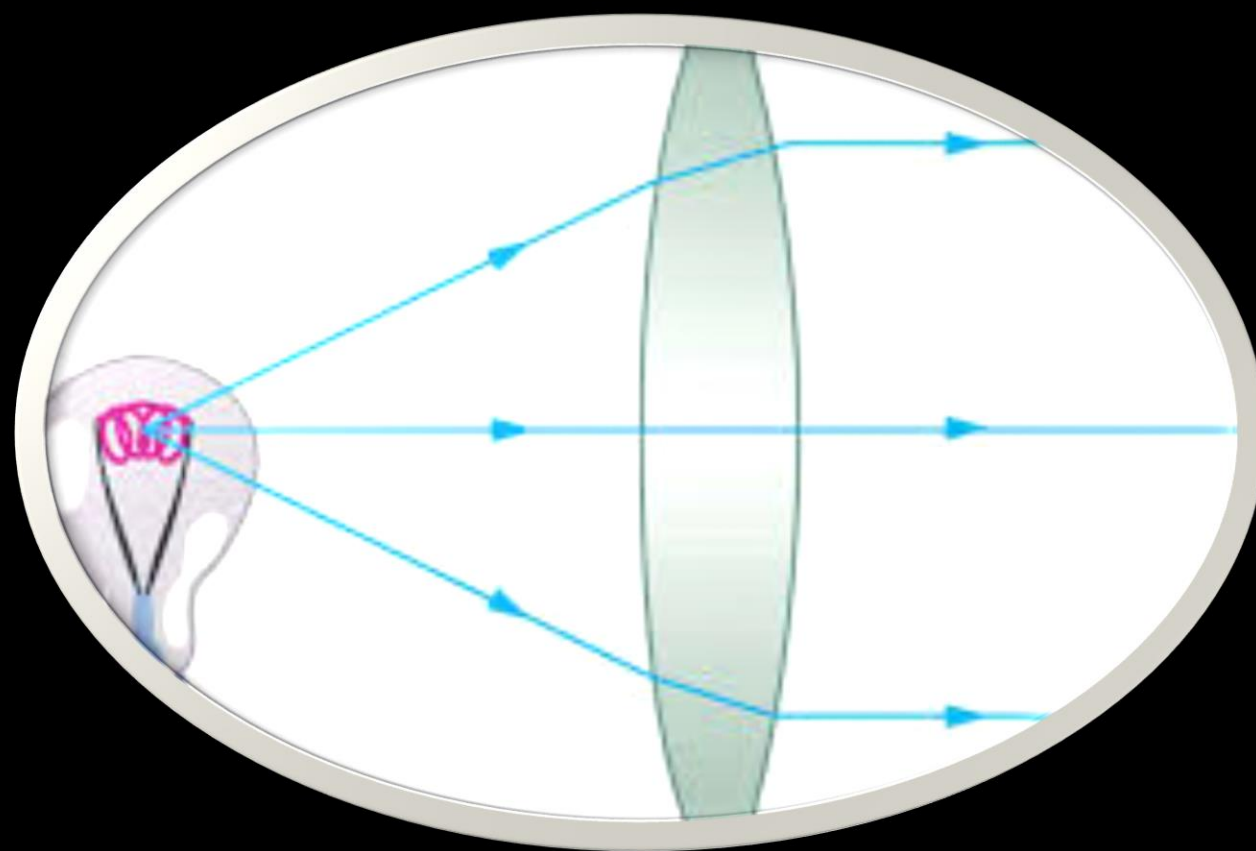


CHAPTER-1- LIGHT REFLECTION AND REFRACTION



Light- Light is a type of electromagnetic radiation and allow to see the object.

Nature of light

There are two theories about the nature of light.

1- Wave theory

2- Particle Theory

1- Wave theory- It is invented by Christian Huygens in (1678).

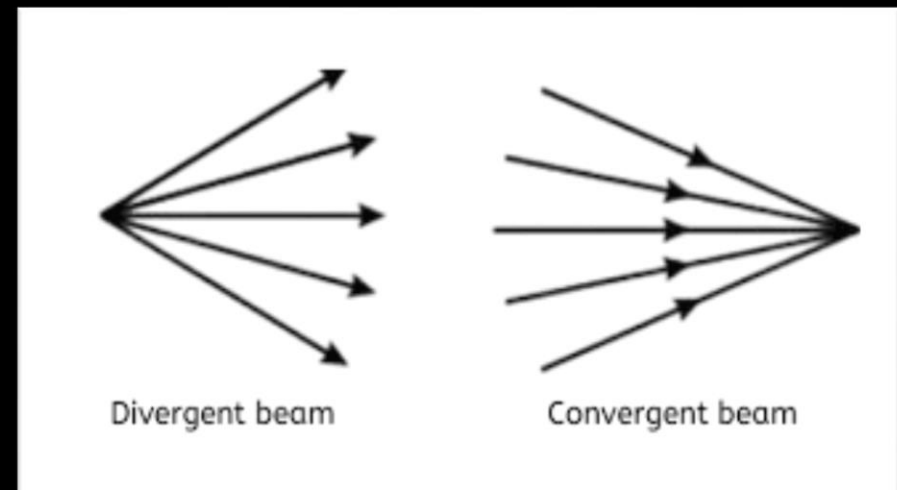
Light consists of electromagnetic waves which do not require a material medium like (solid, liquid or gas) for their propagation.

2- Particle Theory – Isaac Newton (1670 and officially published in 1704 his famous book opticks ,)

- ➔ According to this theory light is composed of particles which travel in straight line at very high speed .
- ➔ Speed of light in vacuum is 3×10^8 m/s.
- ➔ Light has a dual nature wave and particle nature.

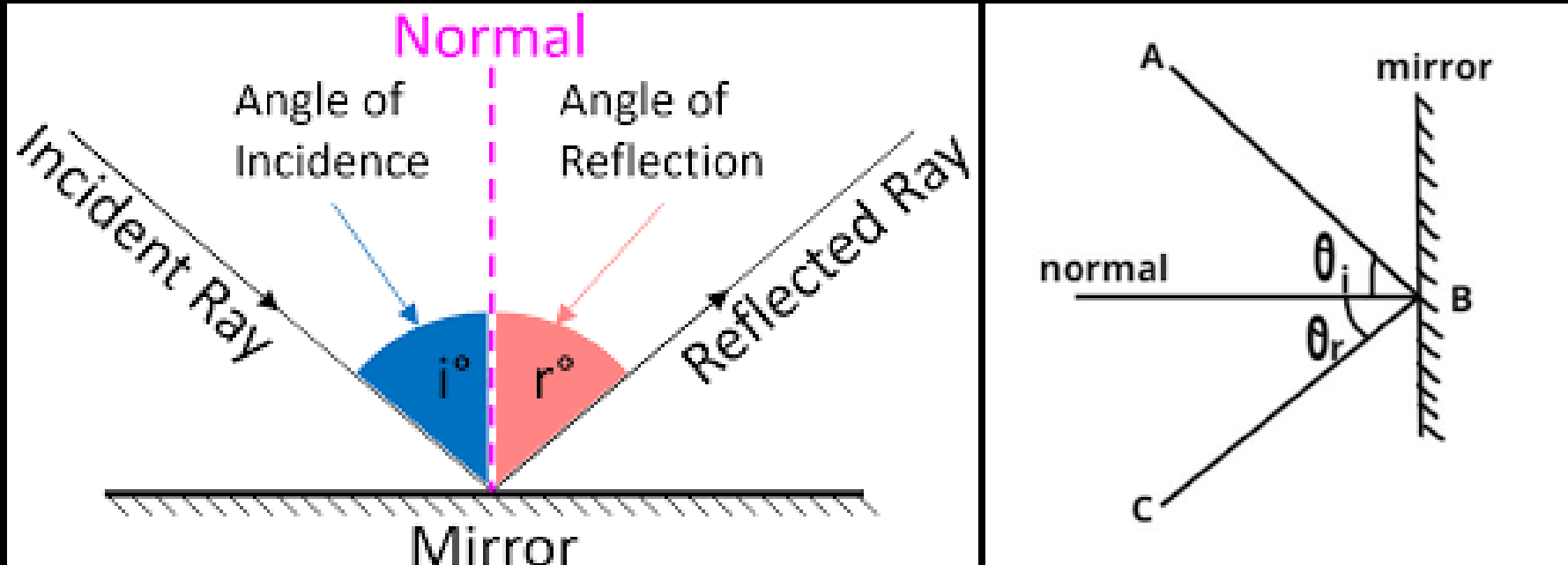
Properties of Light-

- 1-** It does not need medium to travel .
- 2-** A beam of light in which rays propagate to meet a point is called converging beam of light .
- 3-** A beam of light move out of a point is called divergent beam .
- 4-** The speed of light in vacuum is 3×10^8 m/s.



Reflection of light-

The phenomenon of bouncing back of light in the same medium after striking a surface is called reflection.



- ➔ The point at which the incident ray falls on the mirror is called the point of incidence.
- ➔ Normal is a line which is perpendicular to the mirror surface at the point of incidence.

Laws of reflection-

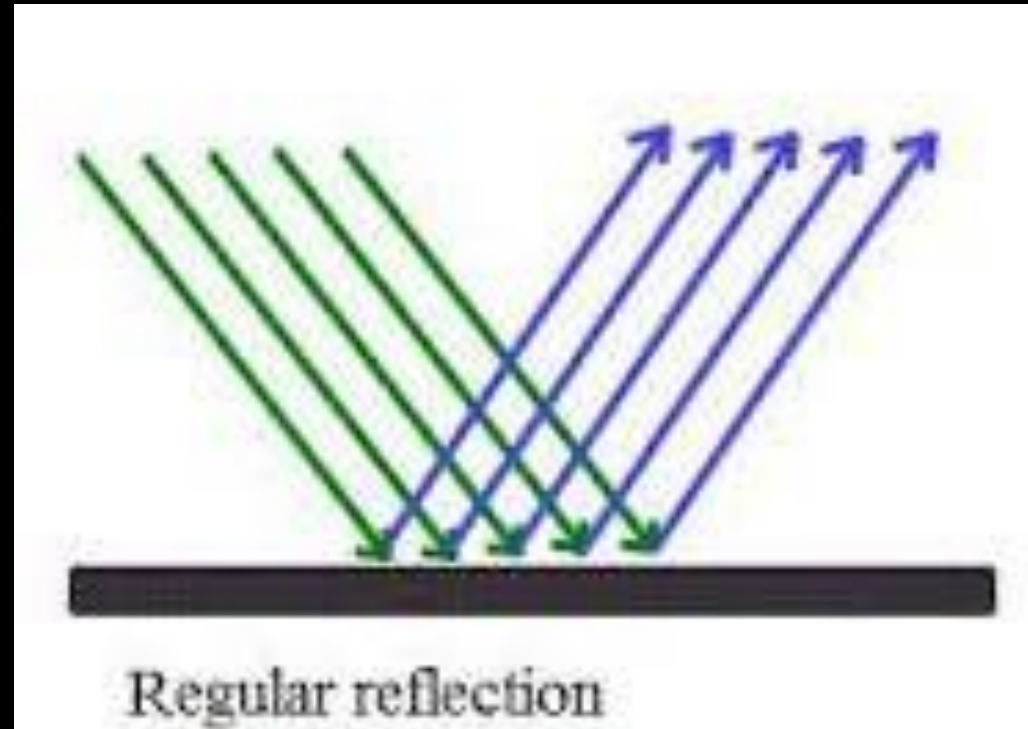
- (i) The angle of incidence is equal to the angle of reflection.
 - (ii) The incident ray, reflected ray and normal all lie in the same plane.
- ➔ The above laws of reflection are applicable to plane mirrors as well as spherical mirrors.

