

**Selina Solutions For Class 9 Physics**  
**Chapter 7 – Reflection Of Light**

**Exercise-7(C)**

**What is a spherical mirror?**

**Solution:**

A spherical mirror is a reflecting surface that is part of a sphere.

**1. Name the two kinds of spherical mirrors and distinguish between them.**

**Solution:**

The two kinds of spherical mirrors depending upon whether the inner or outer surface of the sphere is silvered or spherical, are:

- Concave mirror
- Convex mirror

Concave mirror	Convex mirror
Bulging surface is silvered	Inner surface is silvered
Reflection takes place from the hollow surface	Reflection takes place from bulging surface

**2. Define the terms pole, principal axis and center of curvature with reference to a spherical mirror.**

**Solution:**

Pole – of a mirror is the geometric center of the spherical surface of the mirror

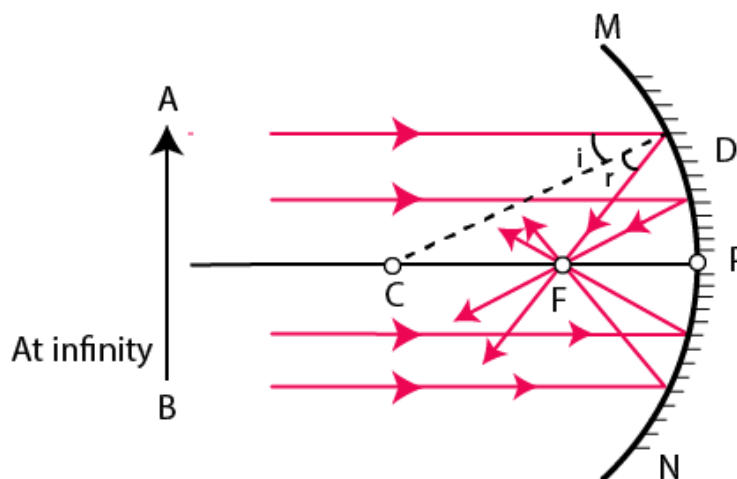
Principal axis – is the straight line that joins the pole of the mirror to its center of curvature

Centre of curvature – with reference to a spherical mirror is the center of the sphere of which the mirror is part of.

**3. Draw suitable diagrams to illustrate the action of (i) concave mirror, and (ii) convex mirror, on a beam of light incident parallel to the principal axis.**

