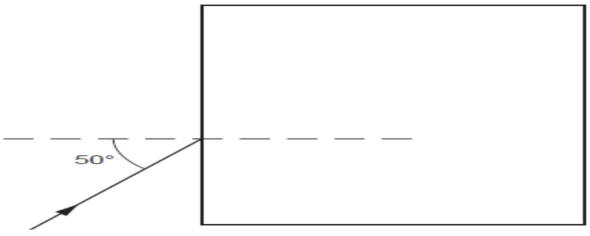
Angle of incidence = Angle of reflection

$i = r$

(iii) In the space below, use a ruler to redraw the periscope, but using prisms instead of mirrors at A and B.



5. (a) **Fig. shows a ray of monochromatic red light, in air, incident on a glass block at an angle of incidence of 50°.**



(i) State what is meant by *monochromatic* light.

Monochromatic light is the light that have single color (frequency/wavelength)

(ii) For this red ray the refractive index of the glass is 1.52. Calculate the angle of refraction for the ray.

$$\text{Refractive index (n)} = \frac{\sin i}{\sin r}$$

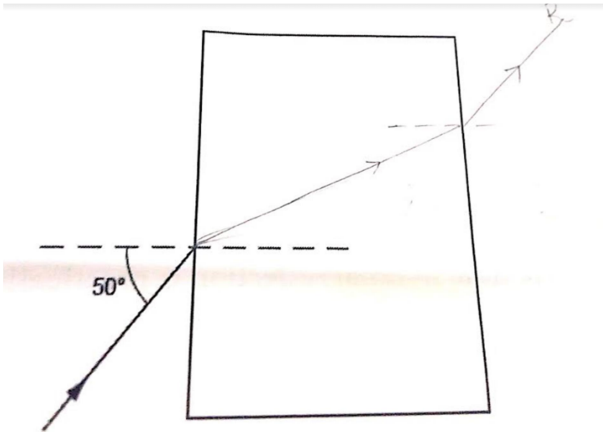
$$1.52 = \frac{\sin 50°}{\sin r}$$

$$\text{Sin r} = \frac{\sin 50°}{1.52} = 0.5039$$

$$r = \sin^{-1}(0.5039) = 30.26°$$

Angle of refraction $= 30.26°$

iii) Without measuring angles, use a ruler to draw the approximate path of the ray in the glass block and emerging from the block. [2]



(b) The red ray in Fig. 7.1 is replaced by a ray of monochromatic violet light. For this violet ray the refractive index of the glass is 1.54. The speed of light in air is 3.00×10^8 m/s.

(i) Calculate the speed of the violet light in the glass block.

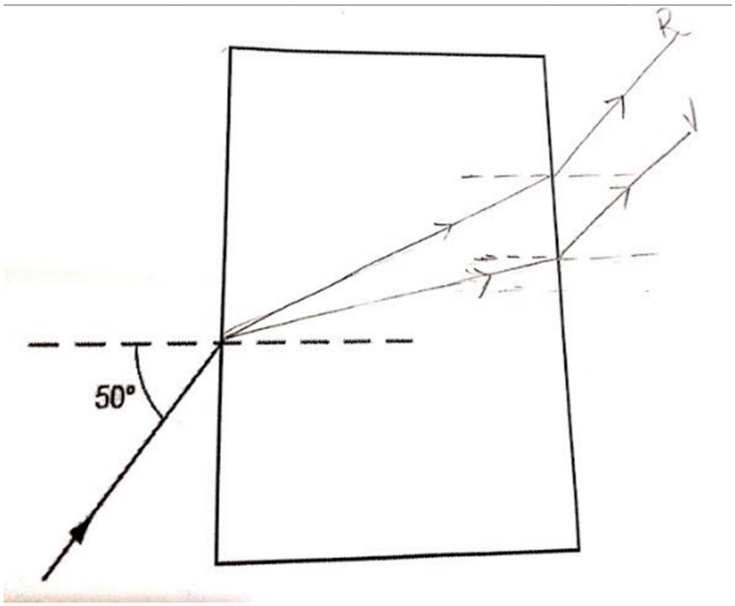
$$\text{Refractive index (n)} = \frac{\text{speed of light in vacuum}}{\text{Speed of light in material}}$$

$$1.54 = 3\times10^8 \text{ m/s} \div \text{speed of violet light.}$$

$$\text{Speed of violet light} = 3\times10^8 \text{ m/s} \div 1.54$$

$$= 1.94 \times 10^8 \text{ m/s}$$

(ii) Use a ruler to draw the approximate path of this violet ray in the glass block and emerging from the block. Make sure this path is separated from the path drawn for the red light in **(a)(iii)**. Mark both parts of this path with the letter V. [2]



(c) (i) Glass has a critical angle of 41°. What does this mean?

When a ray of light is incident on the glass surface the ray is refracted at 90°. Beyond this angle(41°)the ray is not refracted but get reflected.

(ii) Give two examples where total internal reflection is practically used.

Periscopes and optical fibres.

(d) A transparent material has a refractive index of 2.

(i) Calculate the critical angle.

Refractive index (n) = 1/sin C where C = Critical angle.