Note- If a ray of light which is incident normally on a mirror is reflected back along with the same path.

$$\angle i = \angle r = 0$$

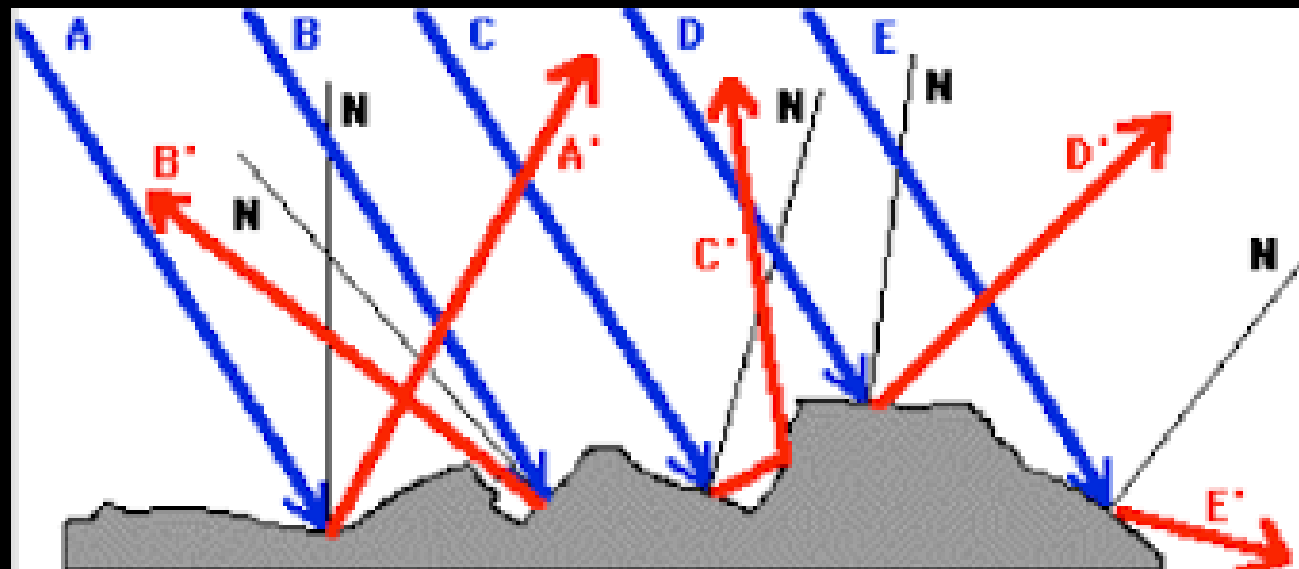
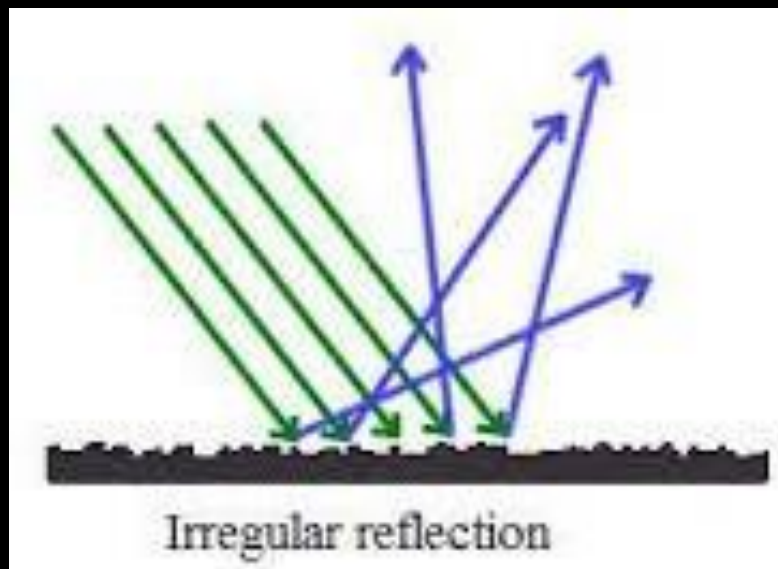
Regular reflection- Regular reflection of light occurs from smooth surface like that a plane mirror.

$$\angle i = \angle r$$



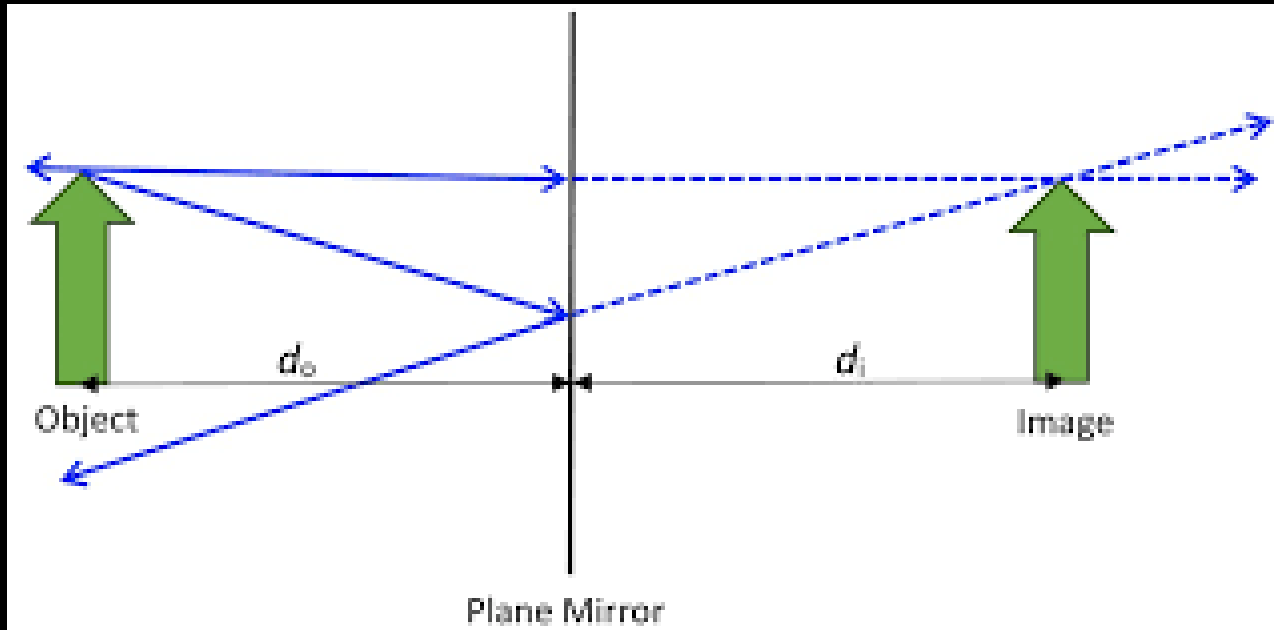
Diffuse reflection- The diffuse reflection of light takes place from rough surface like that of paper chalk ,table etc.

No image is formed in diffuse reflection of light. Because light rays scattered in all directions.



- ➔ If the parallel rays of light falling on a rough surface go in different direction so i and r are different.
- ➔ Angle i and r are same at each point even on the rough surface of an object.

Formation of image in plane mirror-



- ➔ The image formed by a plane mirror can be seen only by looking into the mirror.
- ➔ The nature of image formed by a plane mirror is virtual and erect.
- ➔ The size of image formed by plane mirror is equal to that of the object.
- ➔ The image formed in a plane mirror is at the same distance behind the mirror as the object is in front of the mirror.

Difference between real and virtual image-

Real Image	virtual image-
<p>1- Light rays actually meet to form a real image.</p> <p>2- The image is generally inverted.</p> <p>3- Image can be obtained on the screen .</p> <p>4- This image is in front of mirror and behind the lens. Ex. Cinema screen. Camera sensor.</p>	<p>1- Light rays do not actually Meet to form a virtual image.</p> <p>2- The image is generally erect.</p> <p>3- Image can not be obtained on the screen.</p> <p>4- This image is behind the mirror and in front of the lens. Ex. Plane mirror</p>

Use of plane mirror-

- ➔ It is used to see ourselves.
- ➔ Plane mirror are fixed on the inside walls of certain shops like jewellery shops.
- ➔ Plane mirror are used in making periscopes. (It is an optical instrument used to observe surrounding from a hidden , submerged submarines to see what is going on water surface.)

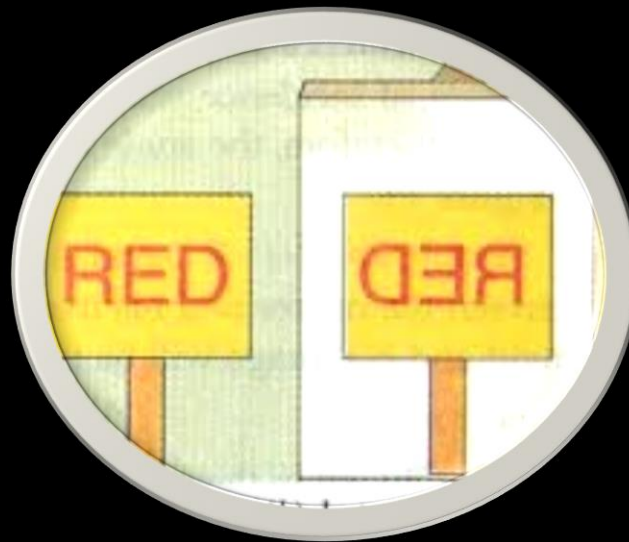
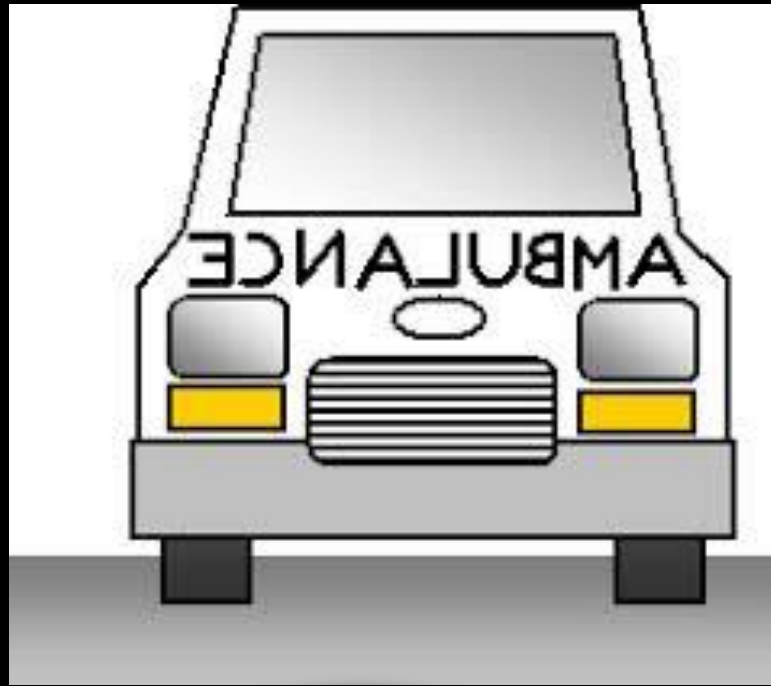
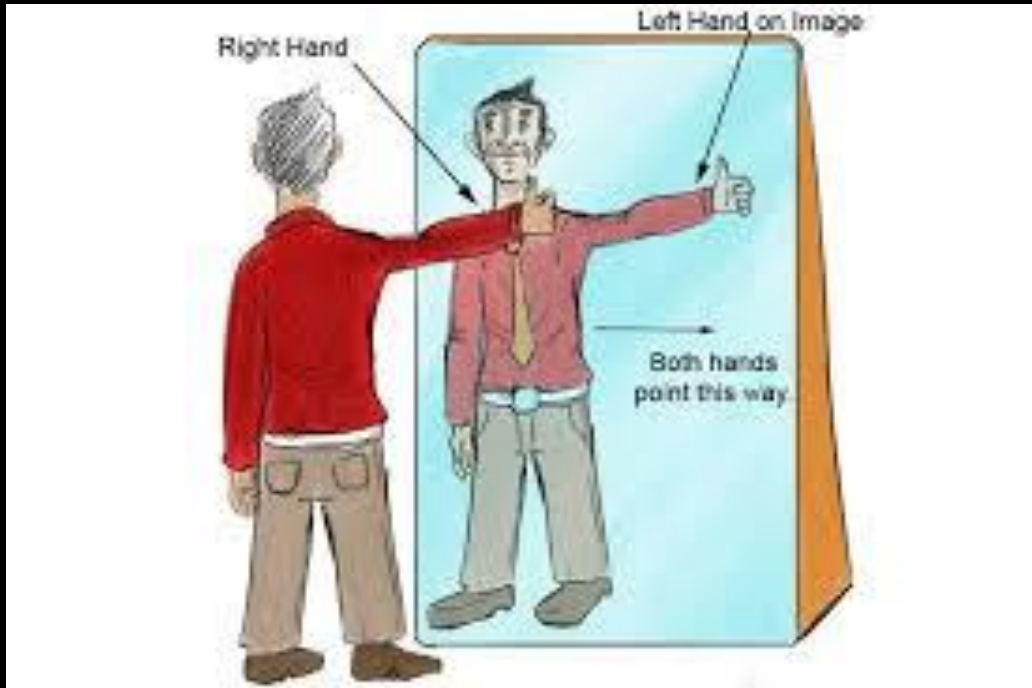