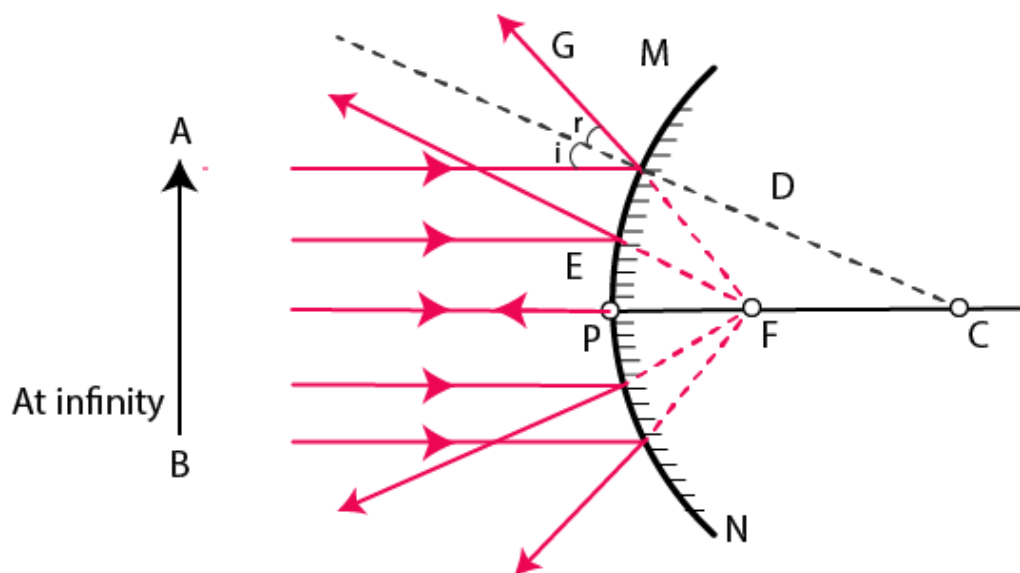
**Solution:**

- (i) Concave mirror



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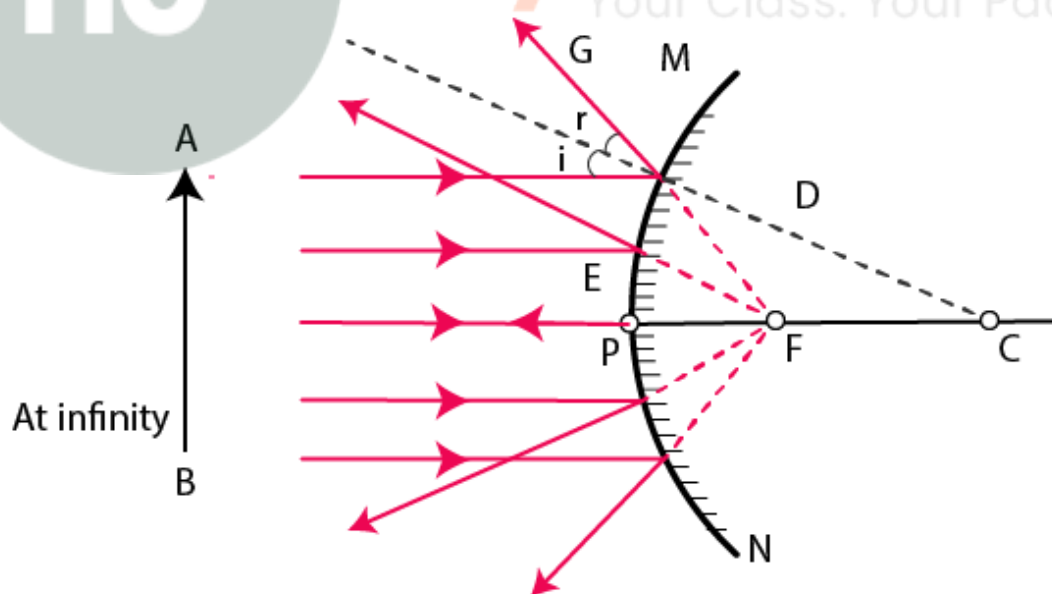
(ii) Convex mirror



4. Name the spherical mirror which (i) diverges (ii) converges the beam of light incident on it. Justify your answer by drawing a ray diagram in each case.

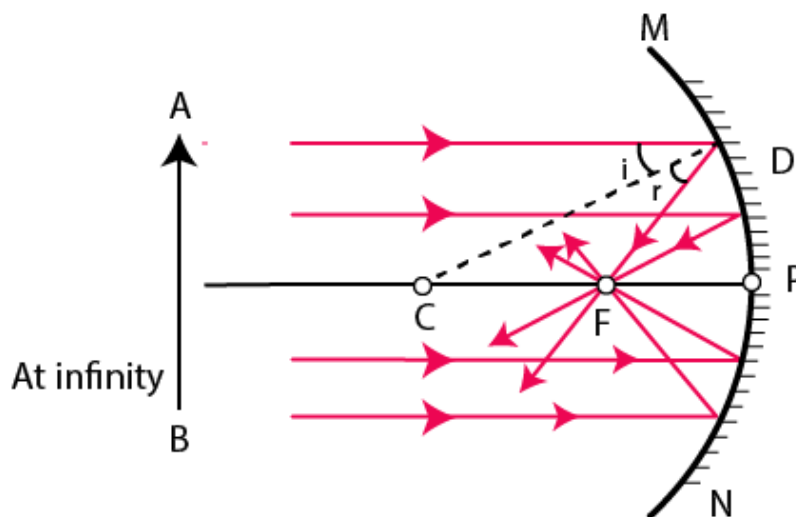
Solution:

(i) The spherical mirror which diverges a beam of light falling on it is the convex mirror



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- (ii) The spherical mirror that converges a beam of light incident on it is the concave mirror

