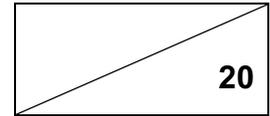




2023 Sec 3 Physics Assignment 3.2 (Answers)

Total Internal Reflection



Name: _____ () Class: 3/ ___ Date: _____

- 1 A ray of light is incident at an angle of 60° at the midpoint O of the plane face AB of a semi-circular glass block, as shown in Fig. 3.1. The refractive index of the glass is 1.55.

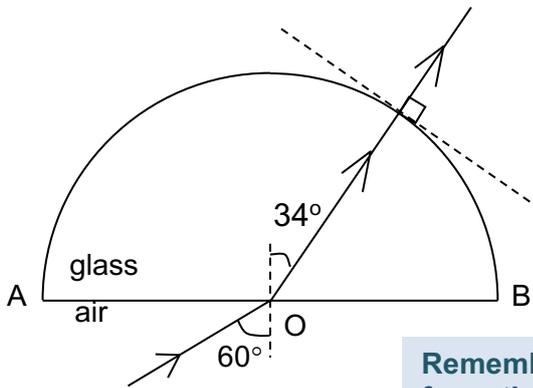


Fig. 3.1

Remember that every light ray from the centre of the circle hits the circumference perpendicularly!

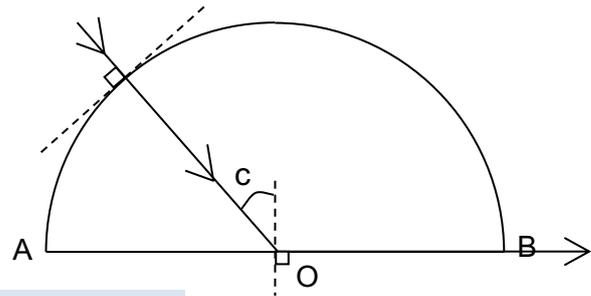


Fig. 3.2

- (a) Calculate the angle of refraction r of this ray at O.

$$n_{glass} \sin r = n_{air} \sin \theta_{air}$$

$$(1.55) \sin r = (1.00) \sin 60^\circ$$

$$\sin r = \frac{\sin 60^\circ}{1.55}$$

$$r = 34^\circ$$

$$r = 34^\circ$$

- (b) Draw the path of this ray from O on Fig. 3.1 until it emerges into the air. Mark the angle of refraction r at O.

- (c) Calculate the critical angle c for the glass-air boundary.

$$n_{glass} \sin c = n_{air} \sin 90^\circ$$

$$(1.55) \sin c = 1$$

$$\sin c = \frac{1}{1.55}$$

$$c = 40^\circ$$

$$c = 40^\circ$$

- (d) On Fig. 3.2, draw the path of a ray, which travels through the curved surface of the glass to O in such a way that it strikes the face AB at an angle of incidence equal to the critical angle c. Label the critical angle c and complete the path(s) of this ray after it has struck the surface AB at O.

- 2 The diagram below which is not drawn to scale, shows the path of a ray of light through one corner of a piece of ice.

Calculate

- (a) the angle of incidence i on the face AB.

$$i = 90^\circ - 18^\circ = \underline{72^\circ}$$

Always the angle between the incident ray and the normal at the point of incidence

- (b) the angle x on the face AB given that the refractive index of ice is 1.43.

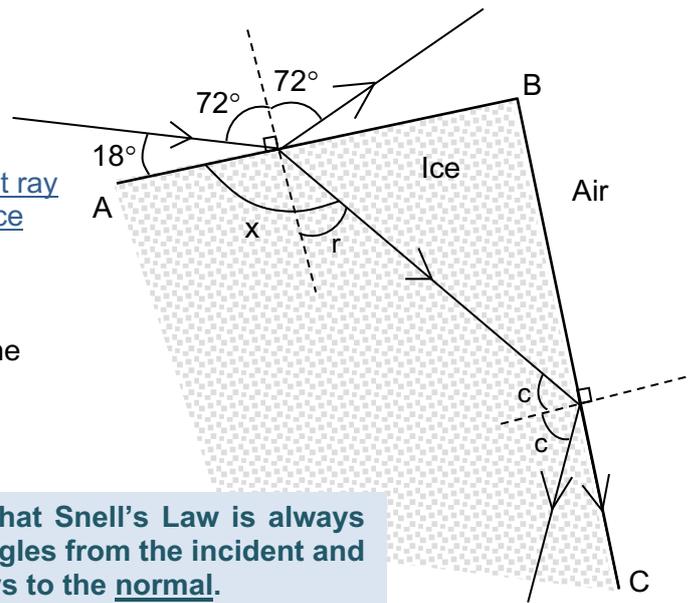
$$(1.43) \sin r = (1.00) \sin 72^\circ$$

$$\sin r = \frac{\sin 72^\circ}{1.43}$$

$$r = \underline{42^\circ}$$

$$x = 90^\circ + r = \underline{132^\circ}$$

Remember that Snell's Law is always about the angles from the incident and refracted rays to the normal.



- (c) On the diagram:

- (i) mark the critical angle c for the ice-air boundary.
- (ii) draw the paths of two additional rays which occur due to partial reflection.