Lateral Inversion-

When an object is placed in front of a plane mirror , then the right side of object appears to become

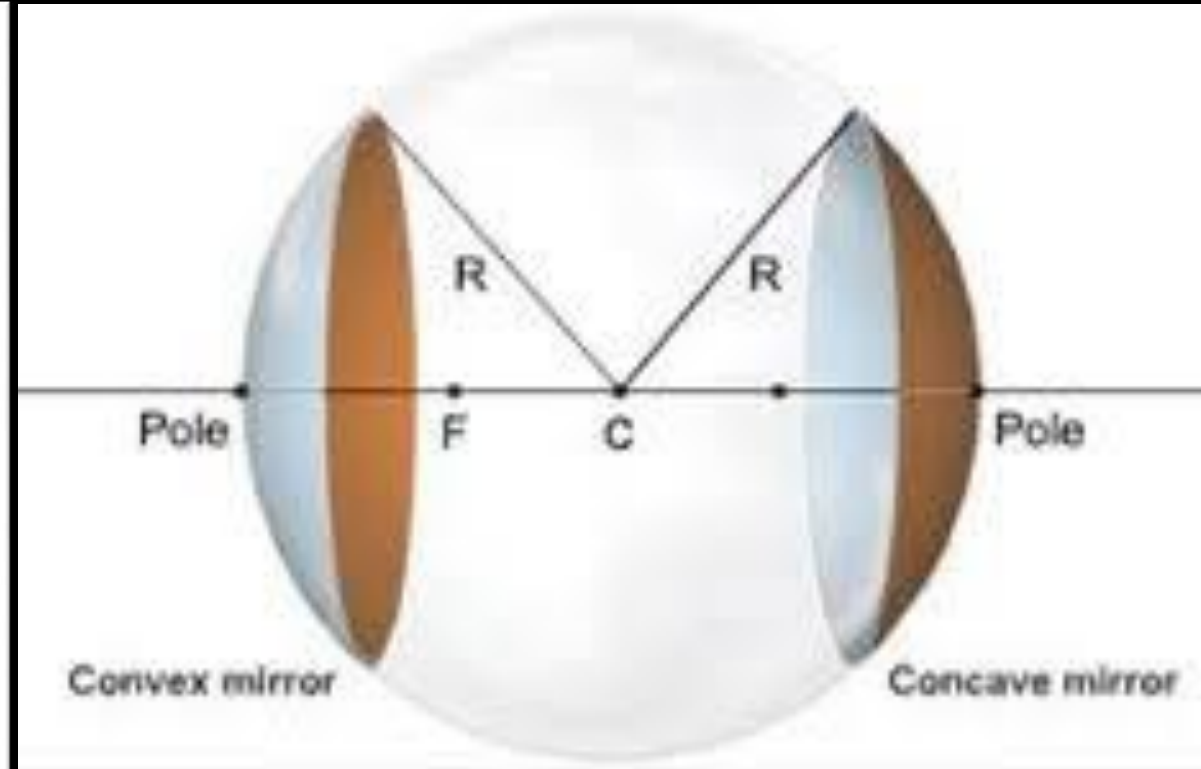
The left side of image, and left side of object appears to become the right side of image, this change of sides of an object and its mirror image is called lateral inversion.

Ex. Our left hand appears to be right hand in the mirror image.



Q. An incident ray makes an angle of 35° with the surface of plane mirror . What is angle of reflection?

Spherical mirrors- A mirror whose reflecting surface is a part of a hollow sphere of glass is called a spherical mirror.



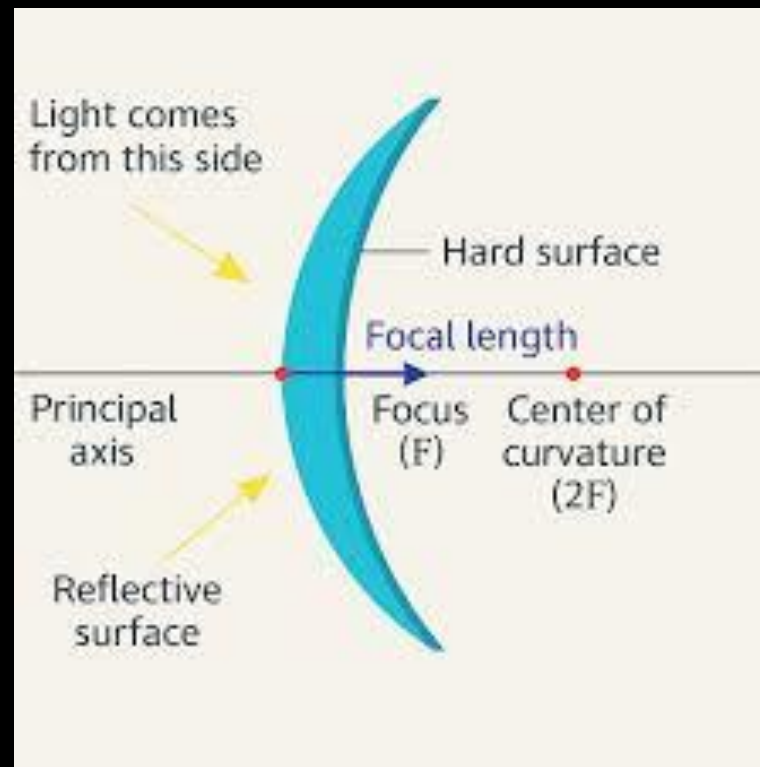
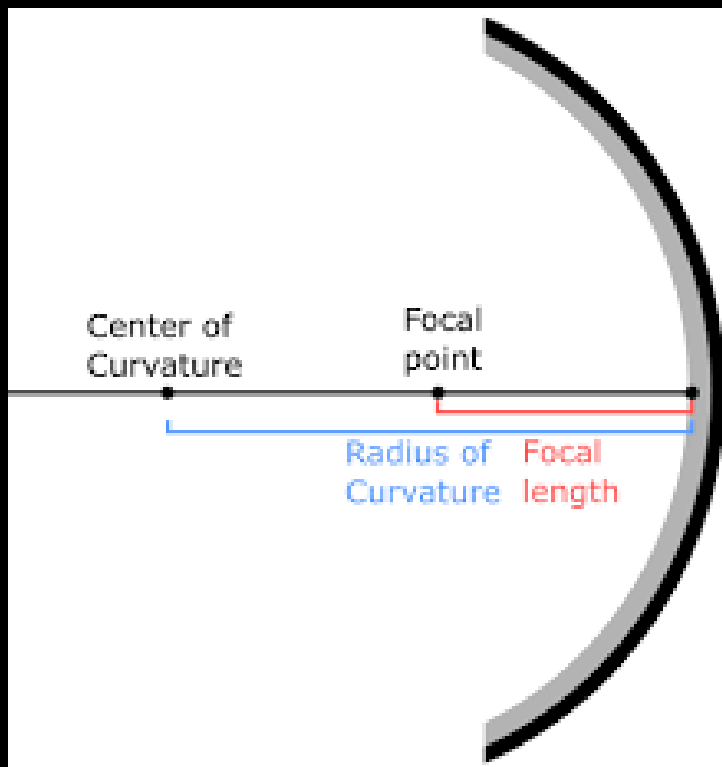
It is two types-