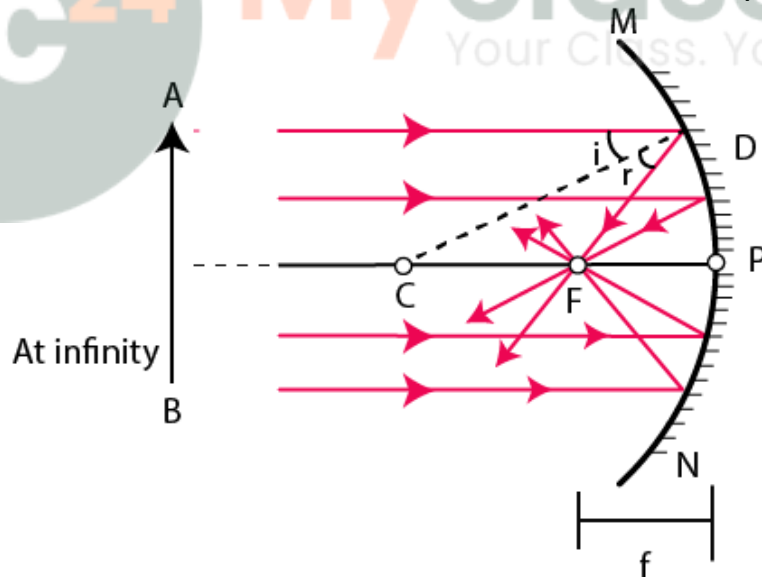


5. Define the terms focus and focal length of a concave mirror. Draw diagram to illustrate your answer.

**Solution:**

Focus of a concave mirror – it is a point on the principal axis through which the light rays that are incident parallel to the principal axis, pass once the light is reflected from the mirror

Focal length of a concave mirror – it is the distance of the focus from the pole of the concave mirror



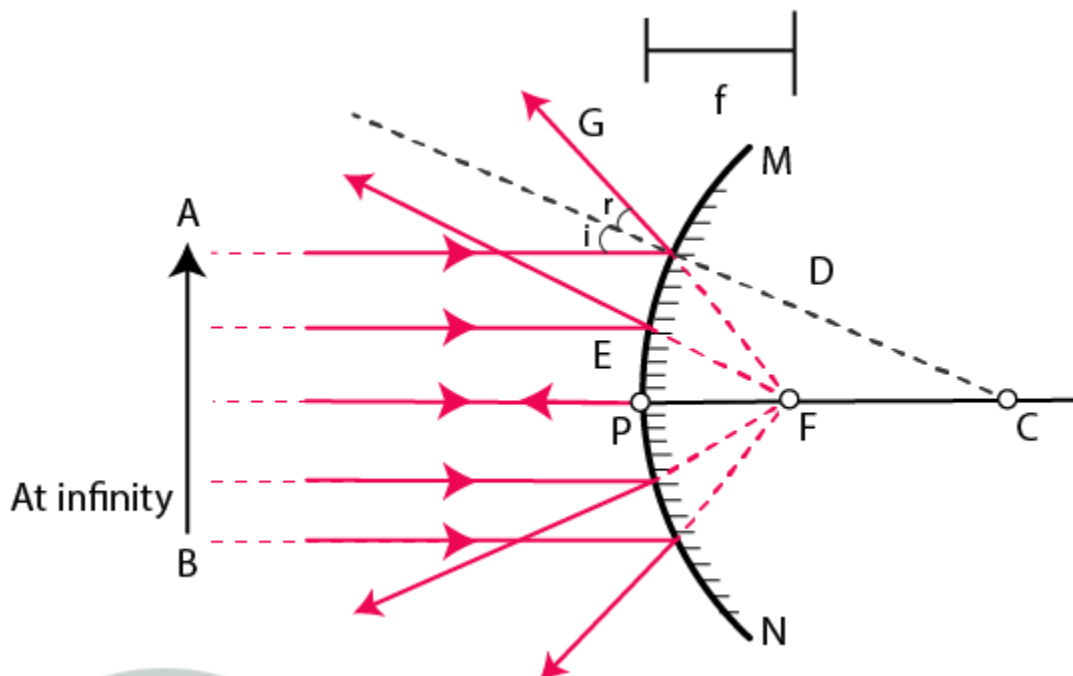
6. Explain the meaning of the terms focus and focal length in case of a convex mirror, with the help of a suitable ray diagram.

**Solution:**

Focus of a convex mirror – it is a point on the principal axis from where the light rays that are incident, parallel to the principal axis, appear to arrive after reflection from the mirror

Focal length of a convex mirror – it is the distance of the focus from the pole of the convex mirror

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7. State the direction of incident ray which after reflection from a spherical mirror retraces its path. Give reason to your answer.

**Solution:**

The incident ray is directed towards the centre of curvature.

