

## LIGHT (REFLECTION AND REFRACTION)

Light is the form of energy that enables us to see.

### Properties of Light

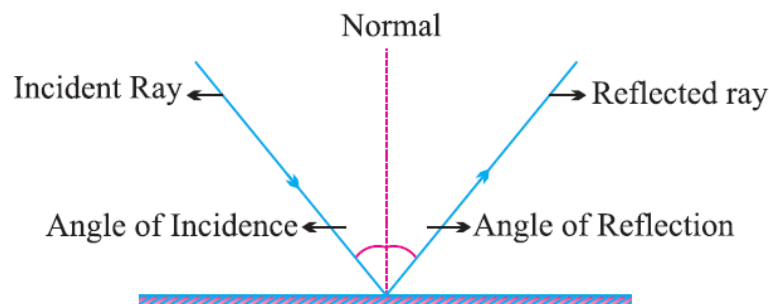
- Electromagnetic wave so does not require any medium to travel.
- Light tends to travel in straight line.
- Light has dual nature i.e., wave as well as particle
- Light casts shadow.
- Speed of light is maximum in vacuum. Its value is  $3 \times 10^8 \text{ ms}^{-1}$ .
- When light falls on a surface, following may happen:
  - a) Reflection
  - b) Refraction
  - c) Absorption

### Reflection

Bouncing back of light when it strikes on a polished surface like mirror.

### Laws of Reflection

1. Angle of incidence is equal to the angle of reflection.
2. The incident ray, the reflected ray and the normal at the point of incidence, all lie in the same plane.

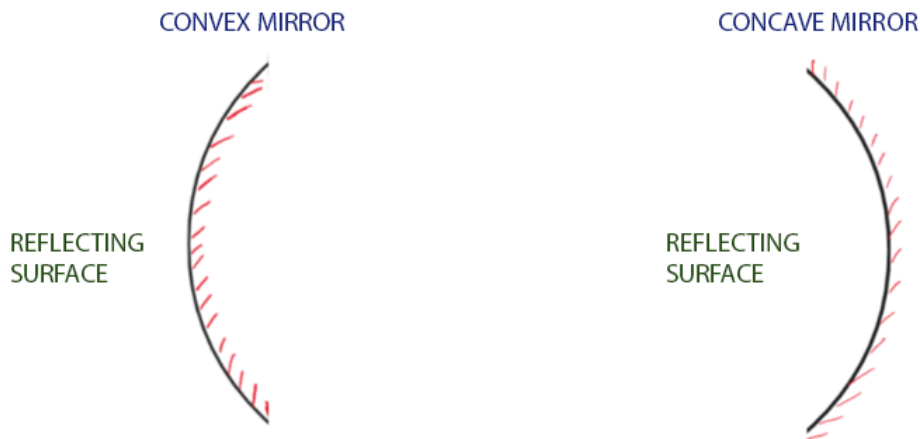


### Lateral inversion

Lateral inversion is **the real or apparent reversal of left and right**. For example, the letter b when laterally inverted becomes the letter d (more or less). It is well-known that a plane mirror causes the apparent lateral inversion of objects.

### Spherical Mirrors

Mirrors whose reflecting surface is curved.



### Convex mirror

A mirror whose reflecting surface is curved outwards is called convex mirror. It is also known as a diverging mirror.

### Concave mirror

A mirror whose reflecting surface is inwards is called concave mirror. It is also known as a converging mirror.

### Some definition related to spherical mirror

#### Principal axis

The line joining the pole and center of curvature.

#### Pole (P)

The center of the spherical mirror.

#### Aperture (MN)

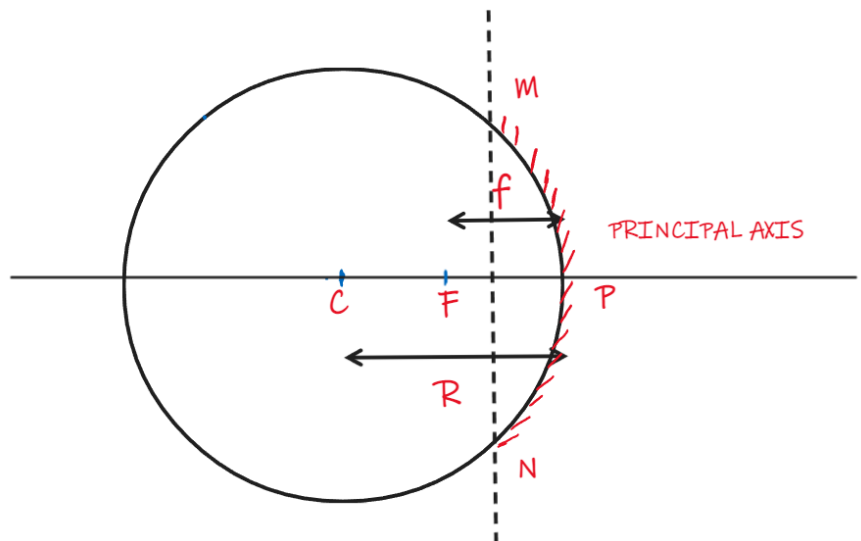
It is the effective diameter of the spherical mirror.

