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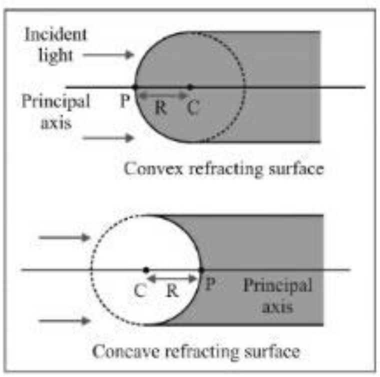
incidence increases, but angle of refraction cannot be greater than 90°. Therefore after point B, refraction of light does not take place, only reflection of light takes place. This is called total internal reflection.

5.6 Refraction through Curved Surfaces

Spherical Refracting Surfaces

A spherical refracting surface is a part of a sphere. For example, the plane face of cylindrical glass rod is curved to form a spherical shape (as shown in the figure).



$P \rightarrow$ Pole of refracting surface

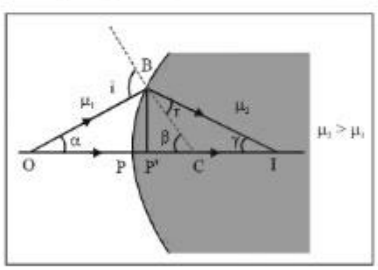
$C \rightarrow$ Centre of curvature

$PC \rightarrow$ Radius of curvature

Principal axis : The line joining pole and centre of curvature.

5.7 Relation between Object Distance and Image Distance Refraction at Spherical Surfaces

Consider the point object O placed in the medium with refractive index equal to μ_1. As $\mu_1 \sin i = \mu_2 \sin r$ and for small aperture i, $r \rightarrow 0$

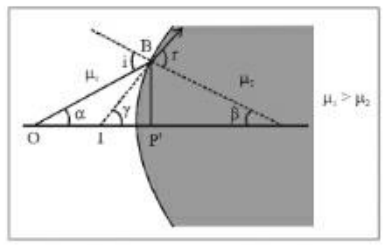


i.e. paraxial rays $\Rightarrow \mu_1 i = \mu_2 r$

$$i = \alpha + \beta,\ \beta = \begin{cases} \gamma + r, & \text{in fig.} \\ r - \gamma, & \text{in fig. II} \end{cases}$$

$\mu_1(\alpha + \beta) = \mu_2(\beta \mp \gamma)$ in fig. I and fig. II

$$\Rightarrow \quad \mu_1\alpha \pm \mu_2\gamma = (\mu_2 - \mu_1)\beta,$$



As aperture is small $\alpha \approx \tan\alpha$, $\beta \approx \tan\beta$, $\gamma \approx \tan\gamma$

$$\mu_1 \tan\alpha \pm \mu_2 \tan\gamma = (\mu_2 - \mu_1)\tan\beta$$

$$\frac{\mu_1}{P'O} \pm \frac{\mu_2}{P'} = \frac{\mu_2 - \mu_1}{P'C} \qquad ...(i)$$

Applying sign convention i.e., $u = -P'O$

$v = P'I$ and $-P'I$, in fig. I and fig. II respectively $R = P'C$

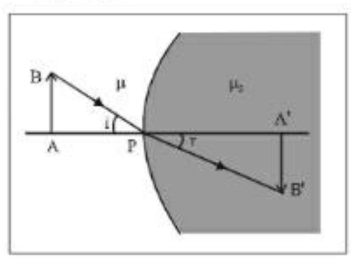
Substituting the above values in equation (i), we get

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R} \quad \text{(For both fig. I and fig. II)}$$

5.8 Linear Magnification for Spherical Refracting Surface

$$m = -\frac{(A'B')}{AB}$$

Now, $\dfrac{\sin i}{\sin r} = \dfrac{\mu_2}{\mu_1}$



As $i, r \rightarrow 0$, $i \approx \sin i \approx \tan i$, $r \approx \sin r \approx \tan r$

$$\frac{\tan i}{\tan r} = \frac{\mu_2}{\mu_1} \text{ or } \frac{AB/PA}{A'B'/PA'} = \frac{\mu_2}{\mu_1}$$