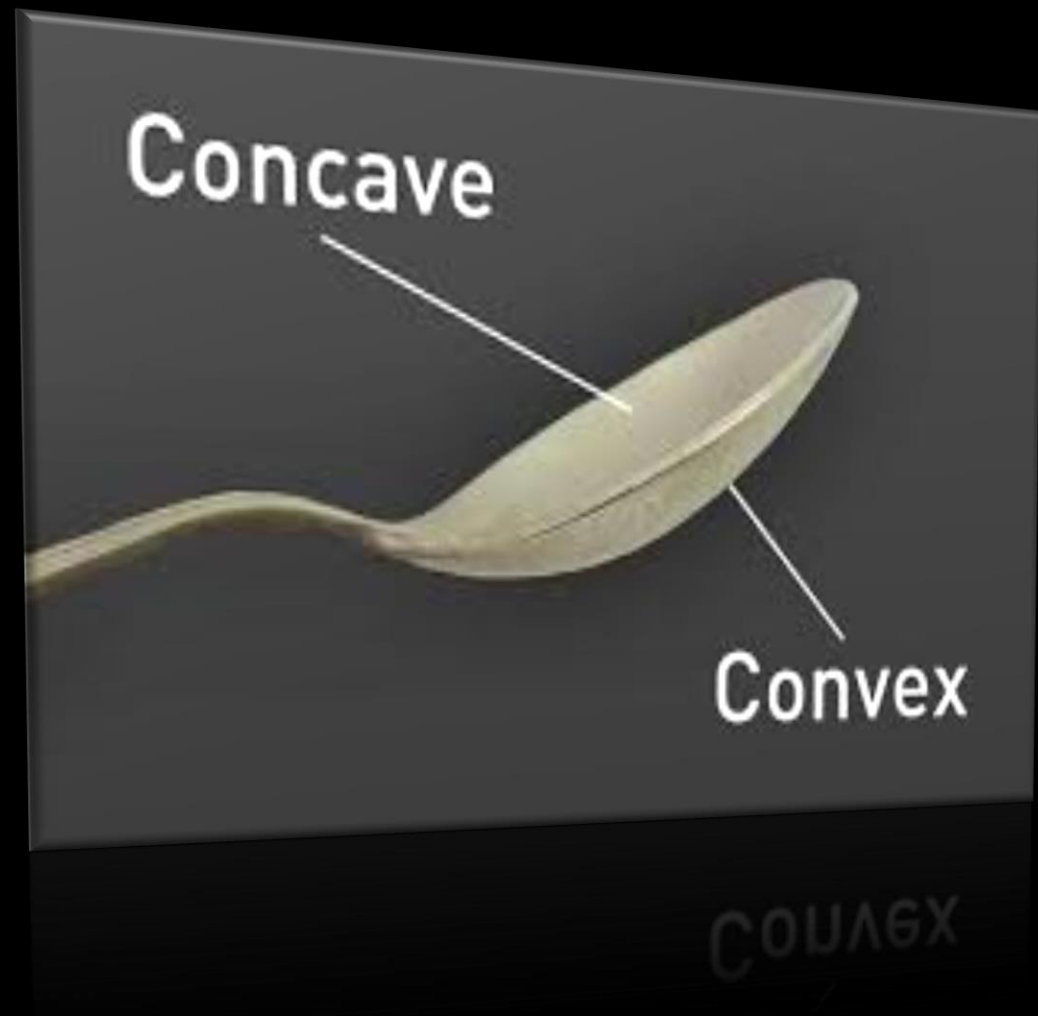
1- Concave mirror

2- Convex mirror

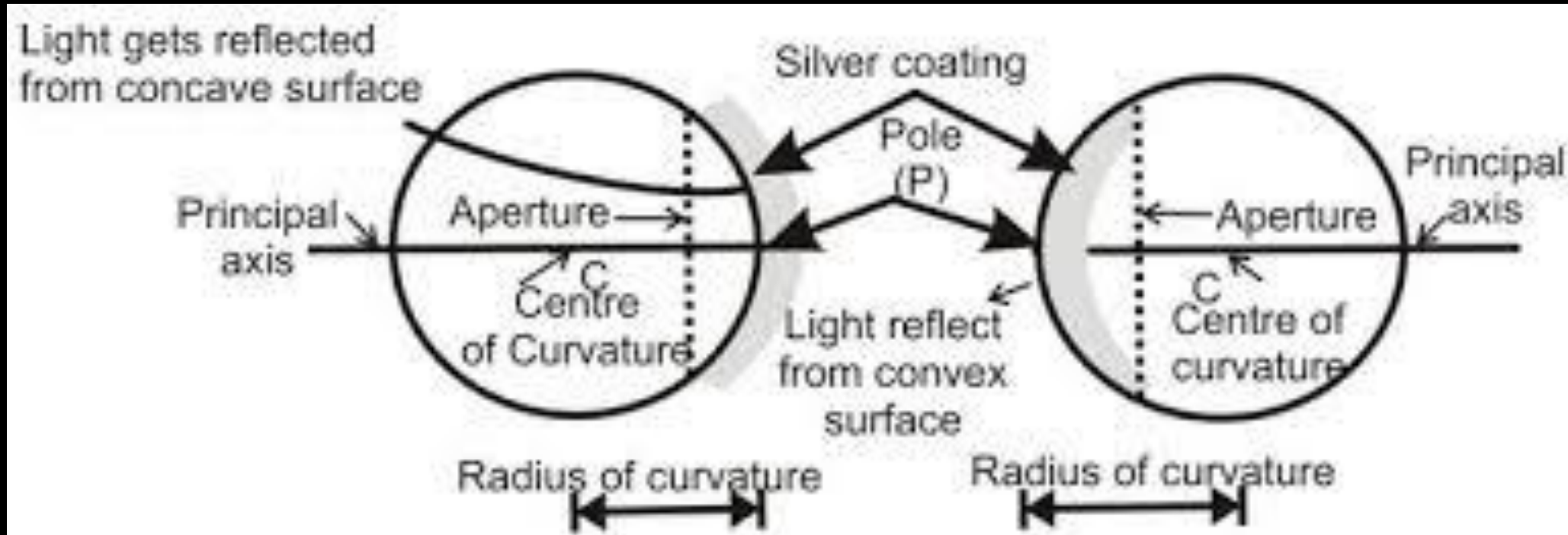
1- Concave mirror- A spherical mirror which has reflecting surface towards the centre of the sphere of which the mirror is a part is called concave mirror.

2- Convex mirror- A convex mirror is that spherical mirror in which the reflecting of light takes place at the convex surface.





Some important terms related to spherical mirrors.



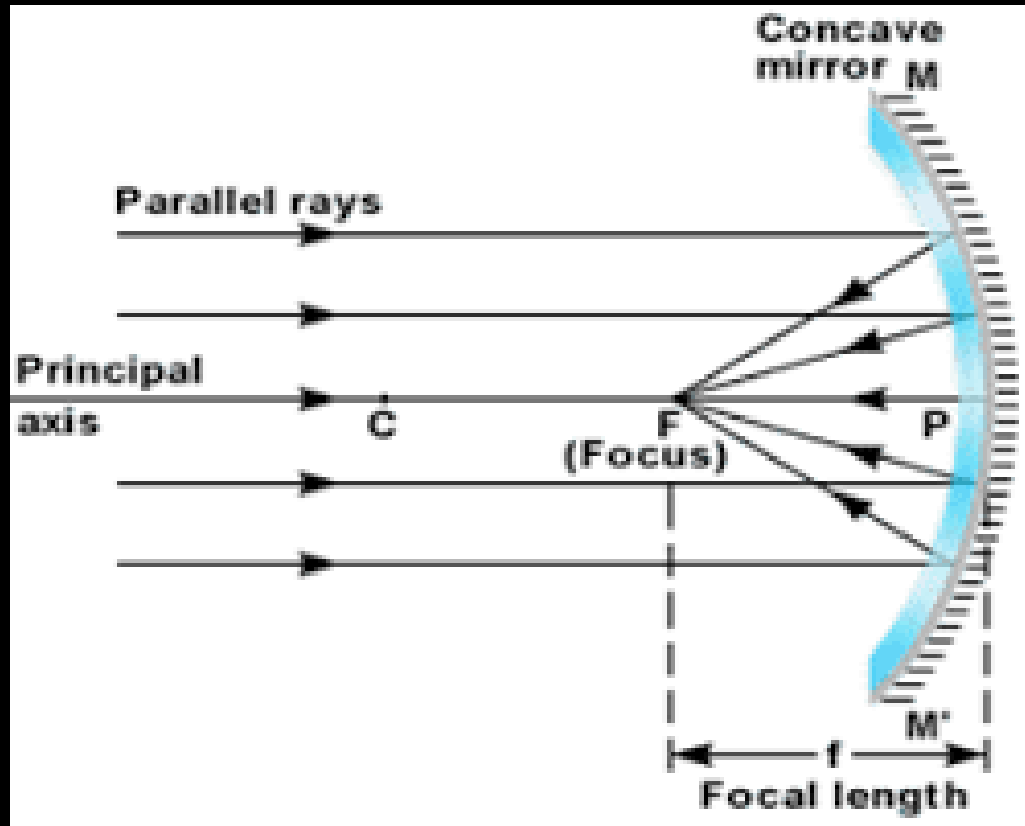
1- Centre of curvature(C)- It is the centre of hollow sphere of which the mirror is a part.

2- Pole (P)- The centre of spherical mirror is called the pole.

3- Radius of curvature(R) – The radius of the sphere of which the mirror surface is a part is called radius of curvature .

4- Principal axis- The straight line passing through the centre of curvature and pole of a spherical mirror is called its principal axis.

Focus and focal length of a concave mirror-

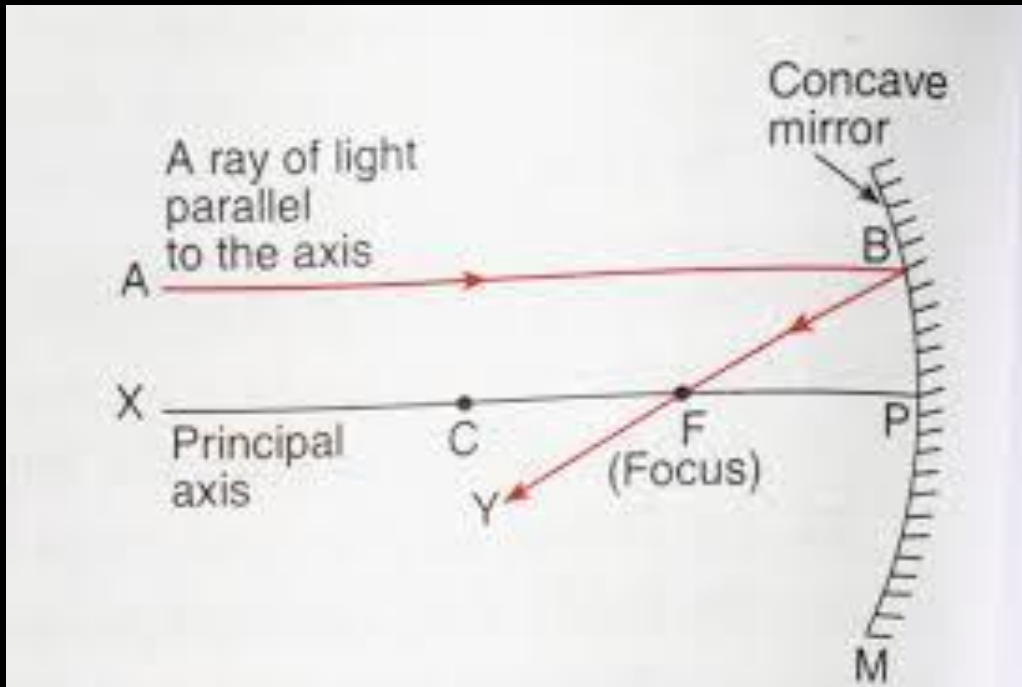


5-Focus - A beam of light parallel to the principal axis after reflection from a concave mirror converges at a point on the principal axis . This point is called focus or principal focus.

