LIGHT – REFLECTION AND REFRACTION

Laws of Reflection:

(i) Angle of incidence is equal to the angle of reflection. ($\angle i = \angle r$)

(ii) The incident ray, the reflected ray and the normal at the point of incidence, all lie in the same plane.

SPHERICAL MIRRORS

IMAGE FORMATION BY A CONCAVE MIRROR FOR DIFFERENT POSITIONS OF THE OBJECT

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus *F*	Highly diminished, point sized	Real and inverted
Beyond the centre of curvature *C*	Between *F* and *C*	Diminished	Real and inverted
At *C*	At *C*	Same size	Real and inverted
Between *C* and *F*	Beyond *C*	Enlarged	Real and inverted
At *F*	At infinity	Infinitely large or highly enlarged	Real and inverted
Between the pole *P* of the mirror and focus F	Behind the mirror	Enlarged	Virtual and erect

IMAGE FORMATION BY A CONVEX MIRROR

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus *F*, behind the mirror	Highly diminished point-sized	Virtual and erect
Between infinity and the pole *P* of the mirror	Between *P* and *F*, behind the mirror	Diminished	Virtual and erect

The corresponding ray diagrams are included in annexure 4

Mirror Formula : $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ is called the mirror formula.

Magnification: The ratio of the size of the image to that of the object is called magnification. For a mirror, magnification (m) is given by.

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

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

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

IMAGE FORMATION BY A CONCAVE LENS

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At focus F_1 point-sized	Highly diminished	Virtual and erect
Between infinity and optical centre *O* of the lenses	Between focus F_1 and optical centre	Diminished	Virtual and erect

IMAGE FORMED BY A CONVEX LENS FOR DIFFERENT POSITIONS OF THE OBJECT

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At focus F_2	Highly diminished, point-sized	Real and inverted
Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
At $2F_1$	At $2F_1$	Same size	Real and inverted
Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
At focus F_1	At infinity	Infinitely large or highly enlarged	Real and inverted
Between focus F_1 and optical centre *O*	On the same side of the lens as the object	Enlarged	Virtual and erect

IMPORTANT FORMULAE

Mirror formula $\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$

where, f = focal length of mirror, u = Distance of the object, v = Distance of the image from pole.

Lens formula $\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$

where, f = focal length of the lens, v = Distance of the image, u = Distance of the object from optical centre.

Power of lens

$$P=\frac{1}{\text{Focal length (in meters)}}=\frac{100}{\text{Focal length (in cm)}}$$

$$P=\frac{1}{f(m)}=\frac{100}{f(cm)}$$

$$\text{Magnification by a lens}=\frac{\text{size of the image}}{\text{size of the object}}$$

$$m=\frac{h_i}{h_o}$$

$$\text{Magnification by a lens}=\frac{\text{Distance of the image from the optical centre}}{\text{Distance of the object from the optical centre}} \text{ or } m=\frac{v}{u}$$

REFRACTIVE INDEX

- Absolute refractive index (n) of a medium is the ratio of speed of light in vacuum or air (c) to the speed of light in the medium (v) i.e.

$$n = \frac{c}{v}$$

- Refraction of light is the phenomenon of change in the path of light in going from one medium to another.

- In going from a rarer to a denser medium, the ray of light bends towards normal and in going from a denser to a rarer medium, the ray of light bends away from normal.

- **Snell's law of refraction:** $\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = {}^1n_2$

- No refraction occurs, when
  (i) light is incident normally on a boundary,
  (ii) refractive indices of the two media in contact are equal.

- Refractive index = $n_{21} = \frac{\text{speed of light in medium 1}}{\text{speed of light in medium 2}} = \frac{\text{refractive index of medium 2}}{\text{refractive index of medium 1}}$

- $\eta_{23} = \frac{\eta_{21}}{\eta_{31}}$