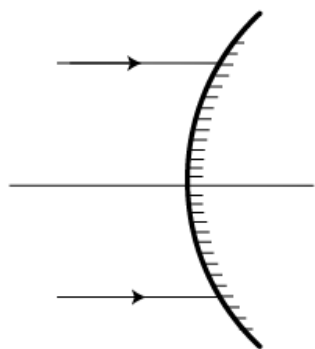
It is because the ray is normal to the spherical mirror,

Hence  $\angle i = 0$ , i.e., the angle of incidence is 0

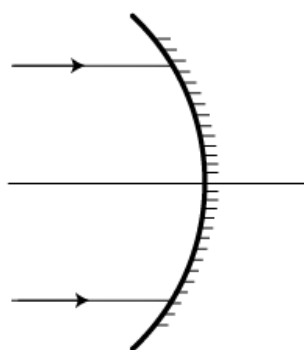
Therefore, the angle of reflection  $\angle r = 0$

8. (i) Name the mirrors shown in figure (a) and (b).

(ii) In each case (a) and (b), draw the reflected rays for the given incident rays and mark focus by the symbol F.



(a)



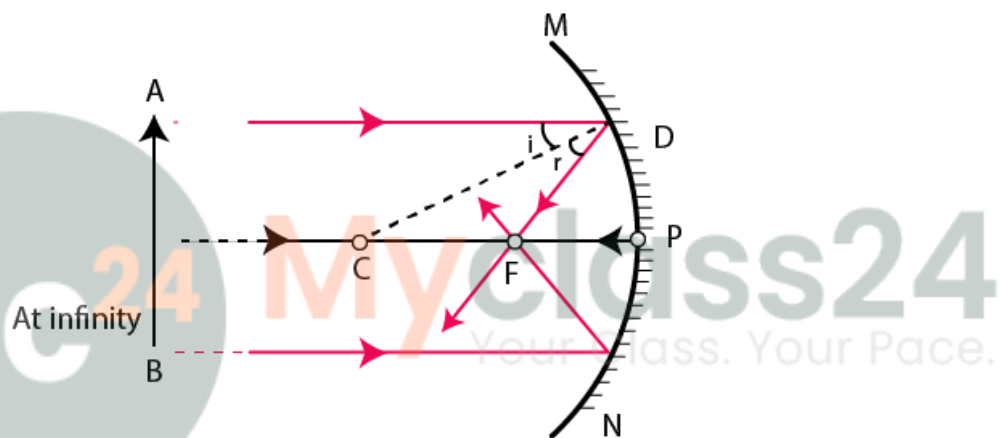
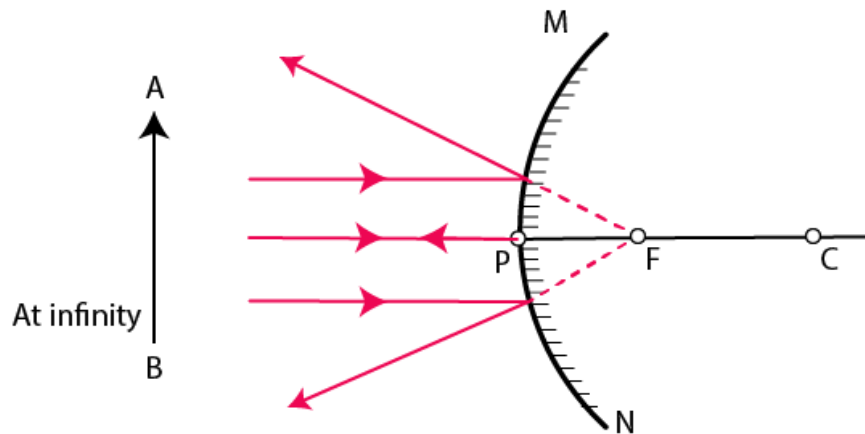
(b)

**Solution:**

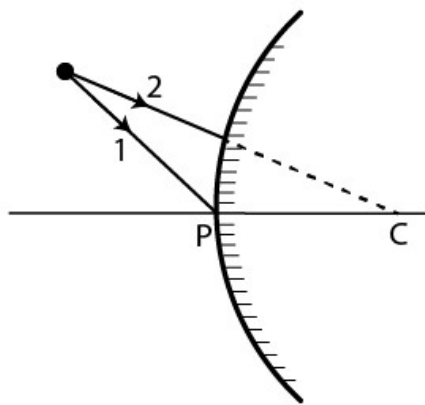
(i) Figure (a) shows a convex mirror

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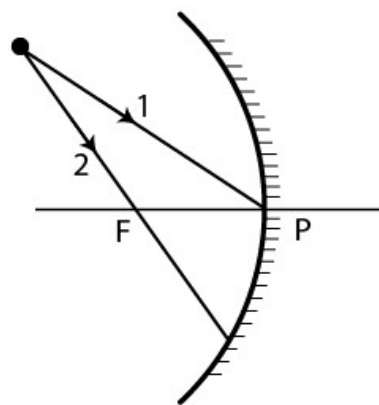
- (ii) Figure (b) shows a concave mirror  
The diagram is as shown:



