MASTERJEE CLASSES

GEOMETRICAL OPTICS

BRAIN MAP

CLASS XII

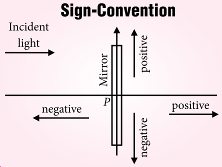
Velocity of the Image of a Moving Object

Object is approaching the focus of a concave mirror from infinite with speed v_{obj},

$v_{image} = \frac{dv}{dt} = -\frac{f^2}{(u-f)^2}\frac{du}{dt}$

$= -m^2 v_{obj}$

Sign-Convention

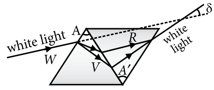


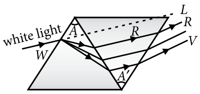
Combination of Prism

- Deviation without dispersion

$(\theta = 0)\quad A' = -\frac{(\mu_V - \mu_R)A}{\mu'_V - \mu'_R}$

$\delta_{net} = (\mu - 1)A + (\mu' - 1)A'$





- Dispersion without deviation

$(\delta = 0)\quad A' = -\frac{(\mu - 1)A}{\mu' - 1}$

$\theta_{net} = (\mu_V - \mu_R)A + (\mu'_V - \mu'_R)A'$

Newton's Formula

If object distance (x_1) and image distance (x_2) are measured from focus,

$f^2 = x_1 x_2$

Through Spherical Mirrors

- **Mirror formula,** $\frac{1}{u} + \frac{1}{v} = \frac{1}{f} = \frac{2}{R}$
- **Magnification,** $m = -v/u$
  - Longitudinal magnification:

    $m_L = -\frac{dv}{du} = \left[\frac{v}{u}\right]^2 = m^2$
  - Superficial magnification:

    $m_s = \frac{\text{area of image}}{\text{area of object}} = m^2$

Angular dispersion, $\theta = (\mu_V - \mu_R)A$

Dispersive power, $\omega = \frac{\mu_V - \mu_R}{\mu_Y - 1}$

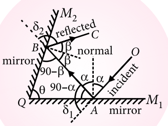
Relation between μ and δ_m

$\mu = \frac{\sin\frac{A + \delta_m}{2}}{\sin\frac{A}{2}}$ where, δ_m = angle of minimum deviation, A = angle of prism

or $\delta_m = (\mu - 1)A$ (Prism of small angle)

REFLECTION OF LIGHT

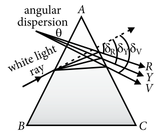
The bouncing back of a light ray to other side of normal in a same medium. According to the law of reflection, $\angle i = \angle r$



GEOMETRICAL OPTICS

Deals with light propagation in the form of rays.

Through Prism



Through Plane Mirrors

Deviation produced by the combination of two plane mirrors,

$\delta = 360 - 2(\alpha + \beta)$

$\delta = 360 - 2\theta$

For two plane mirrors inclined at an angle θ, the number of images of a point object formed are

- $n = 360/\theta - 1$ [If $360/\theta$ is even]
- $n = 360/\theta$ [If $360/\theta$ is odd]

Minimum length (L_m) of a mirror to see complete Image of

- A person in the mirror

  $L_m = 1/2 \times$ (height of person)
- A wall behind a person in the mirror $L_m = 1/3 \times$ (height of wall)

REFRACTION OF LIGHT

Snell's law : When light travels from medium a to medium b, ${}^a\mu_b = \frac{\mu_b}{\mu_a} = \frac{\sin i}{\sin r}$

Refractive index, $\mu = \frac{c}{v}$

Through Spherical Lenses

General relation for spherical surfaces

$\frac{\mu_{denser}}{v} - \frac{\mu_{rarer}}{u} = \frac{\mu_{denser} - \mu_{rarer}}{R}$

Lens maker's formula

$\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

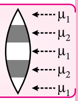
Thin Spherical Lens

Thin lens formula : $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Magnification : $m = \frac{v}{u} = \frac{h_i}{h_0}$

Special Cases

- If half portion of lens is covered by black paper then only intensity of image will be reduced.
- If a lens is made of number of layers of different R.I. for a given λ number of images = number of R.I.



- If lens is cut into two equal parts by a vertical plane, focal length of each part $f' = 2 \times$ focal length of original lens (f)

Through Different Medium

Apparent Depth (d_{ap}) and Normal Shift (x)

- **Object in denser medium is observed from rarer :** $d_{ap} = \frac{d_{ac}}{\mu}$; $x = d_{ac}\left[1 - \frac{1}{\mu}\right]$
- **Object in rarer medium is observed from denser :** $\frac{d_{ac}}{d_{ap}} = \frac{1}{\mu} (< 1)$; $x = [\mu - 1]d_{ac}$
- **Lateral shift :** $d = \frac{t}{\cos r}\sin(i - r)$

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