Subject Physics
Date:- 28/10/24

TENDER HEART HIGH SCHOOL; SEC-33B, CHD.
CLASS- IX
Chapter 4(d)
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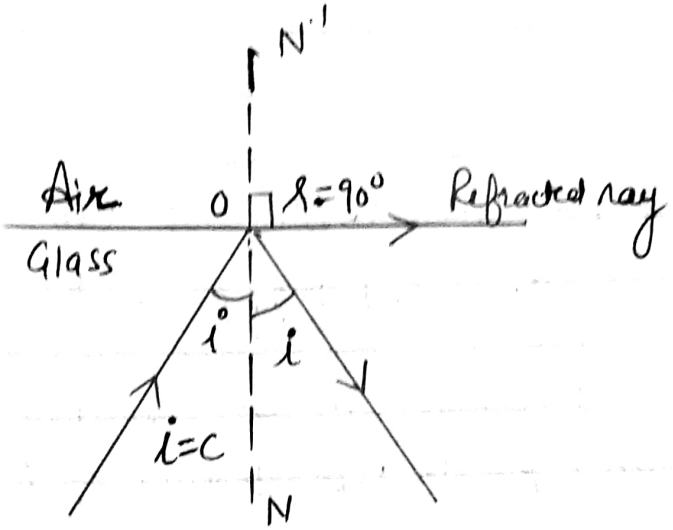
Critical angle and Total Internal Reflection

⇒ **Critical Angle** :→ It is the angle of incidence in the denser medium for which the angle of refraction in the rarer medium is 90°



⇒ **Total Internal Reflection** :→ When a ray of light travelling in a denser medium, incident an angle of incidence greater than the critical angle, the ray is totally reflected back in to the same medium. This phenomenon is called total internal reflection.

⇒ **Conditions for Total Internal reflection**:→

(1) The light must travel from a denser to a rarer medium

(2) The angle of incidence must be greater than the critical angle for the pair of media.

⇒ **Refraction and total Internal reflection of light rays at different angles of incidence** :→

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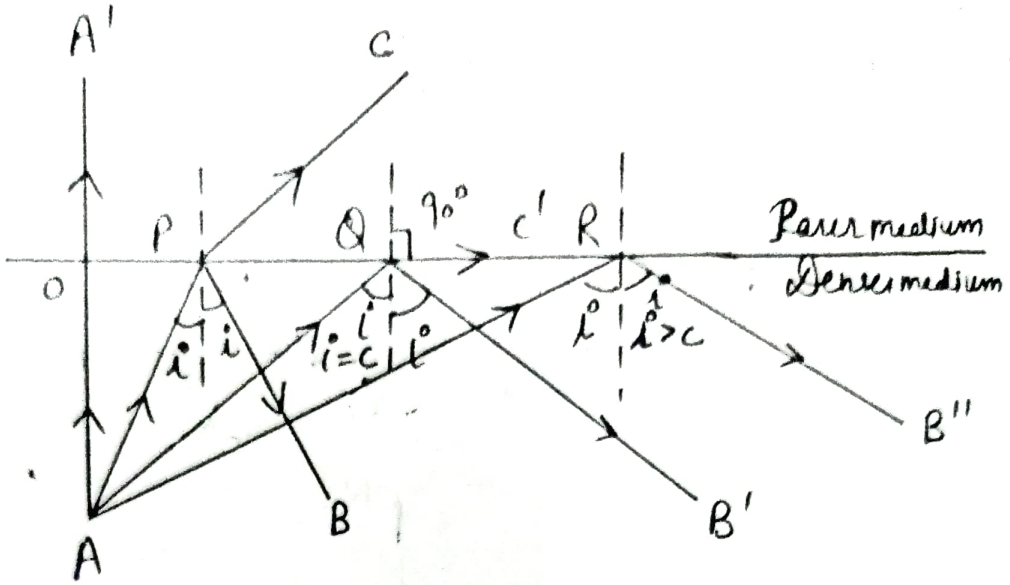


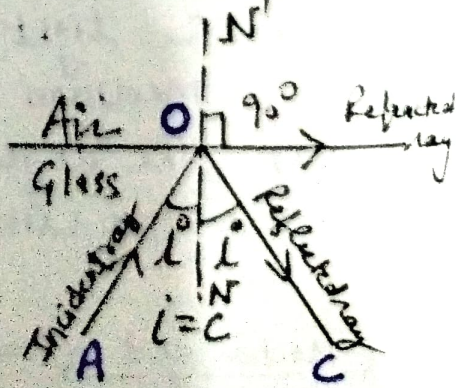
→ for the ray AP, the $\angle i < \angle C$ and ray is partly reflected as PB and partly refracted as PC.

→ For the ray AQ, the $\angle i° = \angle C$, so it is partly reflected as QB' and partly refracted as QC' at an angle of refraction, $\angle r = 90°$

→ For the ray AR; $\angle i° > \angle C$, so the ray is totally reflected at as RB'' an angle of refraction, $\angle r = \angle i°$ (no refraction occurs)

⇒ **Relationship Between Critical angle (C) and Refractive Index**

When ray AO, incident at glass-air interface at $\angle i° = \angle C$ then Applying Snell's law;



$$\frac{\sin i°}{\sin r} = \frac{\sin C}{\sin 90°} = {}_g\mu_a \quad \left[\because \frac{\sin i}{\sin r} = {}^1\mu_2\right]$$

$$\frac{\sin C}{1} \Rightarrow {}_g\mu_a \text{ — } ① \quad \left[\begin{matrix} i° = \angle C \\ \angle r = 90° \end{matrix}\right] \quad [\sin 90° = 1]$$

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as we know by principle of reversibility of light:—

$$_{a}\mu_{g} = \frac{1}{_{g}\mu_{a}} \quad \text{or} \quad _{g}\mu_{a} = \frac{1}{_{a}\mu_{g}}$$

Using Equation (1); $\boxed{\sin C = \frac{1}{_{a}\mu_{g}}}$

⇒ Factors affecting the Critical Angle:→

(a) Colour of light (or wavelength) :→ as we know $\left(\mu \propto \frac{1}{\lambda}\right)$ and critical angle is inversely proportional to the refractive index. $\left(C \propto \frac{1}{\mu}\right)$

as $\lambda_R > \lambda_V$ so $\mu_R < \mu_V$

therefore critical angle is least for the violet light and most for Red light

(b) Temperature :→ On increasing temperature of a medium its refractive index decreases therefore critical angle increases.

Consequences of Total Internal Reflection:→

(a) A piece of diamond sparkles when viewed from certain directions

(b) On a hot sunny day, a driver may see a pool of water (or wet road) in front of him at some distance.

(c) A crack in a glass vessel often shines like a mirror.

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→ to be Continued →