

# Chapter 6. Light

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**Solution 1:**

Convex mirror has a wider field of view.

**Solution 2:**

Convex mirror always produces an erect image of the object.

**Solution 3:**

Convex mirror is used in vehicles to see the traffic on rear side.

**Solution 4:**

We will use convex mirror to see an enlarged image of our face.

**Solution 5:**

Image of object placed at a long distance in front of a convex mirror is formed at principal focus. Radius of curvature of convex mirror is 20 cm.

Focal length of convex mirror = radius of curvature/2.

Focal length of convex mirror =  $20/2 = 10$  cm.

So image will form at principal focus 10 cm away from pole.

**Solution 6:**

Concave mirror can produce real and diminished image of the object.

**Solution 7:**

The distance of the principal focus from the pole of the mirror is called the focal length of the mirror.

**Solution 8:**

The mirror having +20 cm as its focal length is a convex mirror because focal length is taken positive only in case of convex mirror.

**Solution 9:**

The focal length of plane mirror is infinity.

**Solution 10:**

The mirror having -15 cm as its focal length is a concave mirror because focal length is taken negative only in case of concave mirror.

**Solution 11:**

Principal axis is the straight line passing through the pole and the centre of curvature.

**Solution 12:**

Linear magnification is defined as the ratio of the height of the image to the height of the object. It is taken to be positive for an image to be virtual and erect and negative when image is real and inverted.

Magnification = height of image / height of object.

**Solution 13:**

Pole is the centre of the reflecting surface, in this case spherical mirror.

**Solution 14:**

Centre of curvature is the centre of the imaginary sphere to which the mirror belongs.

**Solution 15:**

Three characteristics of light are:-

- Light waves can travel through vacuum.
- Light waves are transverse waves.
- The velocity of light in vacuum is  $3 \times 10^8$  m/s.

**Solution 16:**

Three distinctions between light and sound waves are

- Light waves can travel through vacuum while sound waves cannot.
- Light waves are transverse waves while sound waves are longitudinal waves.
- The velocity of light in air is  $3 \times 10^8$  m/s while the speed of light in air is just about 330 m/s.

**Solution 17:**

- When position of object is at infinity, concave mirror forms a point and Real image at Focus point.
- When position of object is beyond C, concave mirror forms a Diminished, Real and inverted image between F and C.
- When position of object is at C, concave mirror forms a Magnified, Real and inverted image at C.

**Solution 18:**

Image formed by a convex mirror is always Diminished, Virtual and Erect.

**Solution 19:**

Concave mirrors are used in reflecting microscope, in shaving and make up glasses and in ophthalmoscope.

**Solution 20:**

- The distance from the pole in the direction of incident ray is taken positive.
- The distance from the pole in the direction opposite to the incident ray is taken negative.

**Solution 21:**

Mirror formula is the relation between the focal length  $f$  of the mirror, the distance  $u$  of the object from the pole of the mirror, and the distance  $v$  of the image from the pole.

Mirror formula is

$$1/v + 1/u = 1/f.$$

Linear magnification is defined as the ratio of the height of the image to the height of the object. It is taken to be positive for an image to be virtual and erect and negative when image is real and inverted.

Magnification = height of image / height of object.

**Solution 22:**

Mirror formula is the relation between the focal length  $f$  of the mirror, the distance  $u$  of the object from the pole of the mirror, and the distance  $v$  of the image from the pole.

Mirror formula is

$$1/v + 1/u = 1/f.$$

Size of body = 1.5 m.

Magnification of body = 1.5.

Magnification = height of image / height of object.

Height of image = magnification  $\times$  height of object.

Height of image =  $1.5 \times 1.5 = 2.25$  m.

**Solution 23:**

Linear magnification is defined as the ratio of the height of the image to the height of the object. It is taken to be positive for an image to be virtual and erect and negative when image is real and inverted.

Magnification produced by concave mirror is:

Magnification = height of image / height of object.

It is a pure ratio and does not have any units.

**Solution 24:**

Real image	Virtual image
It is formed when two or more reflected rays intersect each other at a point in front of the mirror,	It is formed when two or more reflected rays appear to intersect at a point behind the mirror.
It is inverted	It is erect with respect to object.
It can be obtained on screen.	It can't be obtained on screen.

**Solution 25:**

A smooth and polished surface causes regular reflection while a rough and unpolished surface causes irregular reflection.

**Solution 26:**

When rays of light fall on a surface, they are turned back into the same medium in accordance with some definite laws. This process is known as reflection.

Reflection obeys following two laws

- The incident ray, the reflected ray, and the normal at the point of incidence, all lie in the same plane.
- The angle of incidence and the angle of reflection are always equal.

**Solution 27:**

You can distinguish between plane mirror, a concave mirror, and a convex mirror without touching them. When you look into these mirrors by bringing your face close to each mirror, they will produce an image of your face of different types.

- A plane mirror will produce an image of the same size as your face.
- A concave mirror will produce a magnified image of your face.
- A convex mirror will produce Diminished image of your face.

**Solution 28:**

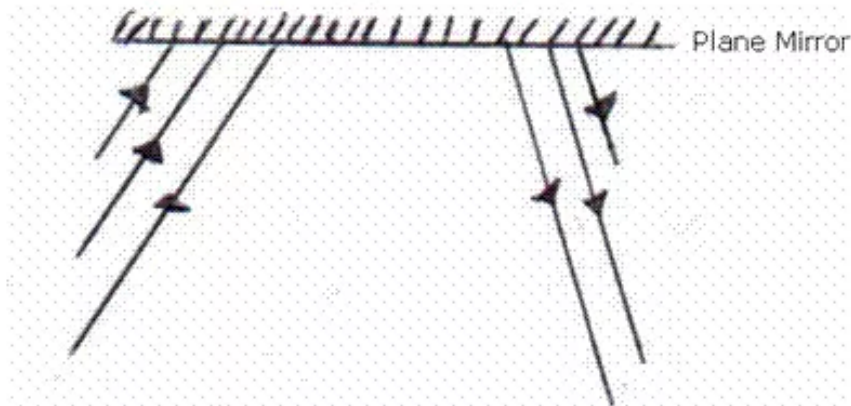
You can distinguish between a concave mirror and a convex mirror without touching them. When you look into these mirrors by bringing your face close to each mirror, they will produce an image of your face of different types.

- A concave mirror will produce a magnified image of your face.
- A convex mirror will produce Diminished image of your face.

