Ray optics Important IIT & JEE formula

Here we going to discuss some important formula regarding ray optics which is important in IIT & JEE perspective.

Refractive index

$$Refractive\ index = \frac{Speed\ of\ light\ in\ vaccum}{Speed\ of\ light\ in\ medium}$$

From

Snell's Law

$$\mu = \frac{Sin\ i}{Sin\ r}$$

- i= angle of incident
- r= angle of refraction
- $d = i - r$ = angle of deviation
- Denser to Rarer Medium
- Lights bends away from normal ($d = r - i$)
- Rarer to denser medium
- Light bends towards normal ($d = i - r$)

$$\boldsymbol{\mu_2^1 = \frac{\mu_2}{\mu_1}}$$

- μ_1= refractive index of medium 1
- μ_2 = refractive index of medium 2
- $\frac{\mu_2}{\mu_1} = \frac{V_1}{V_2} = \frac{\lambda_1}{\lambda_2} = \mu_1 V_1 = \mu_2 V_2$
- V_1 is the velocity of light in 1 medium
- V_2 is the velocity of light in 2 medium.

Refraction at spherical Surfaces

When light goes form rarer to denser medium through a spherical surface having radius of curvature R. We have relation

$$\frac{n_2 - n_1}{R} = \frac{n_2}{v} - \frac{n_1}{u}$$

When, $n_1 < n_2$

$$\frac{n_1 - n_2}{R} = \frac{n_1}{v} - \frac{n_2}{u}$$

Lens Maker Formula

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)\ where \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

f is focal length

μ is refractive index

R_1, R_2 is the radii of curvature

Magnification

It is the ratio of length of the image formed by a lens to the length of the object is known as linear magnification.

$$m = \frac{h_1}{h_0}$$

$$m = \frac{v}{u}$$

$$m = \frac{(f - v)}{f}$$

$$m = \frac{f}{f+u}$$

Convex Lens:

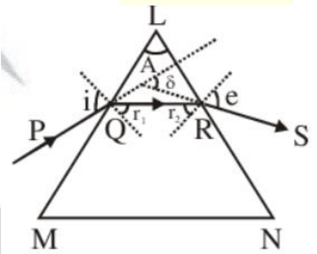
$$\frac{1}{f} = (\mu - 1)(\frac{1}{R_1} + \frac{1}{R_2})$$

Magnifying power of a simple microscope is

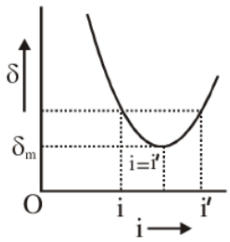
$$m = 1 + \frac{D}{f}$$

Reflection through a prism

(a) $I + e = A + \delta$



(b) $\mu = \frac{Sin\left(\frac{A+\delta_m}{2}\right)}{\sin(\frac{A}{2})}$



Dispersion of light for small angled prisms

$d = (\mu - 1)A$

d= angle of deviation

μ = refractive index

A is angle of prism

Angular dispersion:

For violet and red rays

$\theta = d_v - d_r = (\mu_v - \mu_r)A$

$d_v, d_r =$ Deviation of violet and red

μ_v, μ_r = Refractive indices of violet and red

Dispersive Power

$$\omega = \frac{Angular\ dispersion}{mean\ deviation}$$

$= (d_v - d_r)/d$ Where $d = \frac{d_v + d_r}{2}$ (mean deviation)

$= \frac{\mu_v - \mu_r}{\mu - 1}$ Where $\mu = \frac{\mu_v + \mu_r}{2}$ (mean refractive index, for yellow)