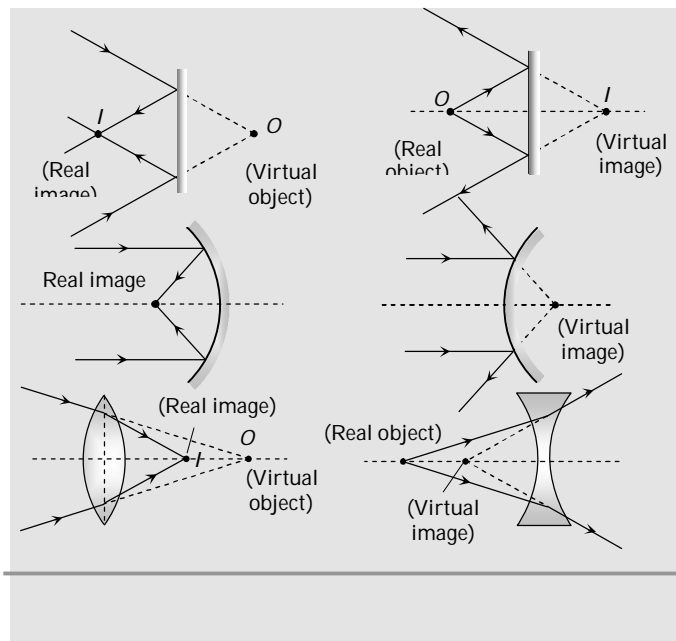


Ray Optics

Light is a form of energy which makes the objects visible to eye. Light propagates as electromagnetic wave. It does not require medium for its propagation. Light travels in a straight line as long as it is travelling in the same homogeneous medium, this is called rectilinear propagation of light. **Between any two points light always travels along minimum time path.** This is known as Fermat's principle.

Real and Virtual Images

If light rays, after reflection or refraction, actually meet at a point then real image is formed and if they appear to meet virtual image is formed.



Reflection of Light

When a ray of light after incidenting on a boundary separating two media comes back into the same media, then this phenomenon, is called reflection of light.

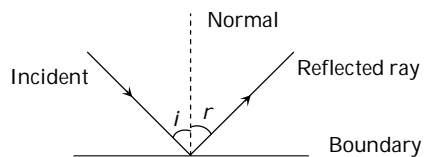
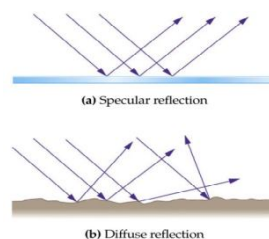


Fig. 29.1

- (1) $\angle i = \angle r$
- (2) After reflection, speed, wave length and frequency of light remains same but intensity decreases.
- (3) There is a phase change of π if reflection takes place from denser medium.

Regular and irregular reflection:



Reflection of light is of two kinds depending on the nature of the reflecting surface—(i) regular reflection and (ii) diffused (or irregular) reflection.

Regular Reflection:

When the reflecting surface is very well polished and smooth, the parallel beam of light that falls on it is regularly reflected. As parallel beam this phenomenon is known as regular reflection.

Note: Regular reflection takes place on highly polished or smooth surfaces

Ex: Plane mirror

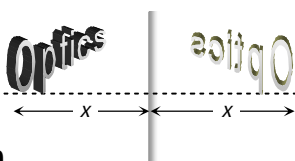
Irregular Reflection:

If the reflecting surface is irregular, the parallel rays of light that fall on it are scattered in all directions. This is called irregular or diffused reflection.

Note: Irregular reflection takes place on rough surfaces

Reflection From a Plane Surface (Plane Mirror)

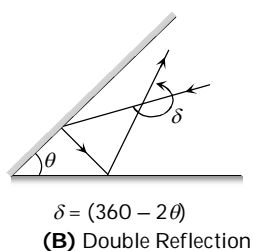
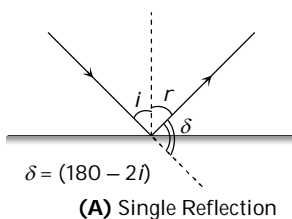
The image formed by a plane mirror is virtual, erect, laterally inverted, equal in size that of the object and at a distance equal to the distance of the object in front of the mirror.



For Plane Mirror Animation

Characteristics of an image formed by a plane mirror:

1. The image is formed behind the mirror and has the same size as the object
2. The image is inverted laterally.
3. The image is as far behind the mirror as the object is in front of it.
4. The image is virtual. It cannot be received on a screen.
5. The image is erected w.r.t object

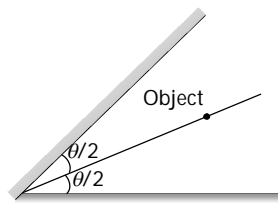


(1) **Deviation (δ)** : Deviation produced by a plane mirror and by two inclined plane mirrors.

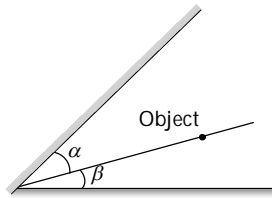
(2) **Images by two inclined plane mirrors** : When two plane mirrors are inclined to each other at an angle θ , then number of images (n) formed of an object which is kept between them.

(i) $n = \left(\frac{360^\circ}{\theta} - 1 \right)$; If $\frac{360^\circ}{\theta} = \text{even integer}$

(ii) If $\frac{360^\circ}{\theta} = \text{odd integer}$ then there are two possibilities



(A) Object is placed symmetrically



(B) Object is placed asymmetrically

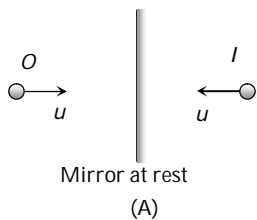
$$n = \left(\frac{360}{\theta} - 1 \right)$$

$$n = \frac{360}{\theta}$$

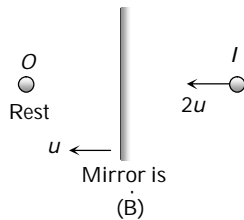
(3) Other important informations

(i) When the object moves with speed u towards (or away) from the plane mirror then image also moves towards (or away) with speed u . But relative speed of image *w.r.t.* object is $2u$.

(ii) When mirror moves towards the stationary object with speed u , the image will move with speed $2u$ in same direction as that of mirror.



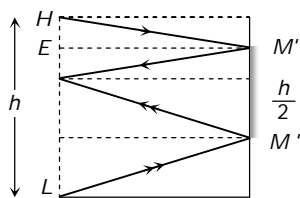
(A)



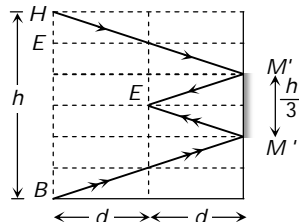
(B)

(iii) A man of height h requires a mirror of length at least equal to $h/2$, to see his own complete image.

(iv) To see complete wall behind himself a person requires a plane mirror of at least one third the height of wall. It should be noted that person is standing in the middle of the room.



(A)



(B)