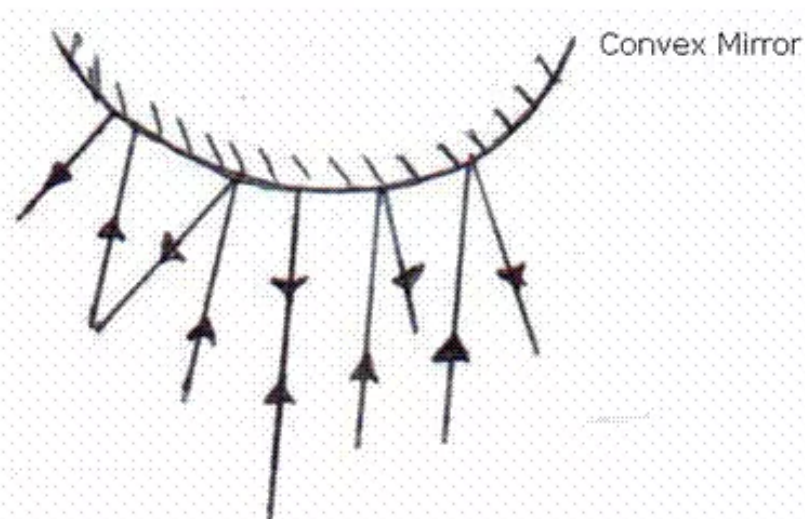
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**Solution 29:**

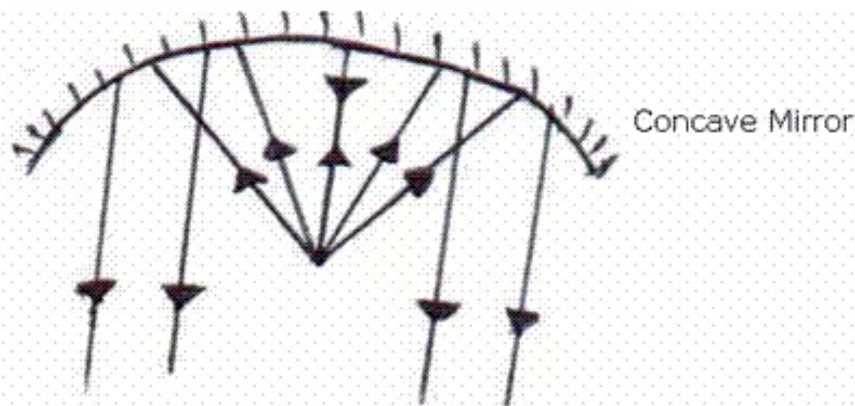
(i) PLANE MIRROR



(ii) CONVEX MIRROR



(iii) CONCAVE MIRROR



### Solution 30:

Uses of concave mirror:

- Concave mirrors are used in reflecting microscope
- Concave mirrors are used in shaving and make up glasses.

Uses of convex mirror: Convex mirrors are used as a rear view mirror in automobiles as it provides a wider view of following traffic.

### Solution 31:

We can see the reflection of our face on a polished table top because a regular reflection occurs in case of a polished surface while on a unpolished table top irregular reflection occurs which make image of our face unclear.

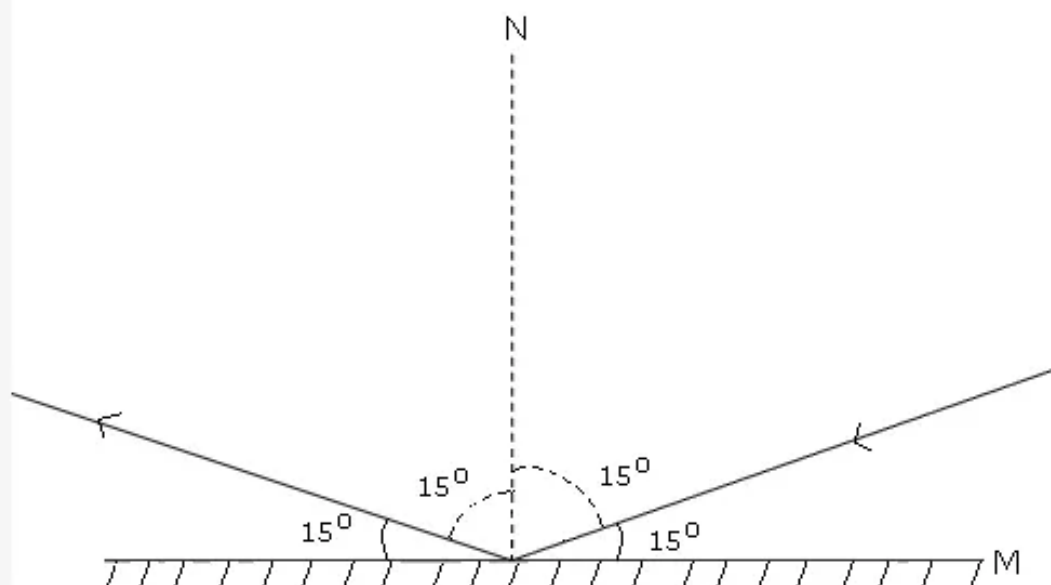
### Solution 32:

- The angle of incidence is the angle made by the incident ray with the plane mirror. **{FALSE}**  
Correct statement is the angle of incidence is the angle made by the incident ray with the normal to the surface of plane mirror.
- If a ray of light incident on a plane mirror is such that it makes an angle of  $30^\circ$  with the normal, then the angle of reflection is  $60^\circ$ . **{FALSE}**  
Correct statement is if a ray of light incident on a plane mirror is such that it makes an angle of  $30^\circ$  with the normal, then the angle of reflection is  $30^\circ$ .
- If the incident ray makes an angle of  $X^\circ$  with the normal, then the angle between the incident ray and reflected ray is  $2X^\circ$ . **{TRUE}**
- The image formed in a plane mirror is real, erect and same size as that of the object. **{FALSE}**  
Correct statement is the image formed in a plane mirror is virtual, erect and same size as that of the object.