$n = 2 = 1 / \sin C$

$\sin C = 1/2 = 0.5$

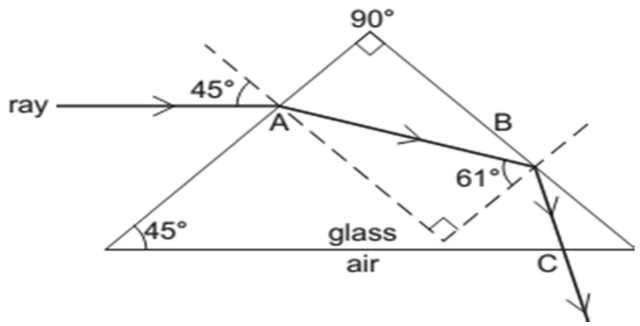
$C = \sin^{-1}(0.5) = 30°$

Critical angle = 30°

(ii) If the refractive index were less than 2, would the critical angle be greater or less than before?

Critical angle will be greater as refractive index and critical angle are inversely proportional.

6. A ray of monochromatic light passes through the glass prism as shown in Figure .



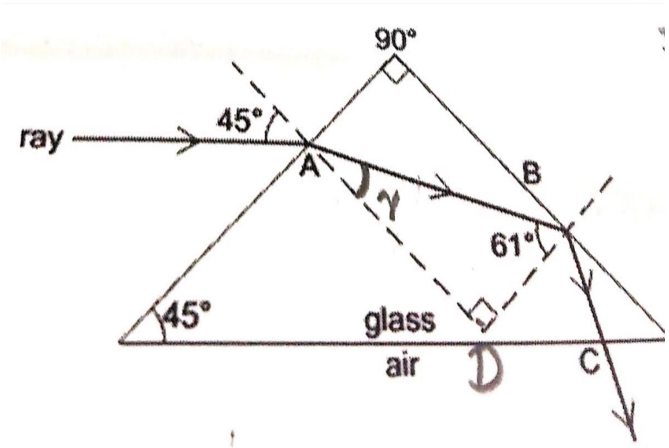
(a) State what is meant by refractive index.

Refractive index is the ratio of the velocity of light in vacuum to velocity of light in a specified medium.

(b) State the name given to what happens to the ray at A.

Refraction

(c) **Use the values on the diagram to calculate the angle of refraction at A (The angles in a triangle add up to 180°).**



From triangle ABD ,

$< r + 61° + 90° = 180°$ (sum of angles in a triangle)

$< r = 180° - (61° + 90 °) = 29°$

Angle of refraction at A $= 29°$

(d) **Calculate the refractive index of the glass.**

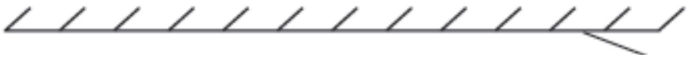
$$\text{Refractive index (n)} = \frac{\sin i}{\sin r}$$

$$= \frac{\sin 45°}{\sin 29°} = 1.45$$

(e) **Explain why the ray does not emerge into the air at B, but does emerge at C.**

At B angle of incidence is greater than critical angle. So the ray under goes total internal reflection. Then it is reflected to C from where it is refracted and emerges into the air.

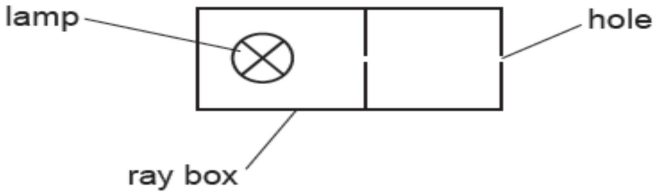
7. **The IGCSE class is investigating the reflection of light by a plane mirror. Figure shows a student's ray-trace sheet.**



(a) On Figure draw a normal to the centre of the mirror.

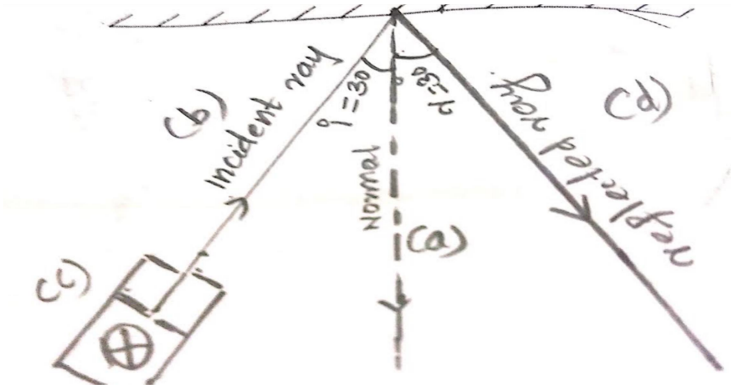
(b) On Figure draw an incident ray at 30° to the normal and to the left of the normal.

(c) Figure shows a diagram of a ray box.



On Figure1 draw the ray box in a suitable position to produce the incident ray that you have drawn.

(d) On Figure 1 draw a reflected ray in the position you would expect it to be using the incident ray that you have drawn.



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

Use darkened room or brighter ray box