# Chap 9. Light: Reflection and Refraction

*1. State the laws of reflection of light.*

First law: The incident ray, the reflected ray, and the normal to the reflecting surface at the point of incidence — all lie in the same plane.

Second law: The angle of incidence (i) equals the angle of reflection (r). i = r

*2. What is a spherical mirror? What are the two types?*

A mirror whose reflecting surface is part of a hollow sphere is called a spherical mirror.

If the inner surface of the sphere part is used as mirror, it is concave mirror. If the outer surface of the sphere part is used as mirror, it is convex mirror.

*3. Short note on concave mirror.*

The nature of the image formed is real and inverted if the object is beyond the focus. It is virtual and erect if the object is between focus and pole.

The focal point is present in front of the mirror.

It is used as shaving mirror, medical inspection mirror, torch reflector.

*4. Short note on convex mirror.*

The nature of the image formed is always virtual, erect, and diminished. It is because the reflected ray diverges.

The focal point is present behind the mirror.

Used as rear-view mirror in vehicles, security mirror.

*5. Define Pole, center of curvature, radius of curvature, and principal axis.*

The pole is the geometric centre of the reflecting surface of a spherical mirror, typically represented by the letter P.

The reflecting surface of a spherical mirror is part of a large, hollow sphere. The centre of curvature is the center of that imaginary sphere. Typically represented by C.

The radius of curvature is the radius of the imaginary hollow sphere. Typically represented by R. It can also be defined as the distance between pole (P), and center of curvature (C).

The principal axis is an imaginary straight line passing through the pole (P) and the centre of curvature (C).

*6. Define principal focus?*

The point on the principal axis where rays parallel to the principal axis converge (concave) or appear to diverge from (convex) after reflection is called principal focus.

*7. Define Focal length. What is it's relation with Radius of curvature.*

The distance between the pole (P) and the principal focus (F) is called focal length (f).

The focal length is half the radius of curvature. (f = R/2)

*8. Write the mirror formula.*

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

u - object distance, v - image distance, f - focal length

*9. Write a note on New Cartesian Sign Convention.*

All distances are measured from the pole (P) of the mirror/lens.

Distances measured in the direction of incident light is positive (+). Distances measured opposite to the direction of incident light is negative (−)

Object is always placed to the left of the Pole, so u is always negative.

For concave mirror: f and R are negative. For convex mirror: f and R are positive.

*10. What is magnification? Write the formula for mirror.*

Magnification (m) is the ratio of the height of the image(h') to the height of the object (h).

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

If m is positive, the image is virtual and erect. In m is negative, the image is real and inverted

If the absolute value of m is greater than one ($|m| > 1$), image is magnified (larger than object).

If the absolute value of m is less than one ($|m| < 1$), image is diminished (smaller than object).

If the absolute value of m is equal to one ($|m| = 1$), the image is of the same size as object.

*11. What is refraction? Why it occurs?*

The bending of light when it passes from one medium to another, such as from air into water or glass, is called refraction.

Refraction occurs because the speed of light changes, when it enters another medium. The speed of light is less in denser

medium (like glass, water) and more in rarer medium (like vaccum, air).

Going from rare to dense medium - light bends towards the normal (angle of refraction < angle of incidence)

Going from dense to rare medium - light bends away from the normal (angle of refraction > angle of incidence).

If light enters perpendicular to the surface (along the normal) - no bending and light travels in straight line.

*12. State the laws of refraction.*

The incident ray, refracted ray, and normal at the point of incidence all lie in the same plane.

The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for a given pair of media.

$$\frac{\sin i}{\sin r} = \text{constant}$$

*13. What is the refractive index of a medium?*

The refractive index(n) of a medium is a measure of how much light slows down (bends) when entering that medium.

Higher refractive index means, optically denser medium and light bends more. For water n = 1.33, for glass n = 1.5, for diamond n = 2.42

*14. What is the lateral displacement of a glass slab?*

When a ray of light passes through a glass slab, it refracts on entering and exiting the glass. The emergent ray is parallel to the incident ray but displaced sideways. This sideways shift is called lateral displacement.