### Solution 33:

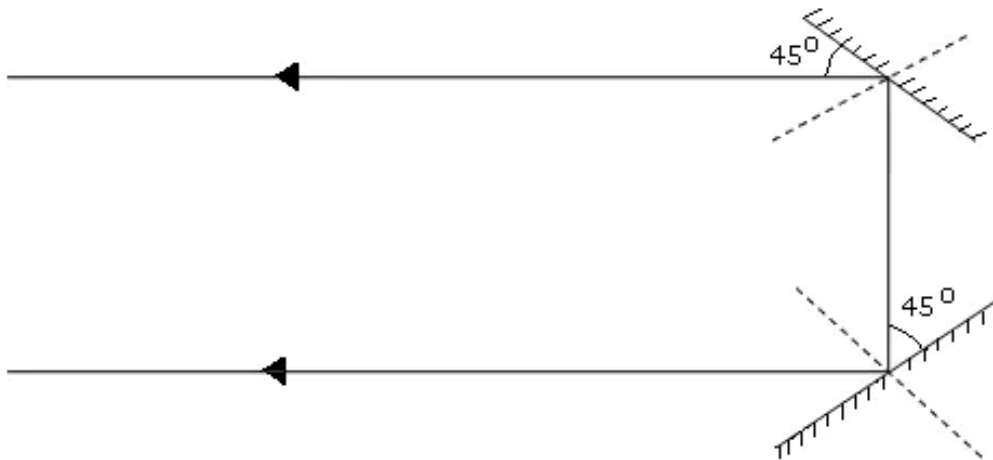
Reflection obeys following two laws

- a. The incident ray, the reflected ray, and the normal at the point of incidence, all lie in the same plane.
- b. The angle of incidence and the angle of reflection are always equal.  
According to these two laws this ray will deviate like this:



**Solution 34:**

Two planes when put in this way then they will turn the incident ray by  $180^\circ$ .

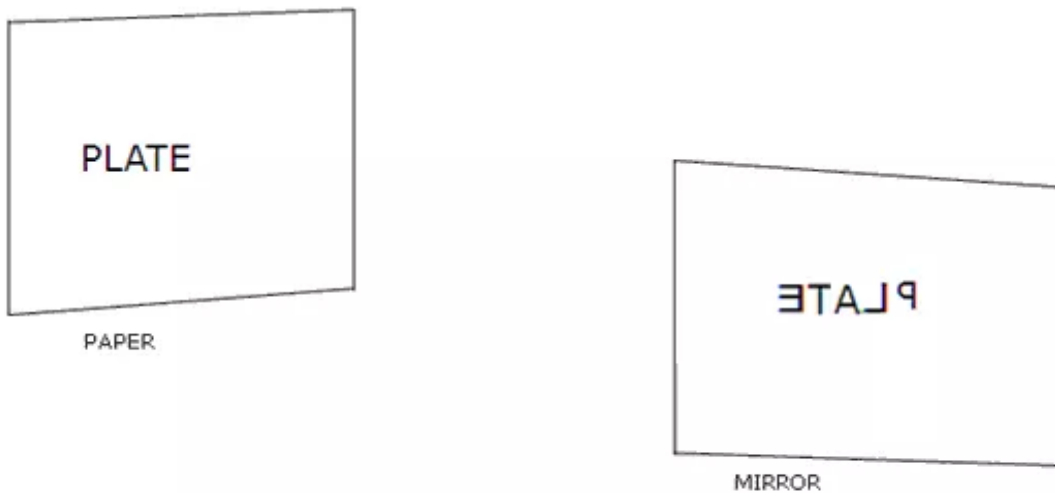


**Solution 35:**

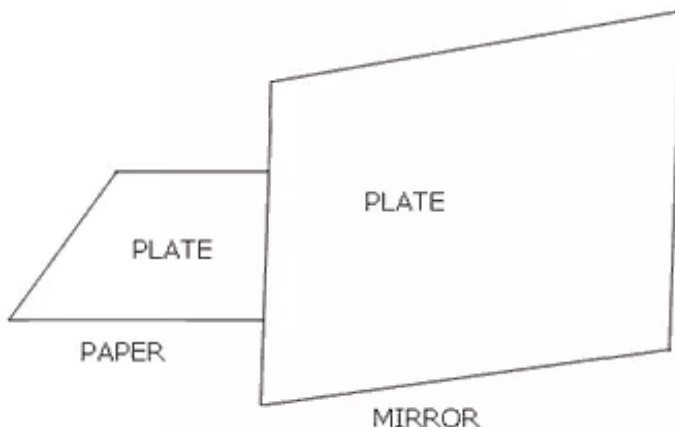
The image formed by a plane mirror is erect and virtual. It is a laterally inverted image. The image formed is of the same size as that of the object. Also, the image and the object are equidistant from the mirror.

**Solution 36:**

(i) When the paper is held parallel to the mirror.



(ii) When the Paper is held perpendicular to the mirror.



**Solution 37:**

Given, distance of boy from the mirror = 3 m

- Distance of image from mirror = distance of boy from the mirror = 3 m  
Distance between boy and his image = distance of boy from the mirror + distance of image from mirror =  $3+3 = 6$  m
- Now, distance of boy from the mirror = 4 m  
Distance of image from mirror = 4 m  
Distance between boy and his image = distance of boy from the mirror + distance of image from mirror =  $4+4 = 8$ m.

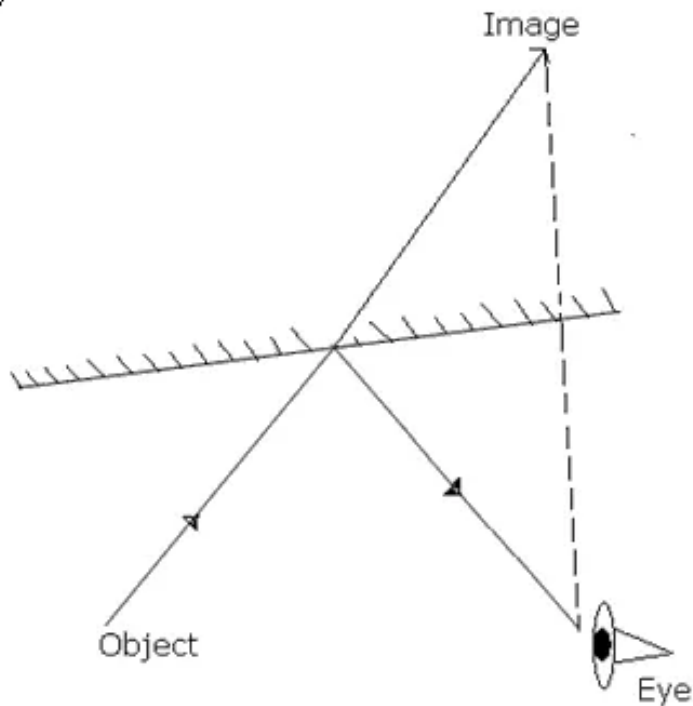
**Solution 38:**

Periscope is used to see over the top of an obstacle. It is also used in submarines for observing for movement of ships. It can be used from the trenches for observing the movement on the surface of earth.