9. Complete the following diagrams in figure by drawing the reflected rays for the incident rays 1 and 2.



(a)

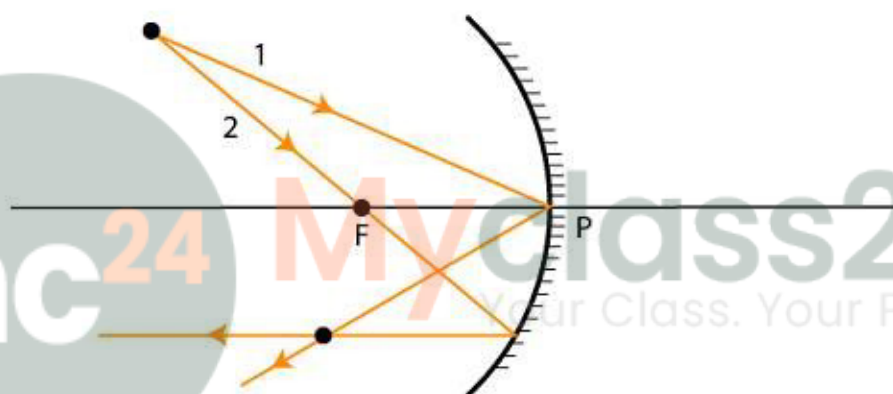
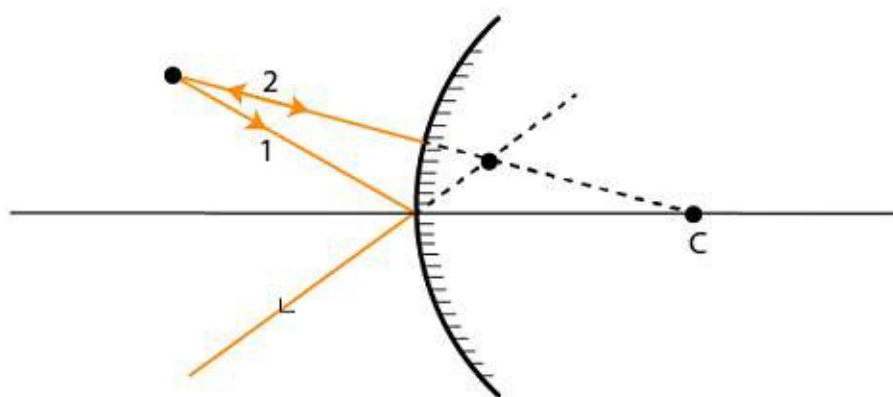


(b)

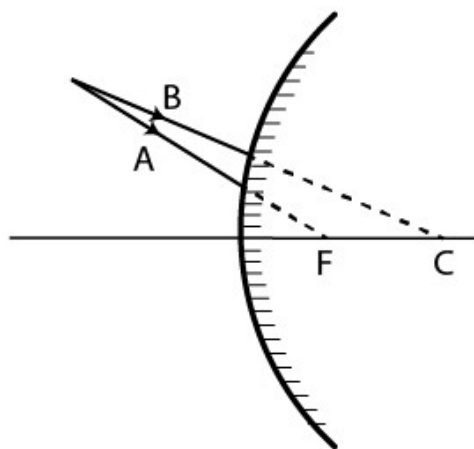
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Solution:

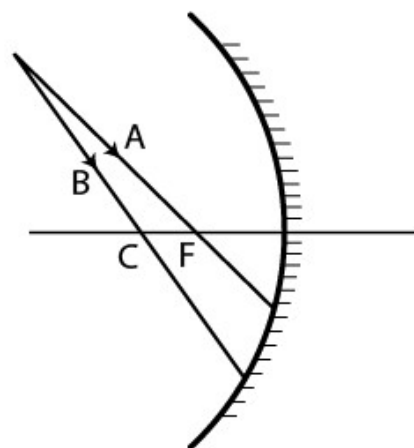
The diagrams are as shown below:



10. Complete the following diagrams shown in figure by drawing the reflected ray for each of the incident ray A and B.



(a)

