Optics

Reflection

When light travelling through homogeneous transparent medium is incident on a surface which separates this medium from another, then a part of the light comes back into the first medium in a definite direction. This is called **reflection** of light. The surface from which reflection takes place is called a reflector. The amount of light reflected depends on:

(i) The angle of incidence and

(ii) (ii) The nature of the two media.

1. Laws of reflection

i. The incident ray, the normal to the reflecting surface at the point of incidence and the reflected ray, all lie in one plane.

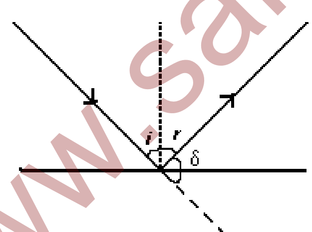
ii. The angle of incidence is equal to the angle of reflection.

iii. Deviation produced in Reflection is

$\delta = 180^0 - (i + r)$

Since r = i

$\Rightarrow \delta = 180^0 - 2i$



2. **Image formed by a plane mirror:** The image of a point source after reflection on a plane mirror

i. Lies on the normal drawn from the source to the mirror,

ii. Is as far behind the mirror as the source is in front of it,

iii. Is virtual in nature,

iv. Is of the same size as the object and

v. Is laterally inverted.

3. A plane mirror can form a real image if a convergent beam strikes the mirror. (object is virtual)

4. The angle between the incident ray and the plane mirror is known as angle of glancing.

5. The angle between the incident ray extended and the reflected ray is called the angle of deviation. If i is the angle of incidence, then the angle of deviation is (180°–2i). The angle of glancing and the angle of incidence are complementary i.e., their sum is 90°.

6. For a normal incidence, the angle of deviation is 180°.

7. For the same incident ray, if the plane mirror is rotated through θ, then the reflected ray rotates through 2θ. Sextant, optical lever and lamp and scale arrangement work on the above principle.

8. When an object is moving in front of a plane mirror with a velocity v, the image of the observer (as seen by him) travels to or opposite to the object with twice the velocity with which the observer moves to or opposite to the mirror. Any stationary observer in front of the mirror sees the image moving with a velocity v.

9. The minimum size of a plane mirror fixed on the wall of a room in which an observer at the center of the room can see the full image of the wall behind him is one third of the wall.

10. The minimum size of the mirror for seeing the full image of a person is half his size.

11. Two mirrors are inclined at an angle θ. If a ray of light is obliquely incident on the first mirror, the deviation after two reflections is $360°-2\theta$ i.e., the deviation of the ray due to successive reflections at the two mirrors does not depend on the angle of incidence but depends on the angle between the mirrors.

12. If two plane mirrors are kept at an angle θ and if an object is kept between them, then the number of images formed (n) is given by the formula, $n=\frac{360^o}{\theta}-1$ or $n=\frac{360^o}{\theta}$ which ever is odd.

13. **Spherical mirror:** If the reflecting surface of a mirror is spherical, then it is called a spherical mirror.

14. **Convex mirror:** When the reflecting surface of a spherical mirror is bulging, then it is called a convex mirror.

15. **Concave mirror:** When the reflecting surface of a spherical mirror is hollow, then it is called a concave mirror.

16. The relation between the focal length (f) and the radius of curvature (r) of a spherical mirror is r=2f.

17. Types of images formed with a concave mirror

18. With a convex mirror, the image is always formed behind the mirror within its focal length. The image if diminished, virtual and erect.

19. The ratio of the size of the image to the size of the object is called linear magnification (m) and m=v/u.

20. **Mirror formulae :** $\frac{1}{f}=\frac{1}{u}+\frac{1}{v}$ or $f=\frac{uv}{u+v}$

v=f(1+m) and u=$f\left(1+\frac{1}{m}\right)$

21. In spherical mirrors of large aperture, the marginal and paraxial rays do not come to the same focus. This is known as **spherical aberration**.

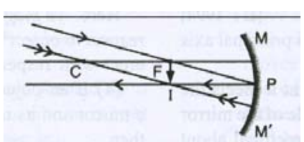
22. A paraboloidal mirror has no spherical aberration. It is used in reflecting telescopes and in search lights.

23. The field of view of a convex mirror is more than that of a plane mirror. Hence convex mirror is used as a rear-view mirror.

24. Concave mirror is an ideal one for shaving purposes. Ophthalmoscope consists of a concave mirror. It is also used by dentists.

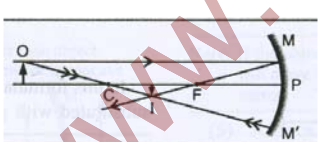
Position of Object	Position of image	Nature
At infinity	At F	Point size; real; inverted
Beyond C	Between F & C	Diminished; real; inverted
At C	At C itself	Same size; real; inverted
Between F & C	Beyond C	Magnified; real; inverted
At F	At infinity	Real
Between P & F	Behind the mirror	Magnified; virtual; erect

1 Object lies at infinity



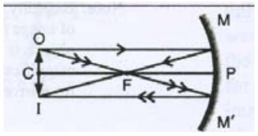
Real, inverted very small image isformed at F

2. Object lies between infinity and C



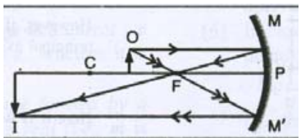
Real, inverted diminished image is formed between F and C

3. Object lies at C



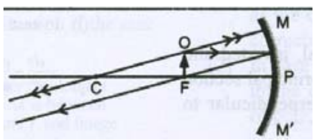
Real, inverted image is formed at C

4. Object lies between F and C



Real, inverted magnified image is formed between C and infinity

5. Object lies at F



Real, inverted, very large image is formed at infinity

6. Object lies between F and P