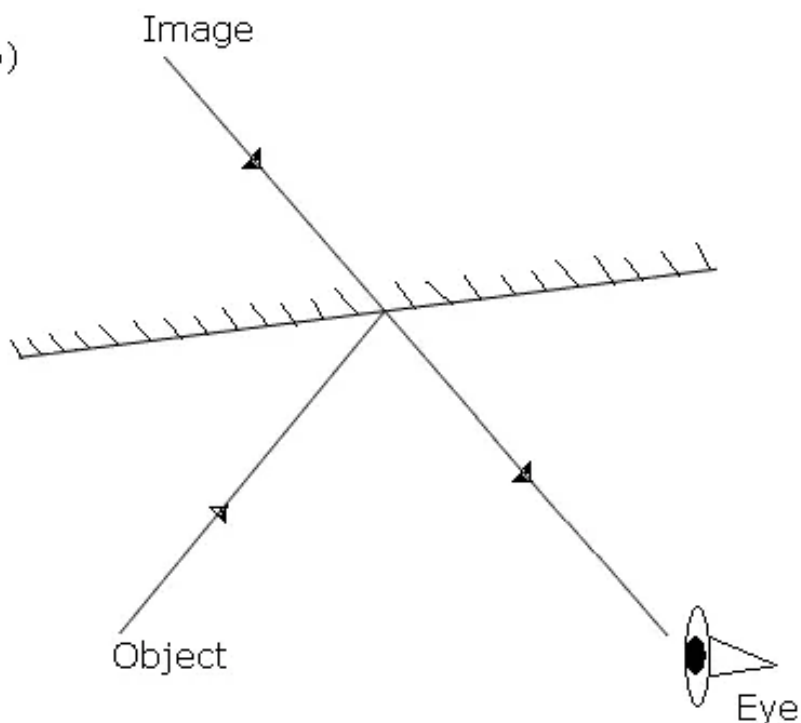
**Solution 39:**

The image observed by the eye after reflection from a plane mirror can be completed as follows:

(a)



(b)



**Solution 40:**

- Pole is the centre of the reflecting surface, in this case spherical mirror.
- Centre of curvature is the centre of the imaginary sphere to which the mirror belongs
- Principal focus of a spherical mirror is a point on the principal axis of the mirror, where all the rays travelling parallel to the principal axis and close to it after



reflection from the mirror, converge to or appear to diverge from.

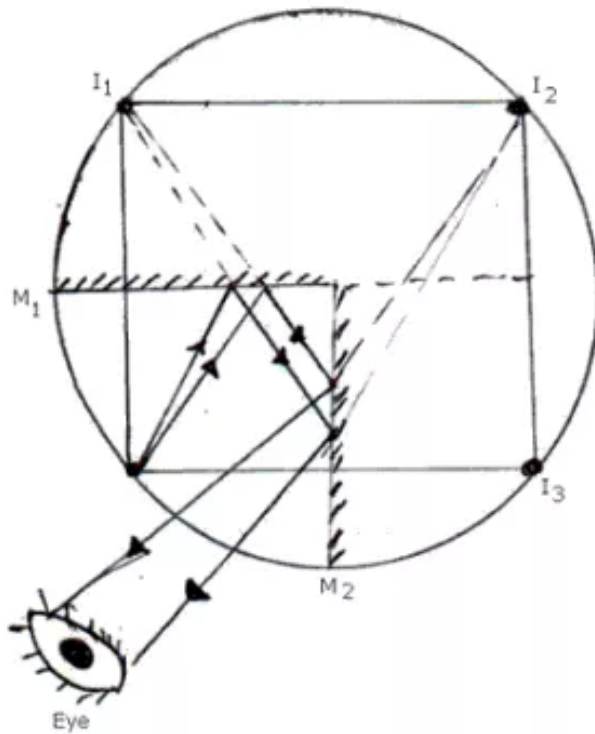
- Principal axis is the straight line passing through the pole and the centre of curvature.
- Focus of a concave mirror is a point on the principal axis of the mirror, where all the rays travelling parallel to the principal axis and close to it after reflection from the mirror converge to that point.
- Normal to the surface of a mirror at any point is the straight line at right angle to the tangent drawn at that point.

### Solution 41:

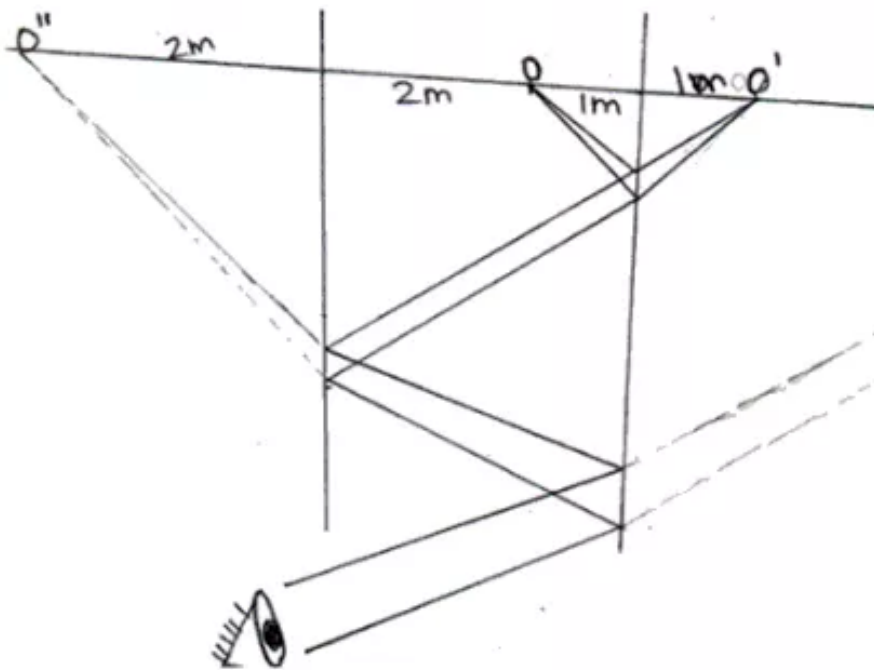
(i) When two mirrors are held perpendicular then number of images is 3 according to rule

Number of images =  $360/X - 1$  if  $360/X$  is even

Number of images is  $360/90 - 1 = 4 - 1 = 3$  images.