#### Centre of Curvature (C)

The center of the hollow glass sphere of which the mirror was a part.

#### Radius of Curvature (R)

The distance between the pole and the center of curvature.



### Focus (F)

The point on principal axis where all the parallel light rays actually meet or appear to meet after reflection.

### Focal length (f)

The distance between the pole and the focus.

### Relationship between focal length and radius of curvature

$$f = \frac{R}{2}$$

### Real image

The image formed when rays of light meet at a point after reflection/refraction is called real image.

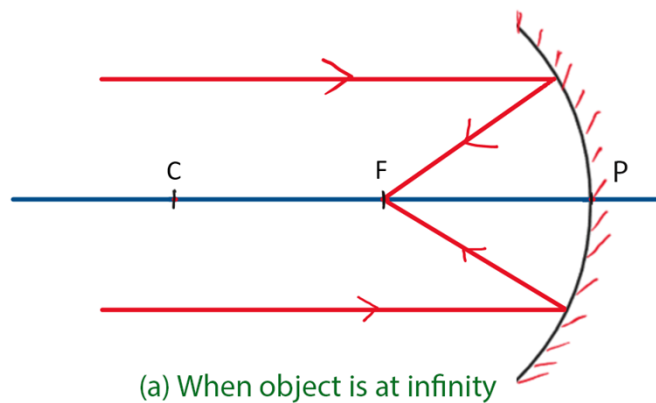
### Virtual image

The image formed when rays of light appear to meet at a point after reflection/refraction is called virtual image.

### Ray diagrams for images formed by concave mirror

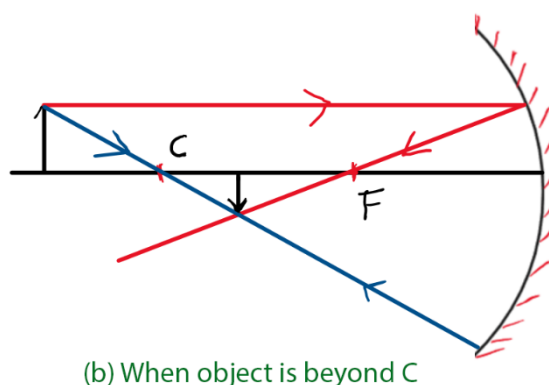
#### a) When object is at infinity

When the object is at infinity then its image is formed **at F** and its nature is **real and inverted** and the size of the image is **pointing size or highly diminished**.



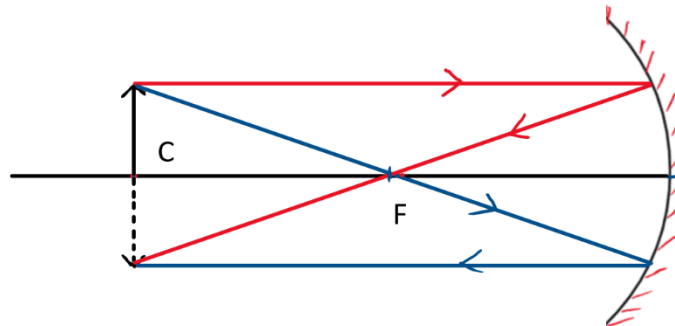
#### b) When object is beyond 'C'

When the object is beyond C then its image is formed **Between 'F' and 'C'** and its nature is **real and inverted** and the size of the image is **diminished**.



c) When object is at 'C'

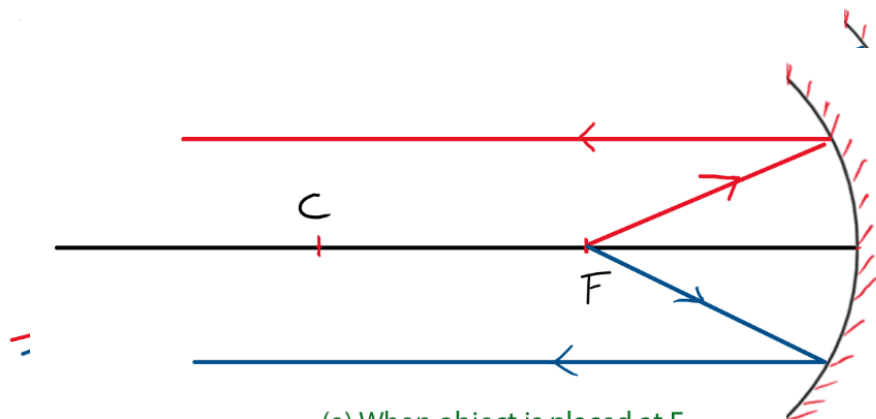
When the object is at C then its image is formed at '**C**' and its nature is **real and inverted** and the size of the image is **Same size as that of object**.



(c) When object is at C

d) When object is placed between 'F' and 'C'

When the object is between F and C then its image is formed **beyond C** and its nature is **real and inverted** and the size of the image is **Enlarged**.