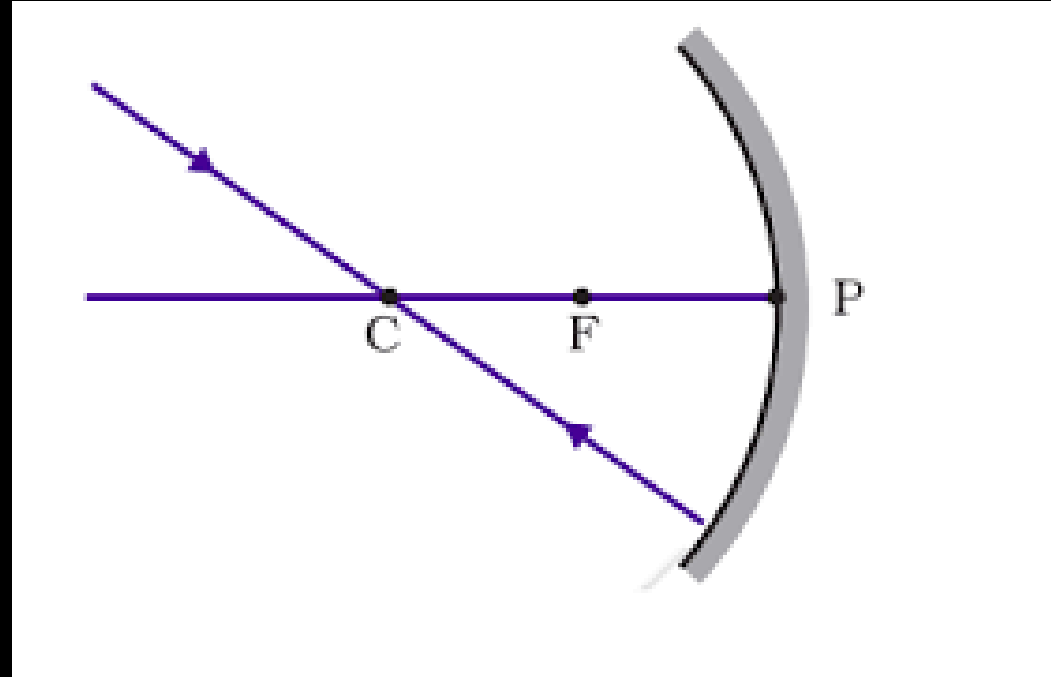
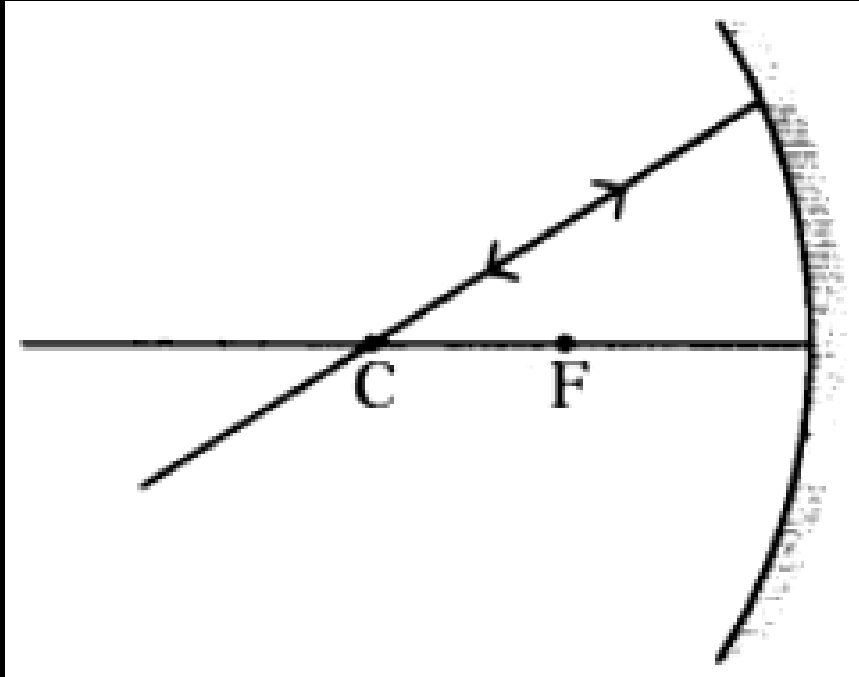
6-Focal length- The focal length of a concave mirror is the distance between its pole and principal focus.

Rules to draw image for concave mirror-

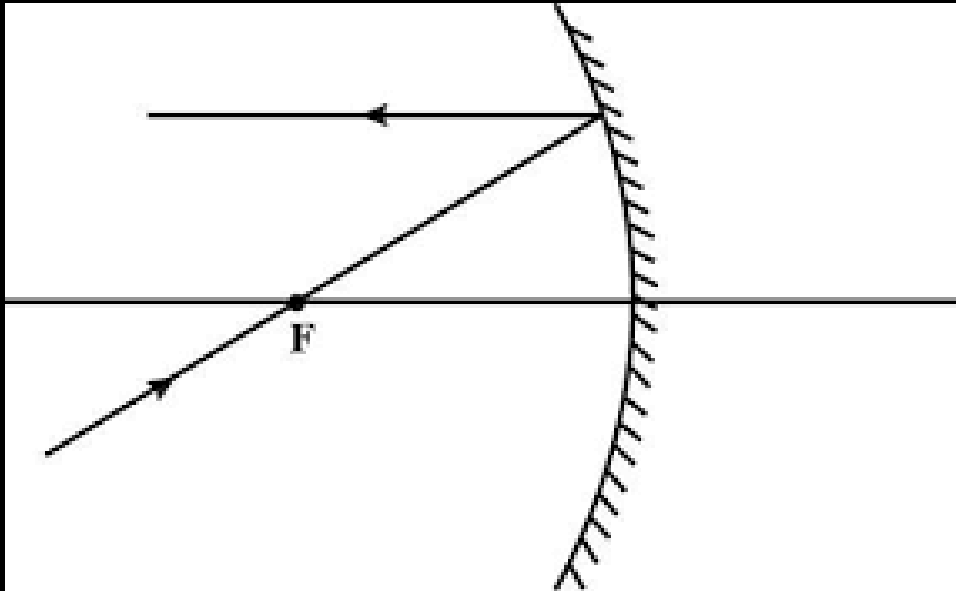
Rule-1 A ray of light which is parallel to the principal axis of a concave mirror, passes through its focus after reflection from the mirror.



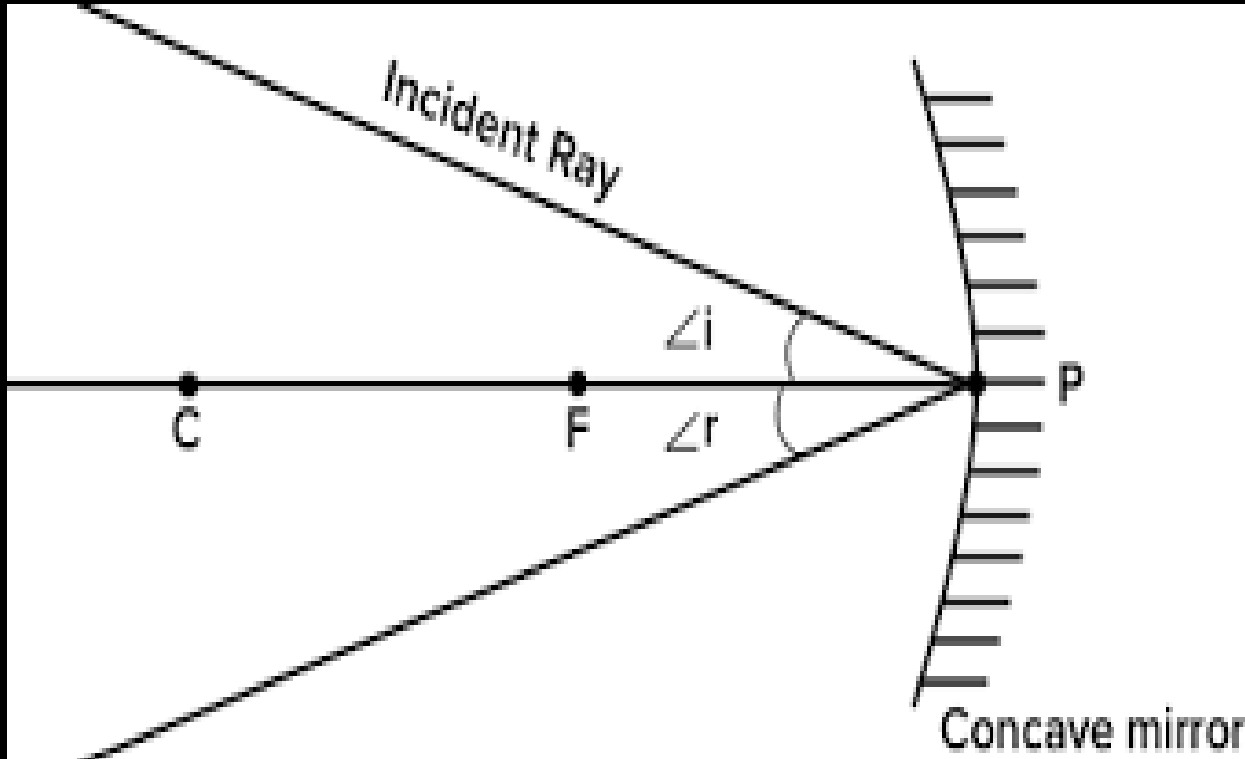
Rule-2 A ray of light passing through the centre of curvature of a concave mirror is reflected back along the same path.



Rule-3 A ray of light passing through the focus of a concave mirror becomes parallel to the principal axis after reflection.



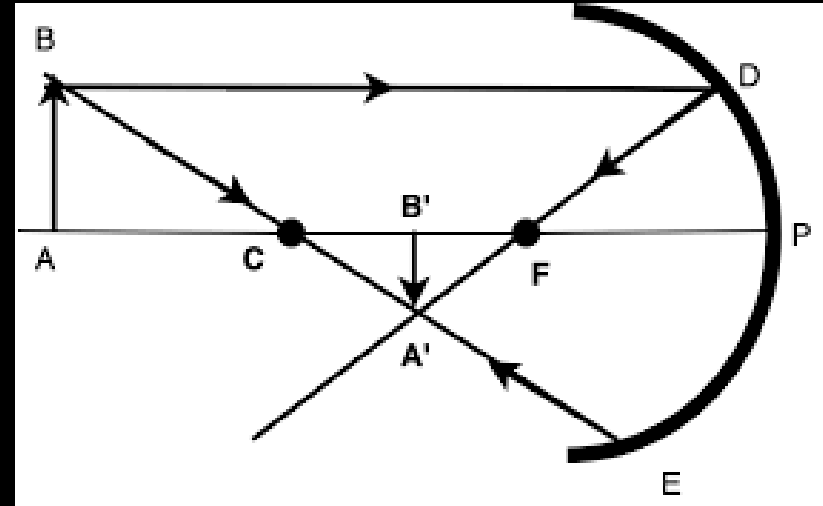
Rule-4 A ray of light which is incident at the pole of a concave mirror is reflected back making the same angle with the principal axis.



Formation of different types of image by a concave mirror-

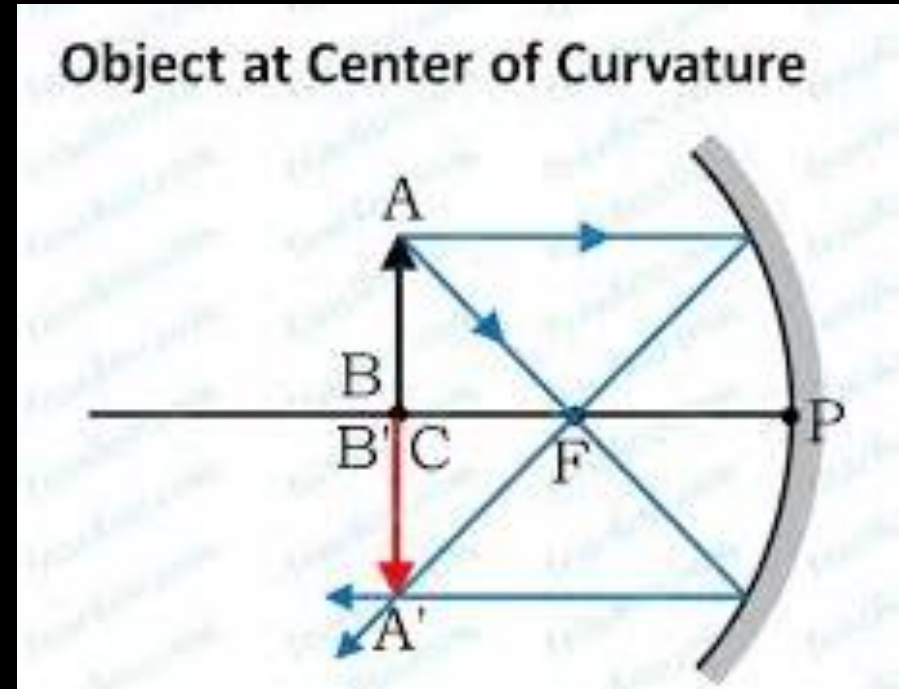
Case-1 When object is placed beyond the centre of curvature.