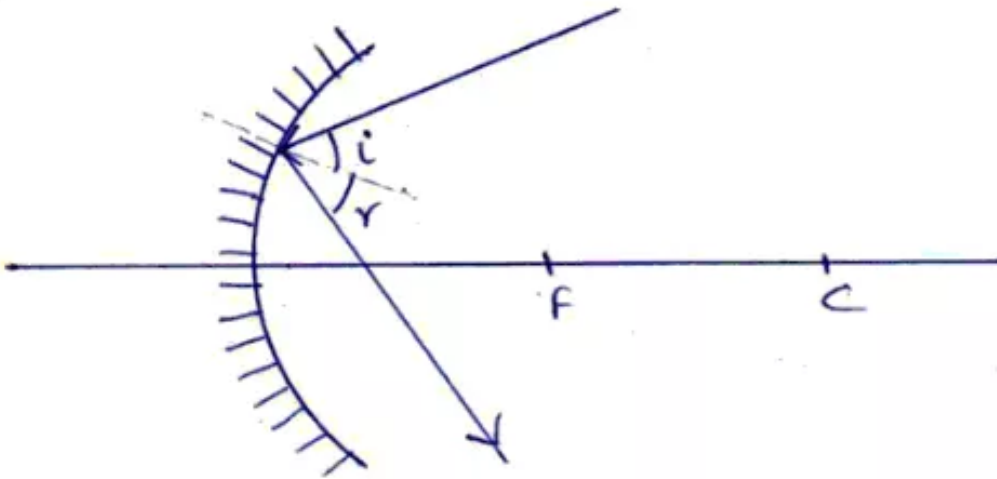
(ii) When two mirrors are held parallel to each other then, infinite numbers of image are formed and first two images are shown in this figure.



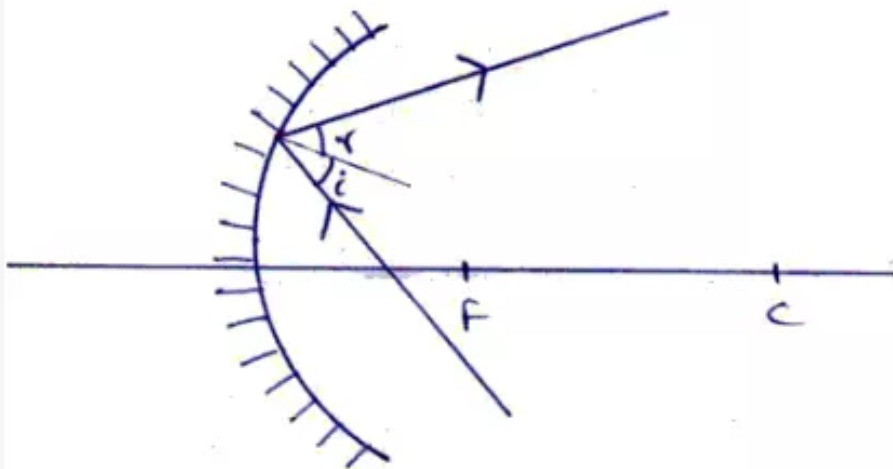
**Solution 42:**

Completed path of the incident ray in following cases are:

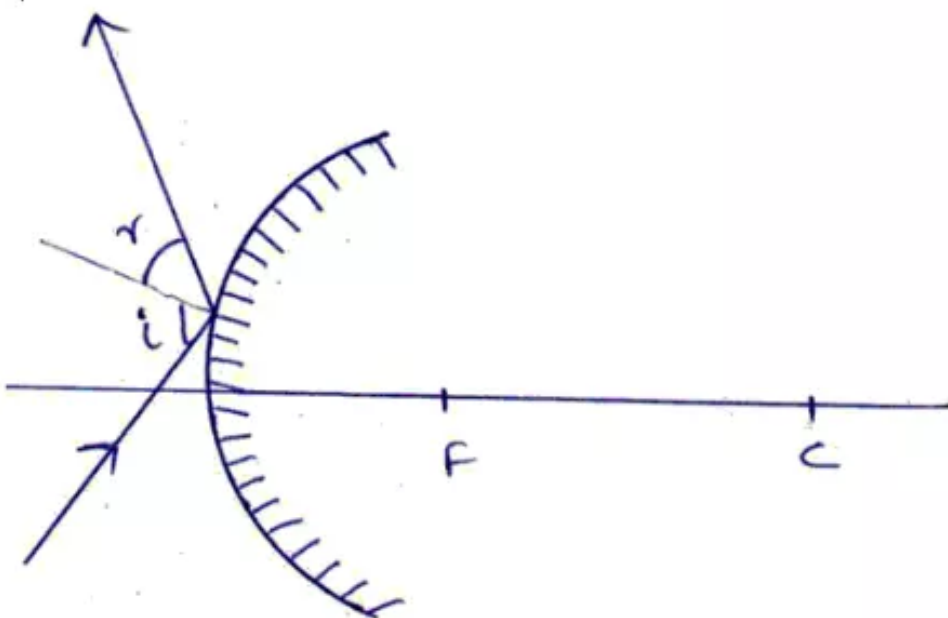
(i)



(ii)

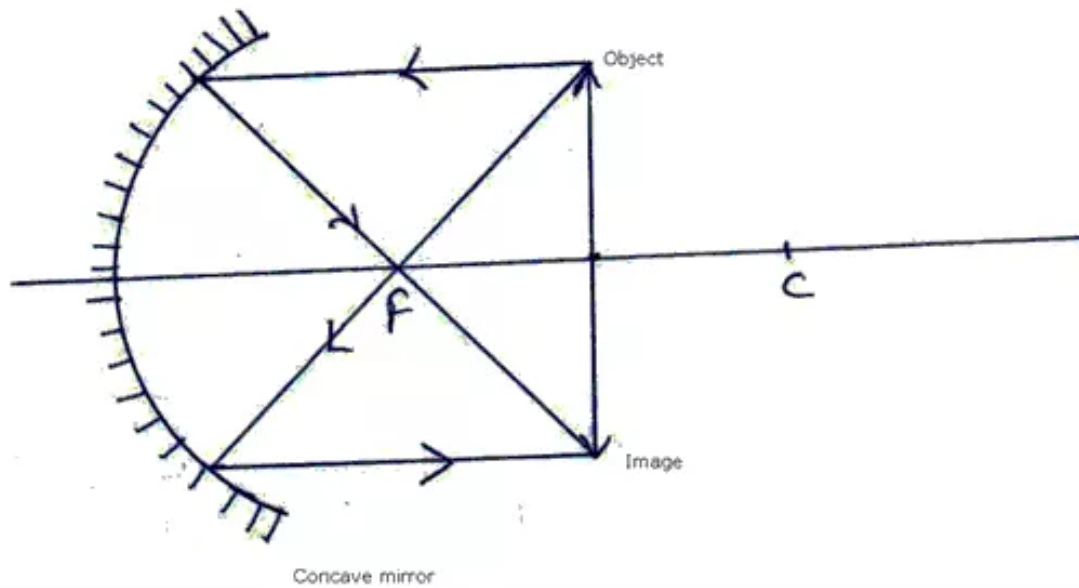


(iii)



**Solution 43:**

Position of image is exactly below the position of object as in this figure.