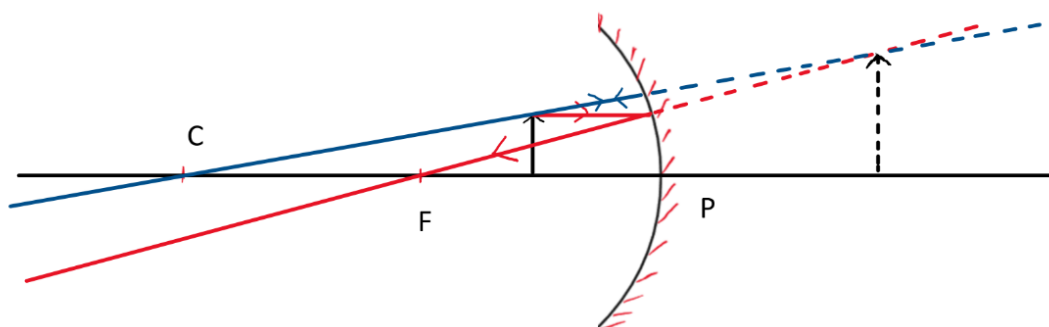
(e) When object is placed at F

e) When object is placed at F

When the object is at F then its image is formed **at infinity** and its nature is **real and inverted** and the size of the image is **highly Enlarged**.

f) When object is between P and F

When the object is at F then its image is formed **at behind the mirror** and its nature is **virtual, erect** and the size of the image is **Enlarged**.



(f) When object is between P and F

### 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	Real and inverted
Beyond 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	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	enlarged	Virtual and erect

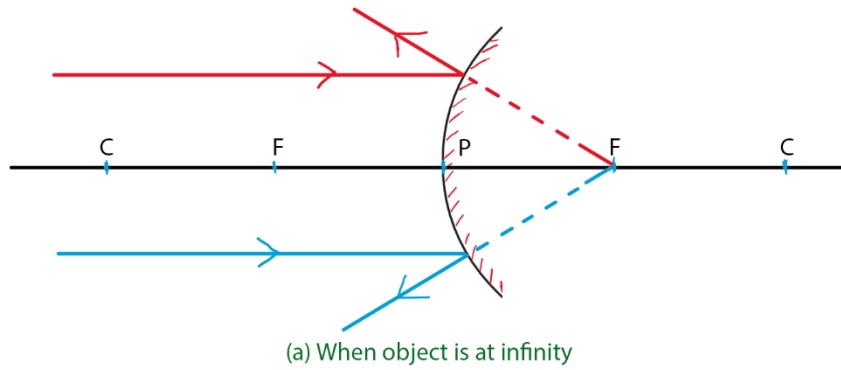
### Uses of Concave Mirror

- I. Used in torches, search lights and vehicles headlights to get powerful parallel beam of light.
- II. Concave mirrors are used by dentists to see large image of teeth of patients. (Teeth have to be placed between pole and focus).
- III. Large concave mirrors are used to concentrate sunlight to produce heat in solar furnace.

### Ray diagrams of images formed by convex mirror

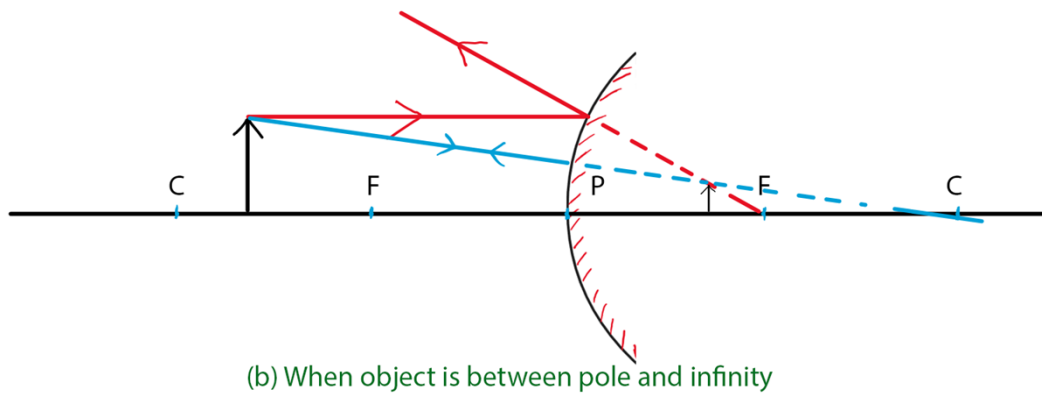
#### a) When object is placed at infinity:

When the object is at infinity then its image is formed **at F** and its nature is **virtual, erect** and the size of the image is **point sized**.



**b) When object is placed between pole and infinity**

When the object is between pole and infinity then its image is formed **between P and F** and its nature is **virtual, erect** and the size of the image is **diminished**.



- A full-length image of a tall building/tree can be seen in a small convex mirror.

**Nature, position and relative size of the image formed 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

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