- 1-** Position of image b/w F and C
- 2-** Nature- Real and inverted
- 3-** Size of image smaller than object (Diminished)



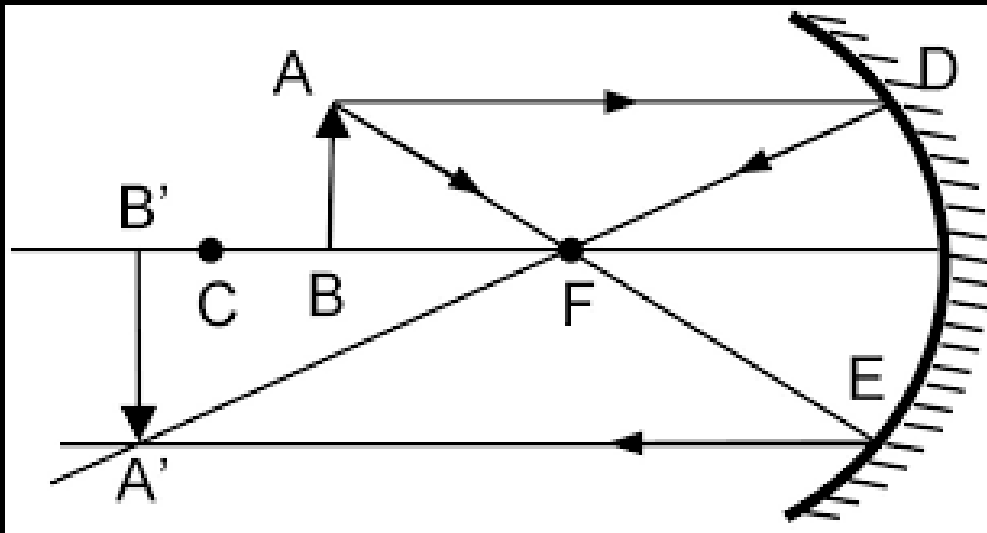
Case-2 When object is placed at the centre .

- 1- Position of image at C
- 2- Nature- Real and inverted
- 3- Same size as the object



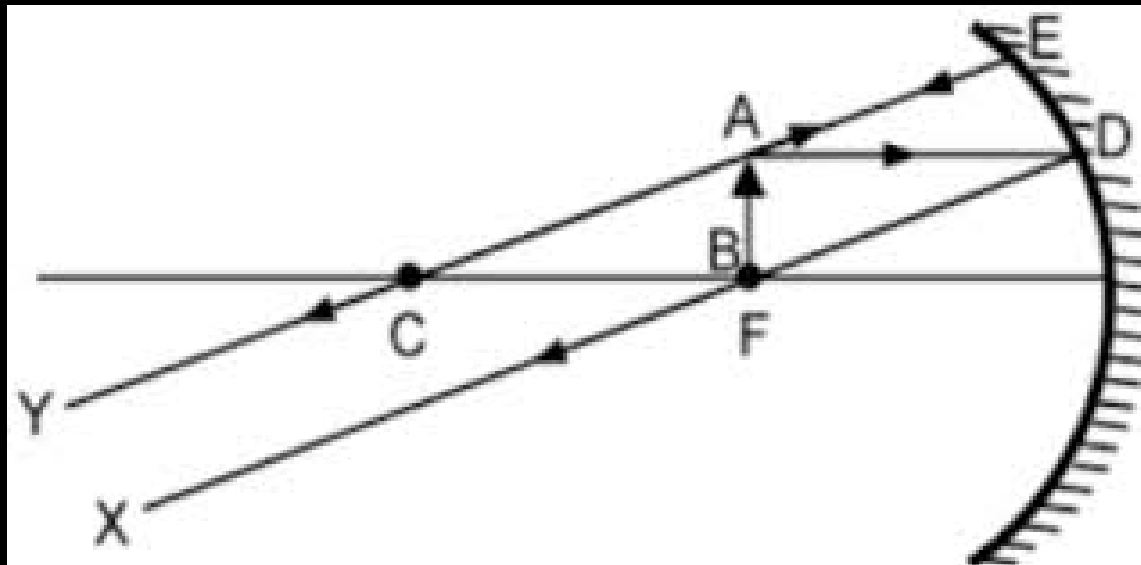
Case-3 When object is placed between C and F.

- 1-** Position of image beyond at C
- 2-** Nature- Real and inverted
- 3-** larger than object (magnified)



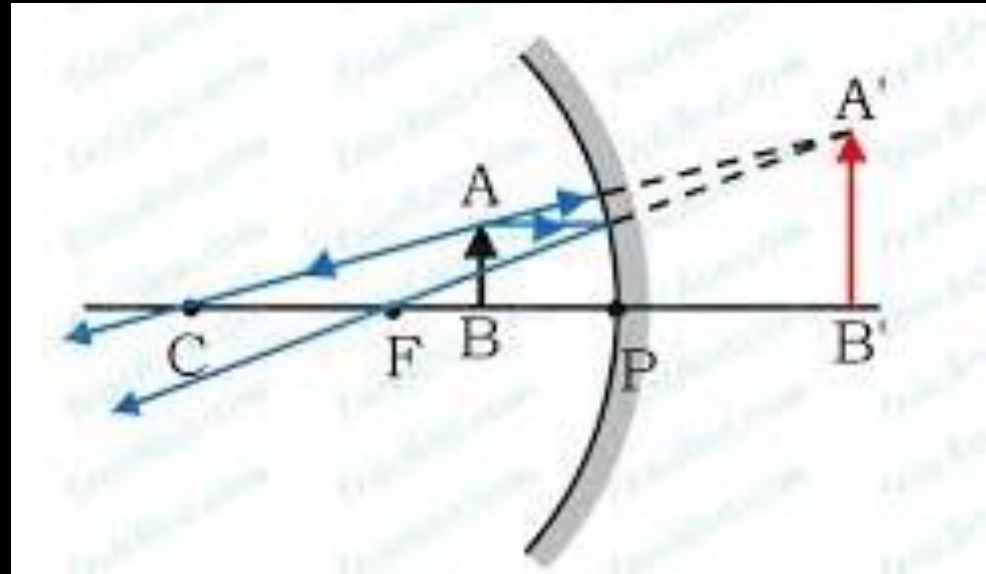
Case-4 When object is placed at F .

- 1- Position of image at infinity.
- 2- Nature- Real and inverted
- 3- highly enlarged (highly magnified)



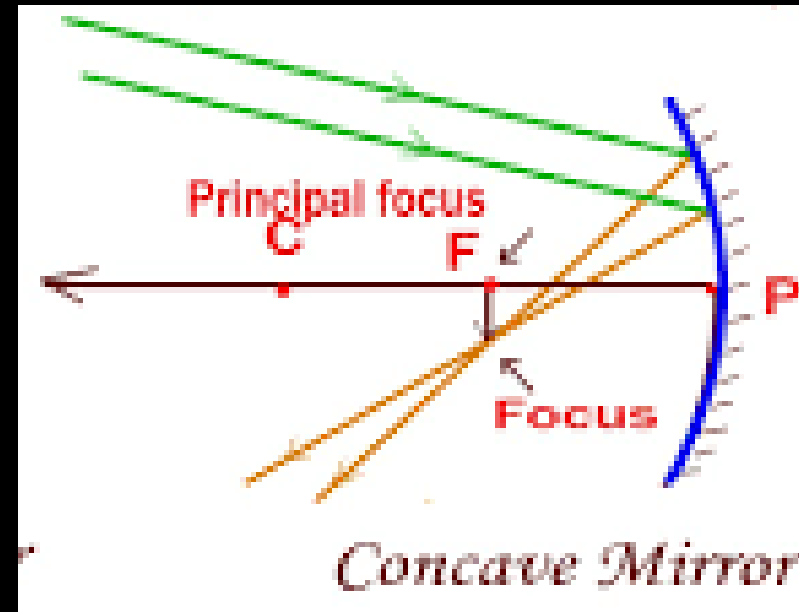
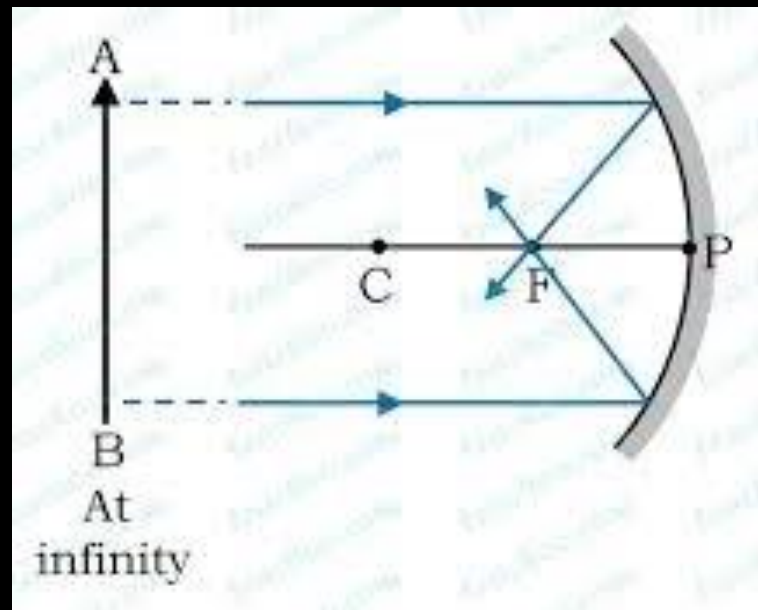
Case-5 When object is placed between F and P.

- 1- Position of image behind the mirror.
- 2- Nature- virtual and erect.
- 3- larger than object (magnified).



Case-6 When object is placed at infinity .

- 1- Position of image at F.
- 2- Nature- real and inverted.
- 3- highly diminished (point sized).



Note- In concave mirror diminished virtual image is not formed

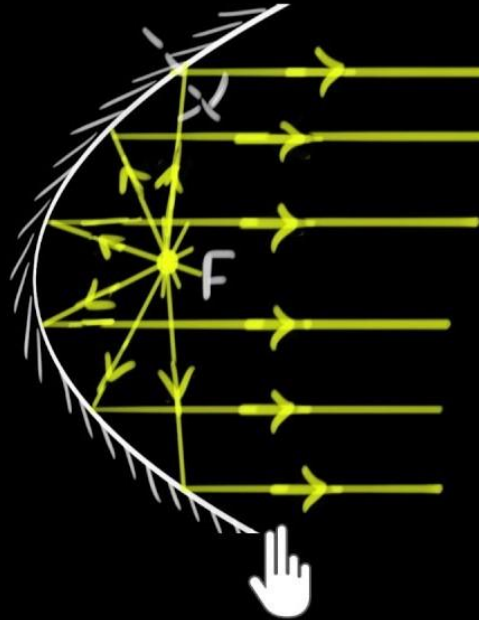
Use of concave mirror-(Converging mirror)

- 1- Concave mirrors are used as shaving mirror to see a large image of the face.
- 2- Concave mirrors are used in head light of car.



3- Concave mirrors are used by dentists to see the large images of the teeth of patients.

4- Concave mirrors are used as reflectors in torches, and search lights to get powerful beams of light.



- 5-** Concave mirrors are used as doctor,s head mirrors to focus light coming from a lamp on to the body parts of a patient(such as (ENT)).
- 6-** Concave mirrors are used in TV dish antennas to receive T.V signals from the distance communications satellites .



7- Large concave mirrors are used in the field of solar energy to focus sun,s rays for heating solar furnaces.



Mirror Formula

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

- ➔ A formula which gives the relationship between v, u and f of a spherical mirror is known as mirror formula.

f = focal length of the mirror

v = distance of image from the mirror

u = distance of object from the mirror

Linear magnification- The ratio of the height of image to the height of object is known as linear magnification.