**Solution 44:**

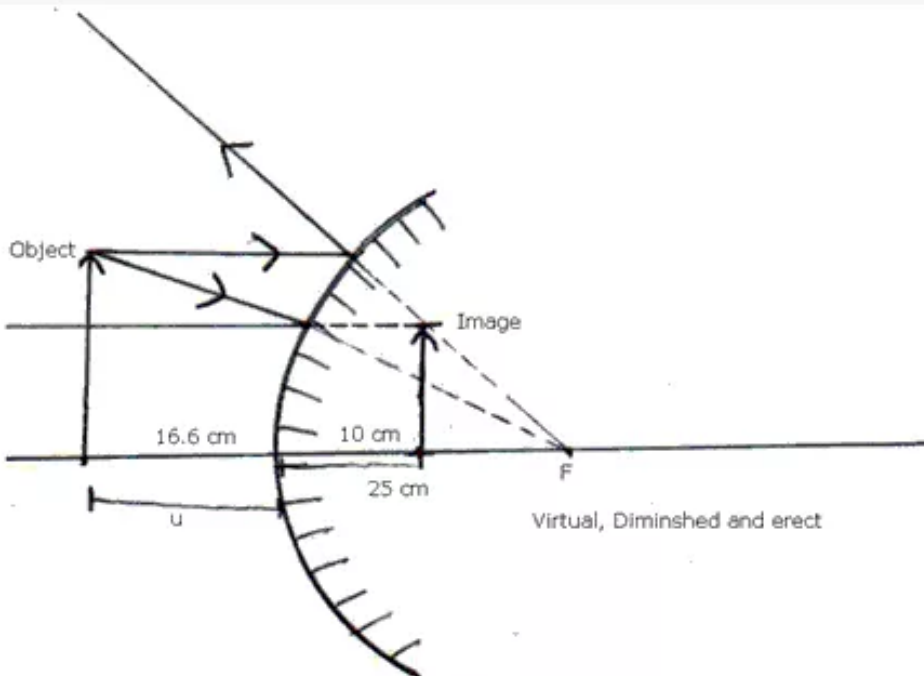
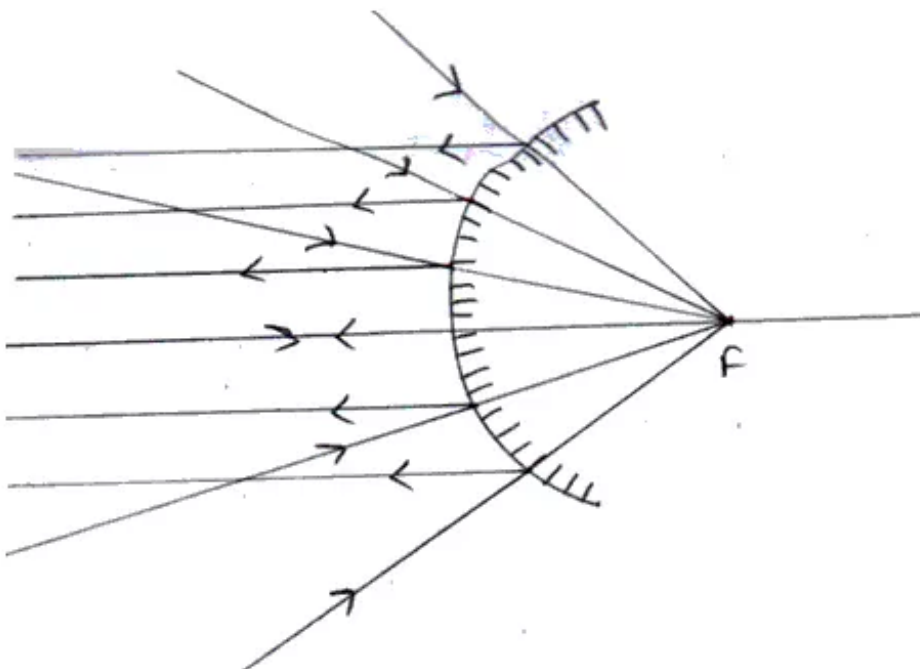


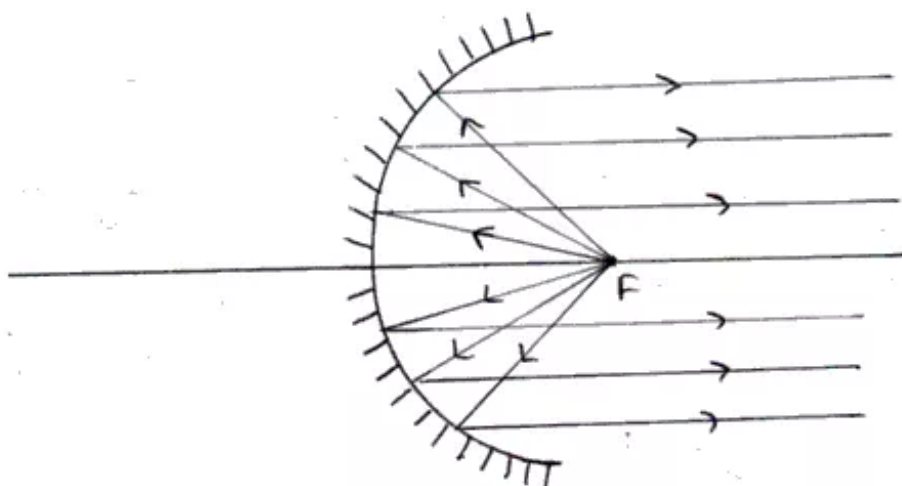
Image formed is virtual, Diminished and erect.

**Solution 45:**

(i) In case of convex mirror all rays incident parallel to principal axis appear to diverge from a Focal point. So it has a wider field of view as it converge all rays to a single point.



(ii) In case of concave mirror if object is placed at Focal point then ray emerging from it after reflecting from mirror would be parallel to principal axis.



**Solution 46:**

(i) Focal length = 25 cm.

Object distance = 20 cm.

Height of object = 10 cm.