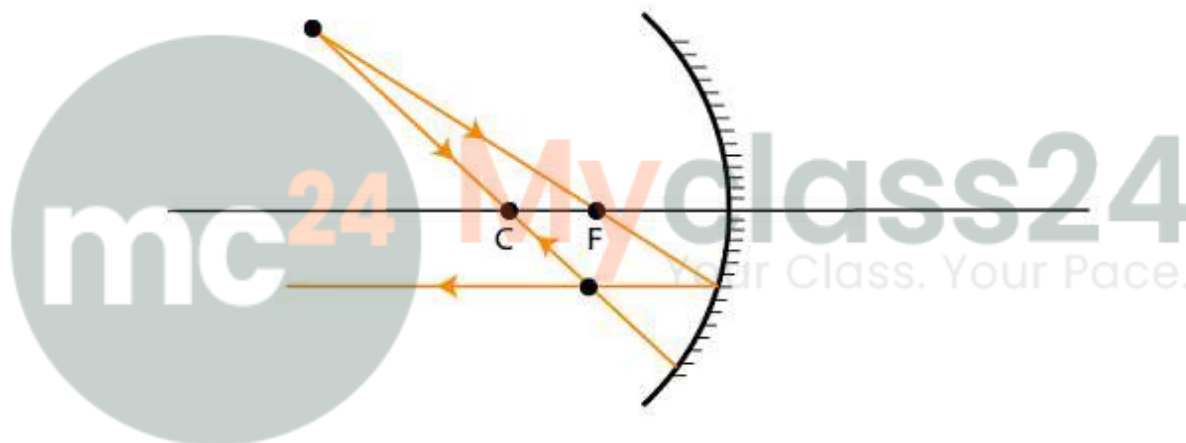
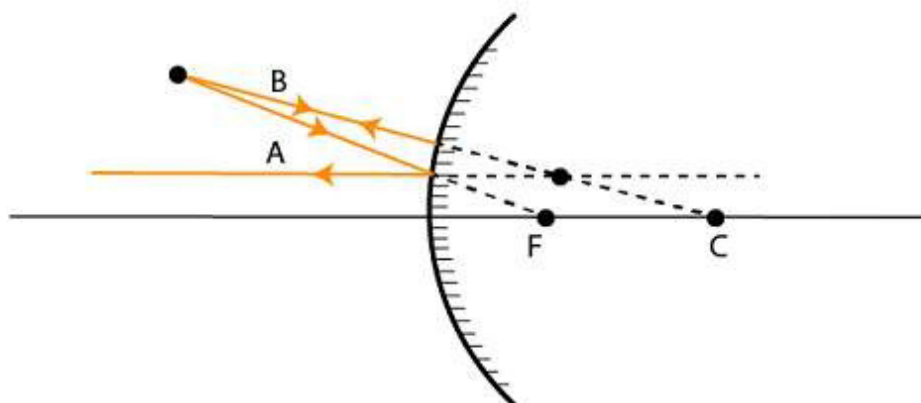


(b)

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**Solution:**

The diagram is as shown



**11. State the two consecutive rays that are chosen to construct the image by a spherical mirror for a given object? Explain your answer with the help of suitable ray diagrams.**

**Solution:**

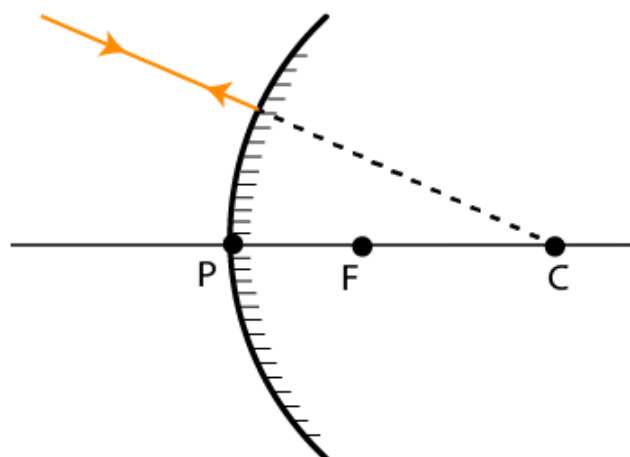
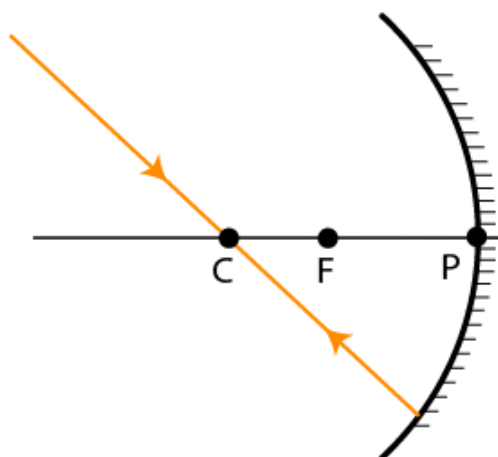
The two convenient rays, chosen to construct the image by a spherical mirror are as follows:

- A ray that passes through the center of curvature

A ray passing through (for concave mirror) or directed towards (for convex mirror) the center of curvature of a spherical mirror is reflected back along its own path.