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

V = distance of image

U = distance of object

M = magnification

➔ If value of m is positive then image will be **virtual and erect.**

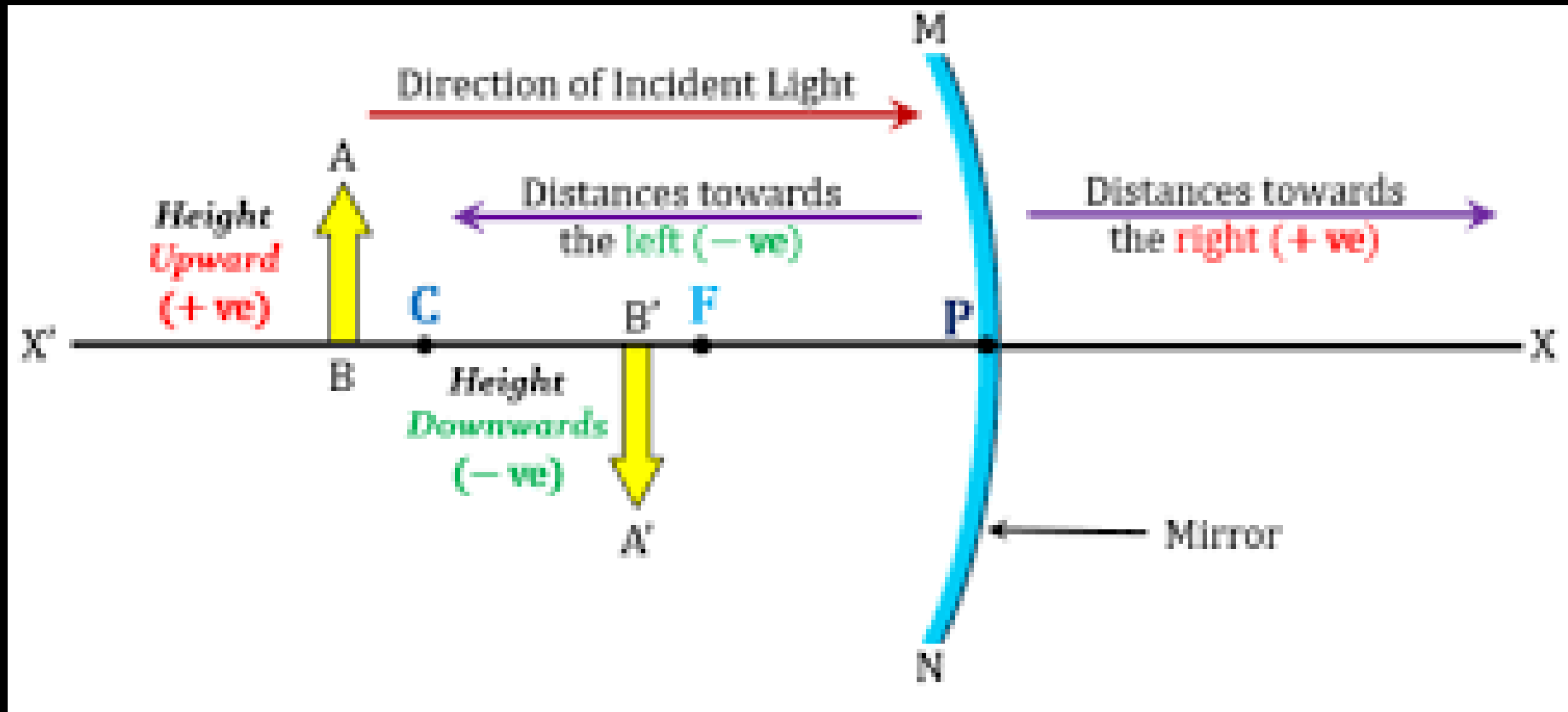
➔ If value of m is negative then image will be **real and inverted.**

If $m > 1$ then image is magnified

If $m < 1$ then image is diminished.

If $m = 1$ the image is same size of object.

Sign convention for concave mirror-



→ U and f always negative , v always negative but when object placed between F and P the v is positive.

→ h_o always positive.

→ h_i always negative but positive when object between F and P .

Q.1 An object of size 7.0 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed , so that a sharp focused image can be obtained? Find the size and the nature Of the image.(NCERT)

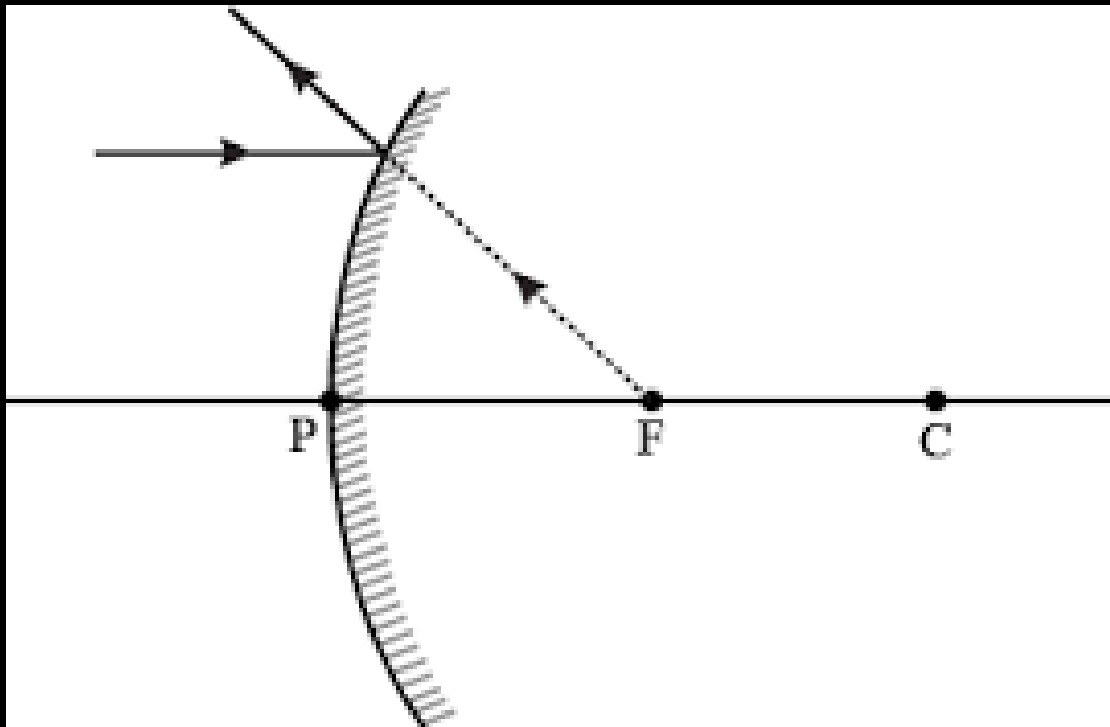
Q.2 Find the size nature and position of image formed when an object of size 1cm is placed At a distance of 15 cm from a concave mirror of focal length 10 cm.

Q.3 How far should an object be placed from the pole of a converging mirror of focal length 20cm to form a real image of the size exactly $1/4^{\text{th}}$ the size of the object.

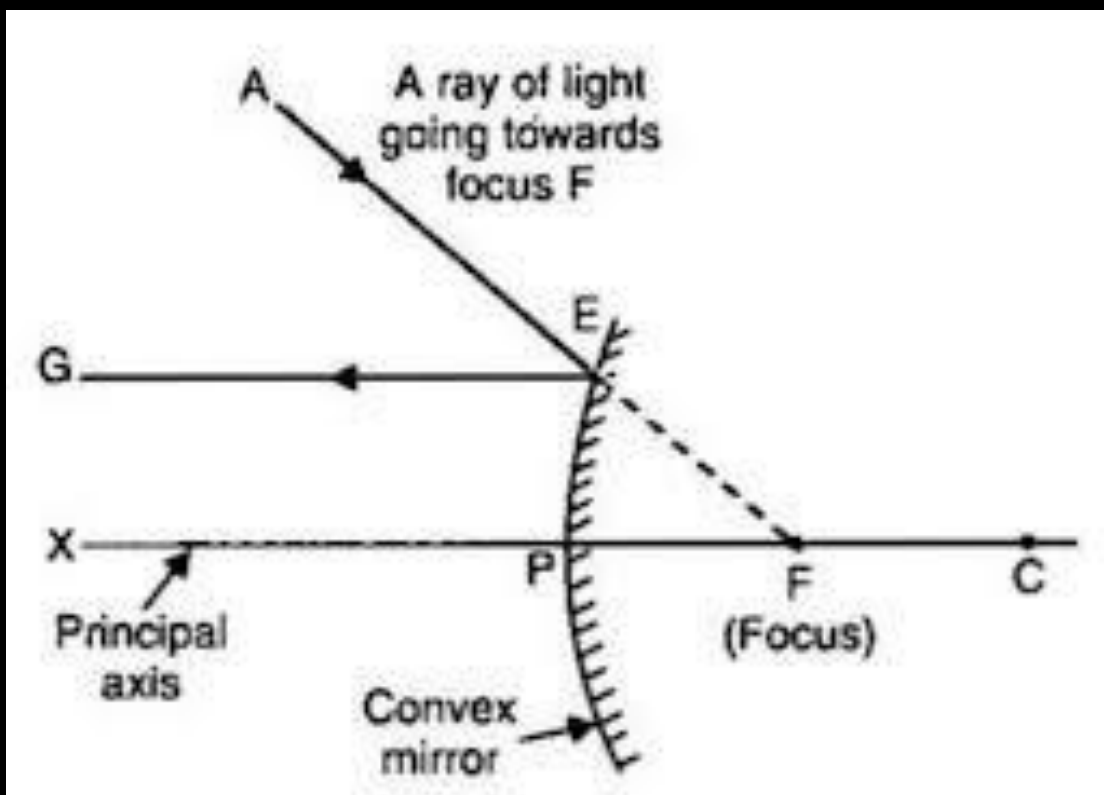
Q.4 When an object is placed at a distance of 50 cm from a concave spherical mirror, the magnification produced is $-1/2$ where should the object be placed to get a magnification of $-1/5$?