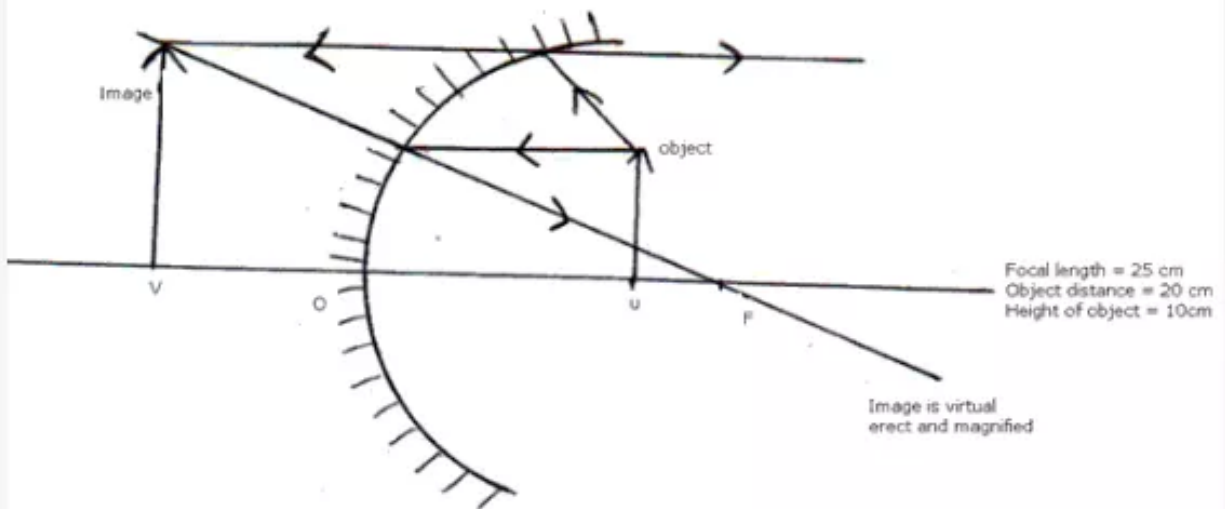


Image is VIRTUAL, ERECT and MAGNIFIED.

(ii) Focal length = 25 cm.

Object distance = 20 cm.

Height of object = 10 cm.

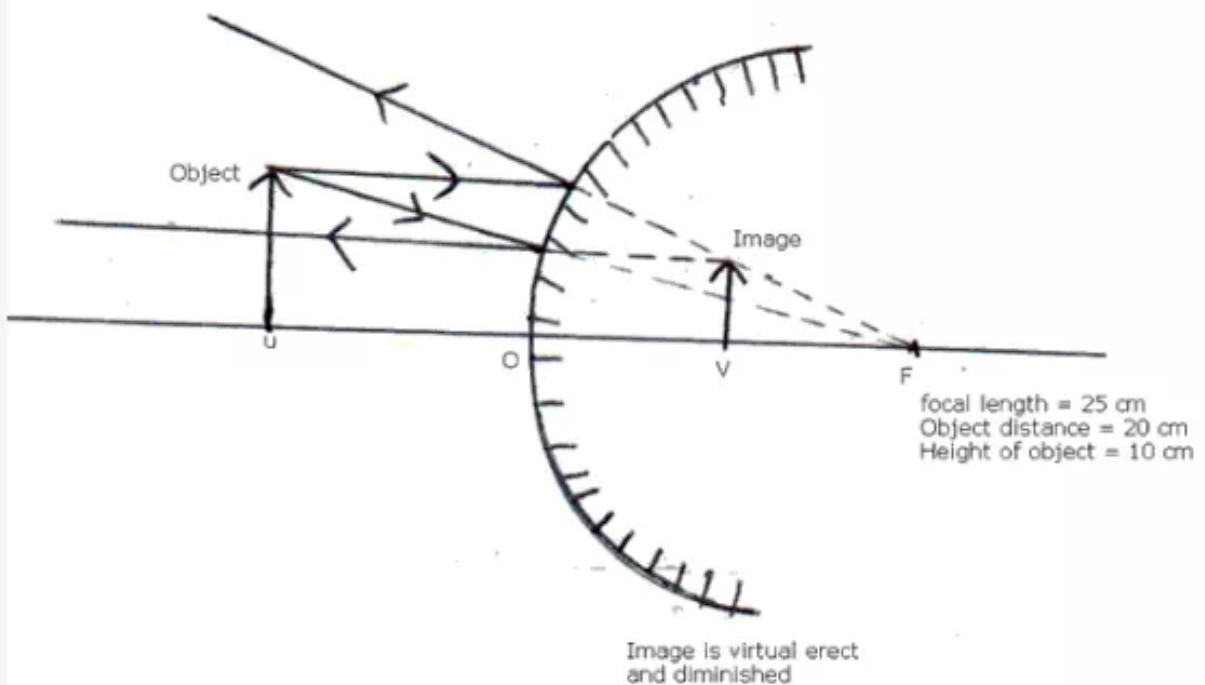


Image is VIRTUAL, ERECT and DIMINISHED.

**Solution 47:**

Focal length of concave mirror = 10 cm.

Object distance = 30 cm.

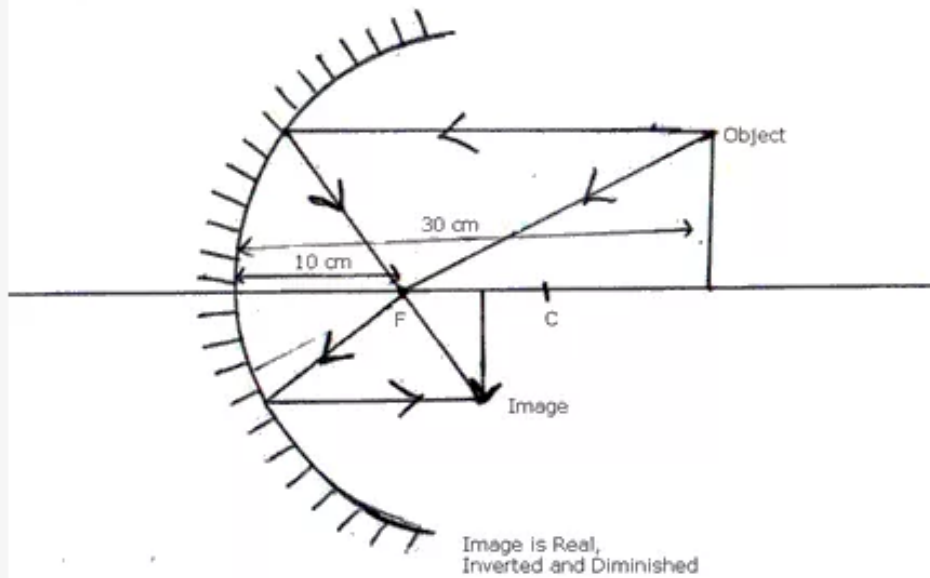


Image is real, inverted and diminished.