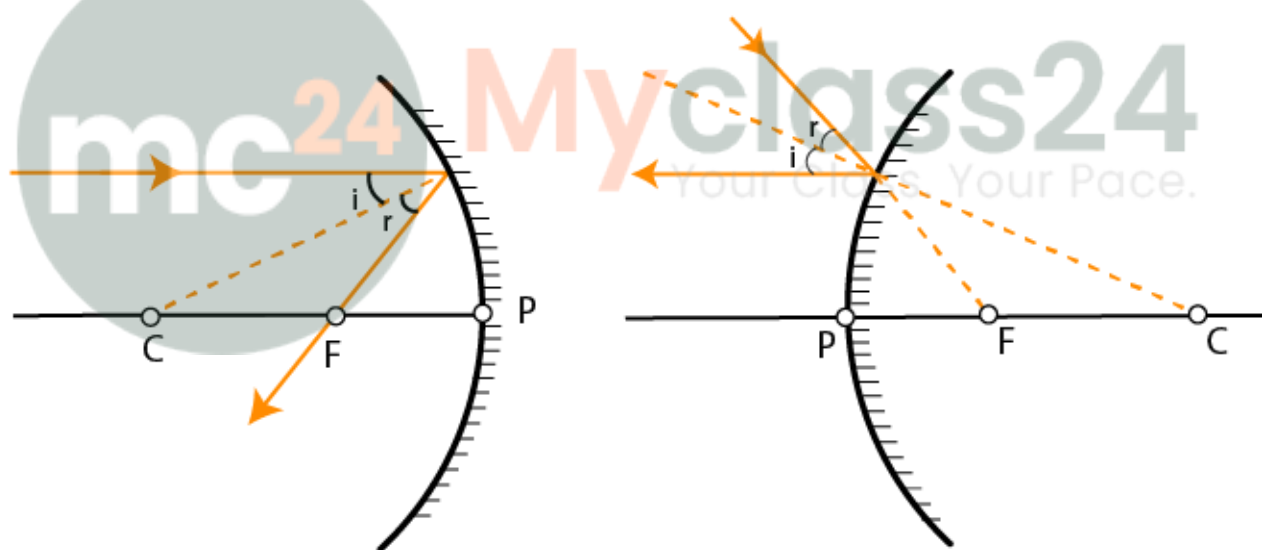
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- A ray that is parallel to the principal axis

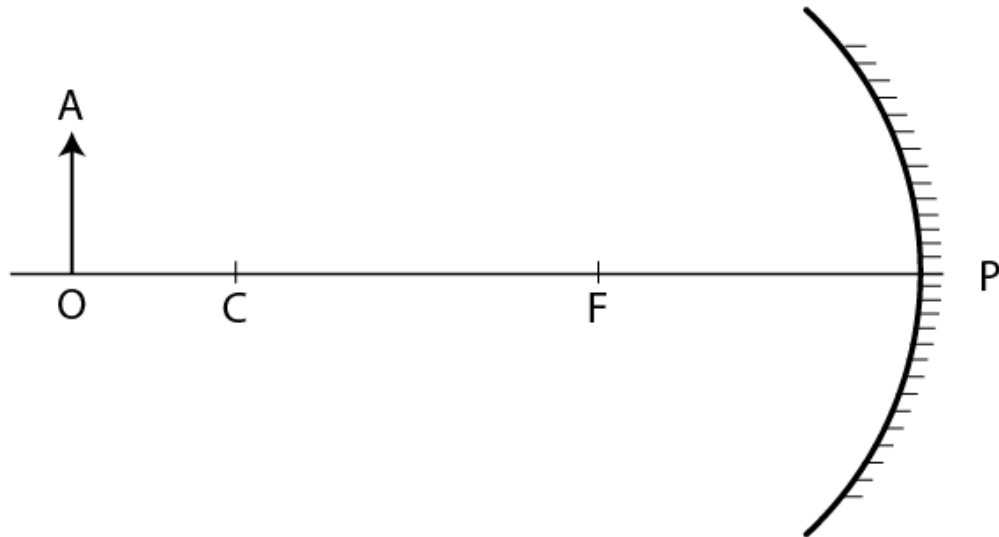
A ray incident parallel to the principal axis, once it is reflected from a spherical mirror, either passes (concave mirror) or appears to be coming (convex mirror) from the focus.