Rules to draw image for convex mirror-

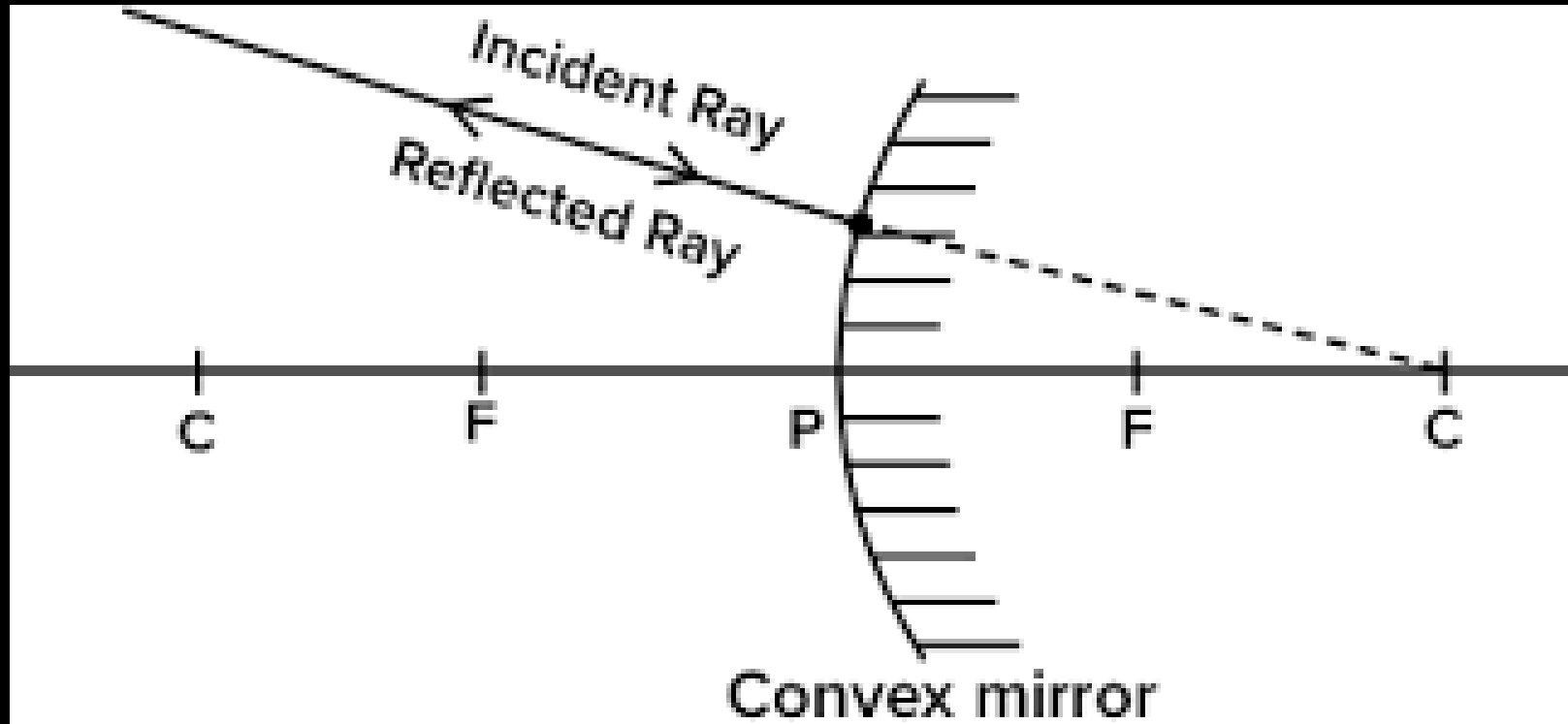
Rule-1 A ray of light which is parallel to the principal axis of a convex mirror appears to be coming from its focus after reflection from the mirror.



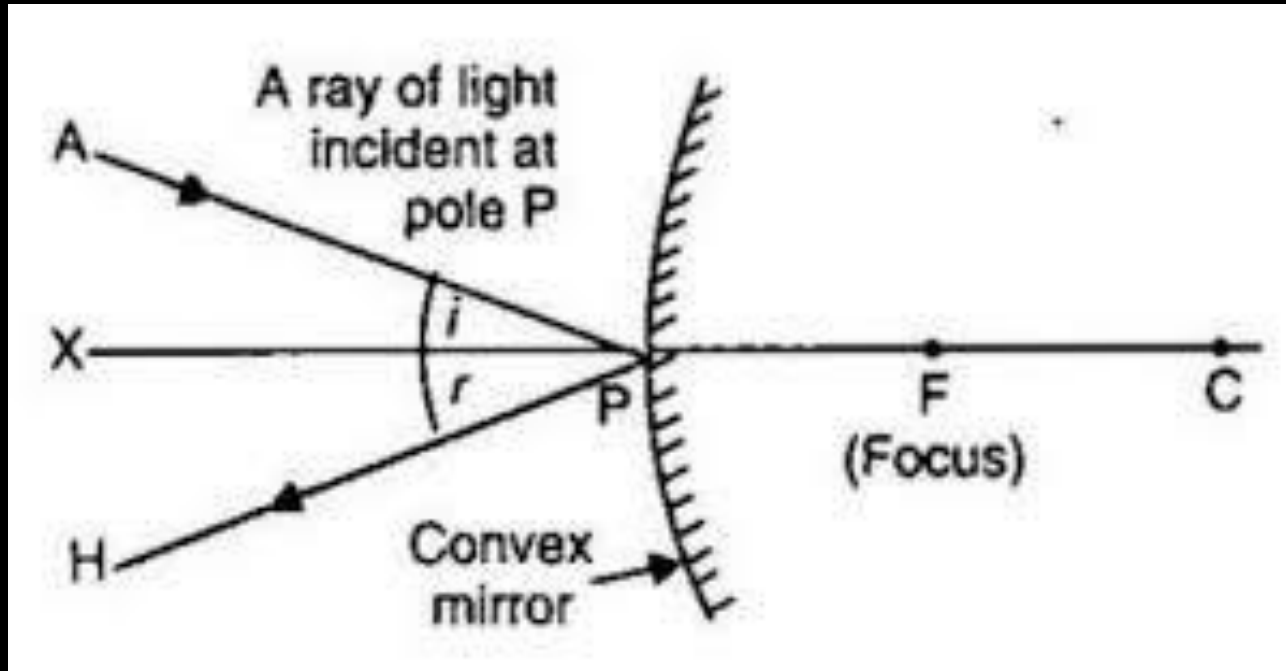
Rule-2 A ray of light going towards the focus of a convex mirror becomes parallel to the principal axis after reflection.



Rule-3 A ray of light going towards the centre of curvature of a convex mirror is reflected back along the same path.



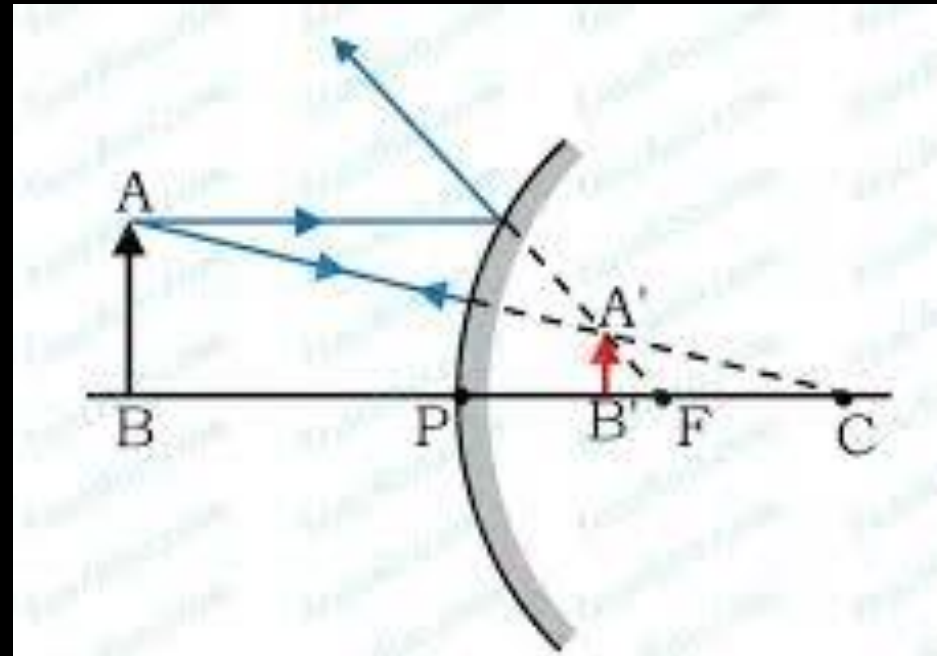
Rule-4 A ray of light which is incident at the pole of a convex mirror is reflected back making the same angle with the principal axis.



Formation of image by convex mirror-

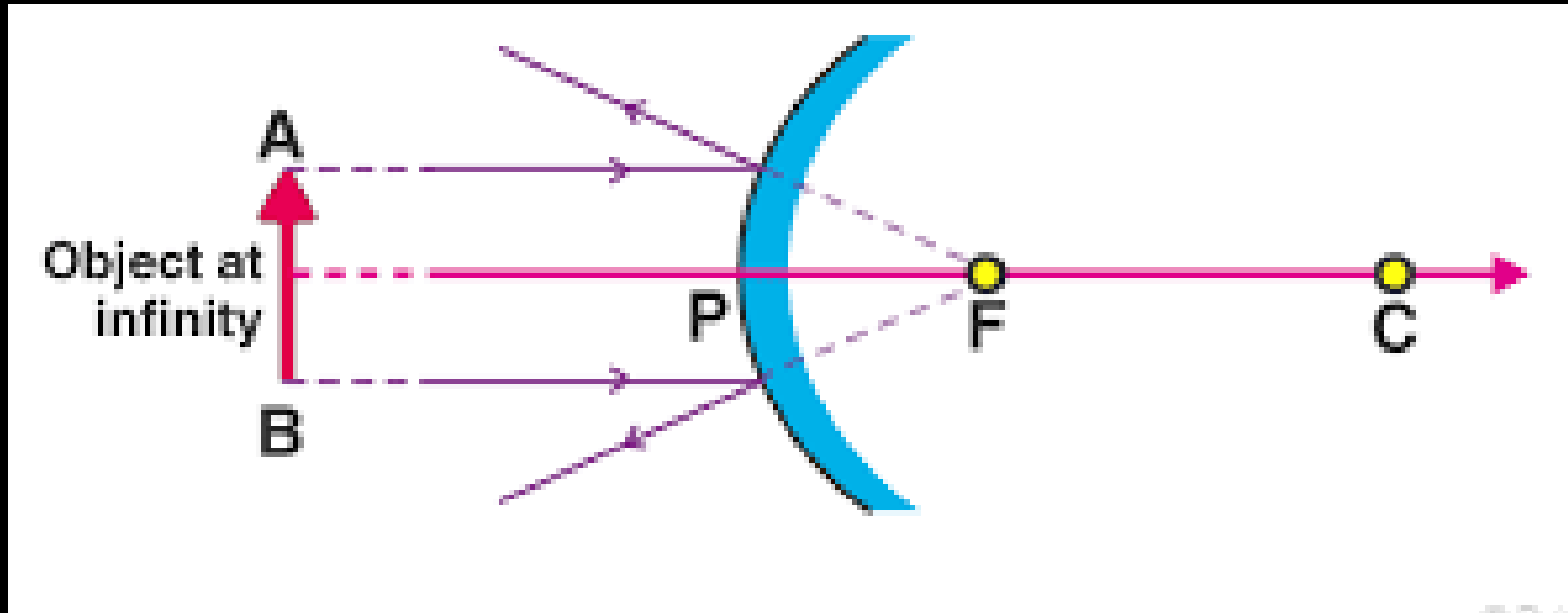
Case-1 When object is placed anywhere between pole and infinity in front of convex mirror.

- 1- Position of image b/w F and P behind the mirror.
- 2- nature of image virtual and erect
- 3- size of image diminished (smaller than object)



Case-2 When object is placed at infinity.

- 1- Position of image behind the mirror at F.
- 2- nature of image virtual and erect
- 3- size of image highly diminished point sized.



Use of convex mirror-(diverging mirror)

- 1- convex mirrors are used as rear-view mirrors in vehicles (like cars, trucks and buses) to the traffic at the rear(back) side.
- 2- Big convex mirrors are used as shop security mirrors.
- 3- Convex mirror always produce erect image of the object.



Mirror formula same as concave mirror-

Sign convention of convex mirror-

Note- U always negative

v, f, h_i , h_o always positive

Q.1 A diverging mirror of radius of curvature 40cm forms an image which is half the height of the object Find the object and image position.

Q.2 An object 5cm in length is placed at a distance of 20cm in front of a convex mirror of radius of Curvature 30cm . Find the position of the image. Its nature and size.(NCERT)