**Solution 48:**

Height of object = 5 cm.

Distance of object = 30 cm.

Focal length of mirror = 40 cm.

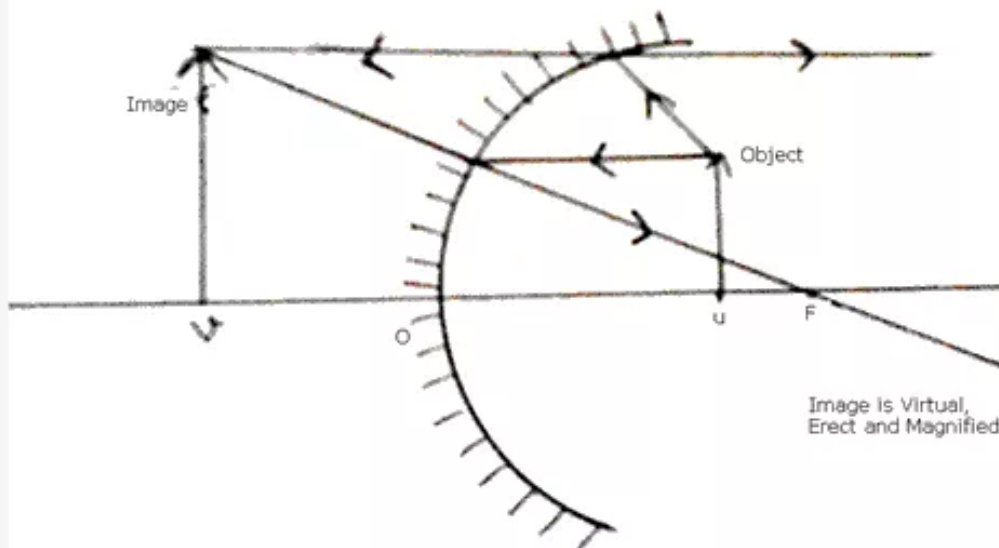
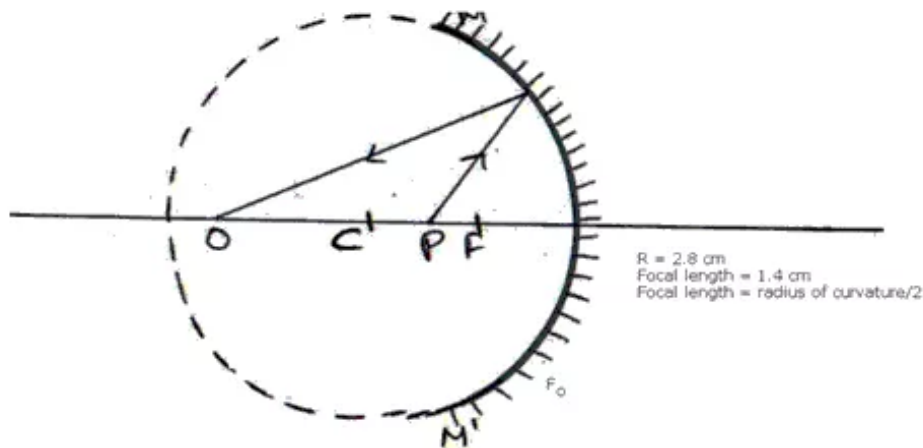


Image is virtual, erect and magnified.

### Solution 49:

- (i) Centre of curvature can be determined by constructing the imaginary sphere to which lens belongs.
- (ii) Value of radius of curvature can be found by measuring the radius of this imaginary sphere geometrically.
- (iii) Focal length is the midpoint of pole and centre of curvature.
- (iv) focal length of mirror = centre of curvature/2.

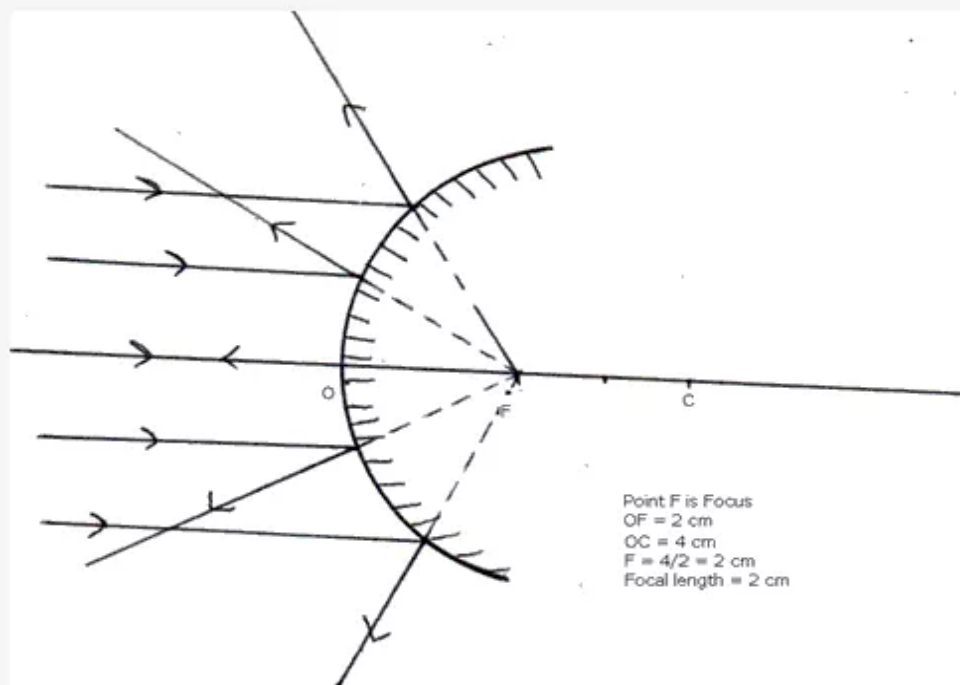


Centre of curvature = 2.8 cm.

Focal length of mirror = 1.4 cm.

Focal length = radius of curvature/2.

### Solution 50:



We know when incident ray is parallel to principal axis then they appear to diverge from a point F.

Geometrically we can find this value and this comes to 2 cm.

Centre of curvature = 4 cm.

Focal length = centre of curvature/2.