12. Figure shows a concave mirror with its pole at P, focus F and center of curvature C. Draw ray diagram to show the formation of image of an object OA.

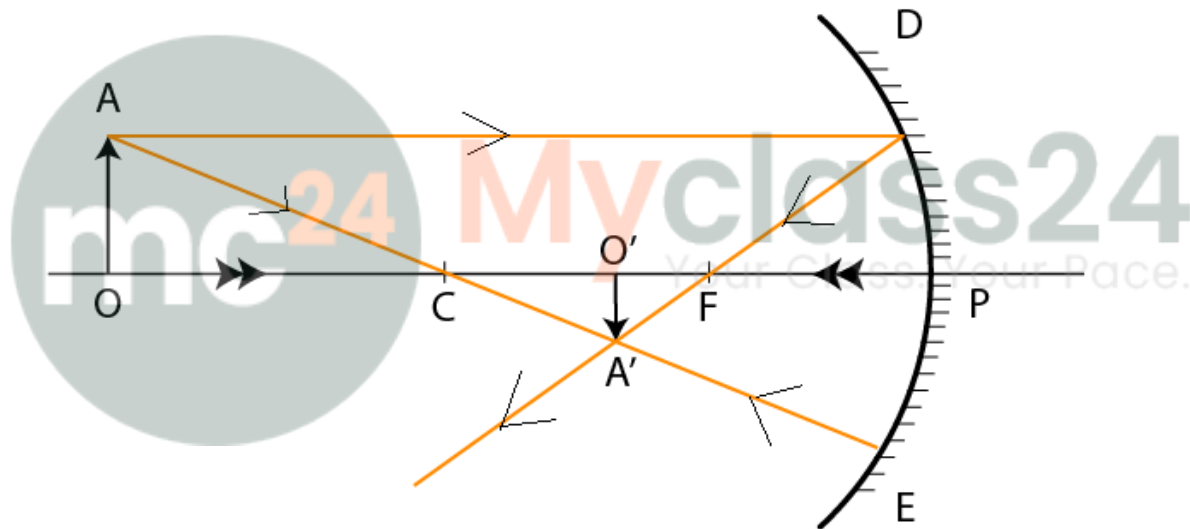
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**Solution:**

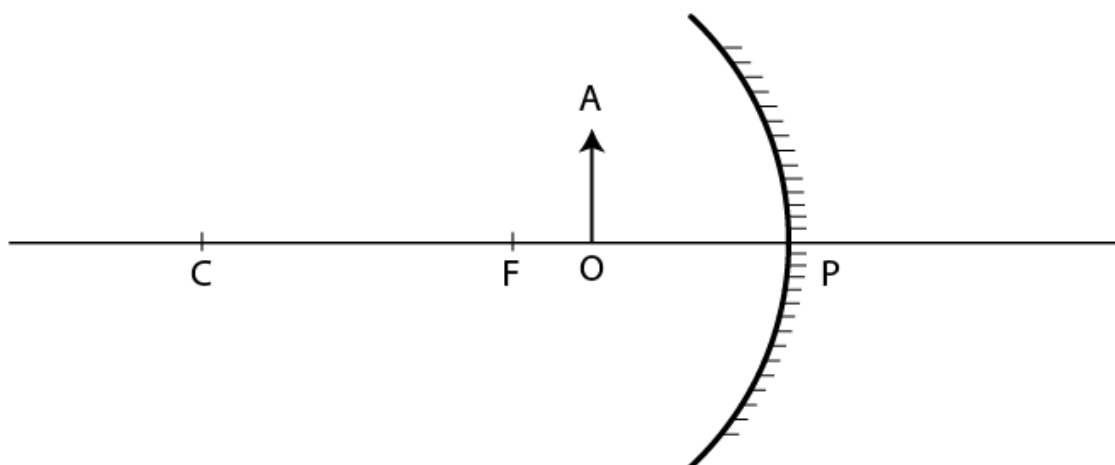
The required diagram is as shown:



13. Figure shows a concave mirror with its pole at P, focus F and center of curvature C. Draw ray diagram to show the formation of image of an object OA.

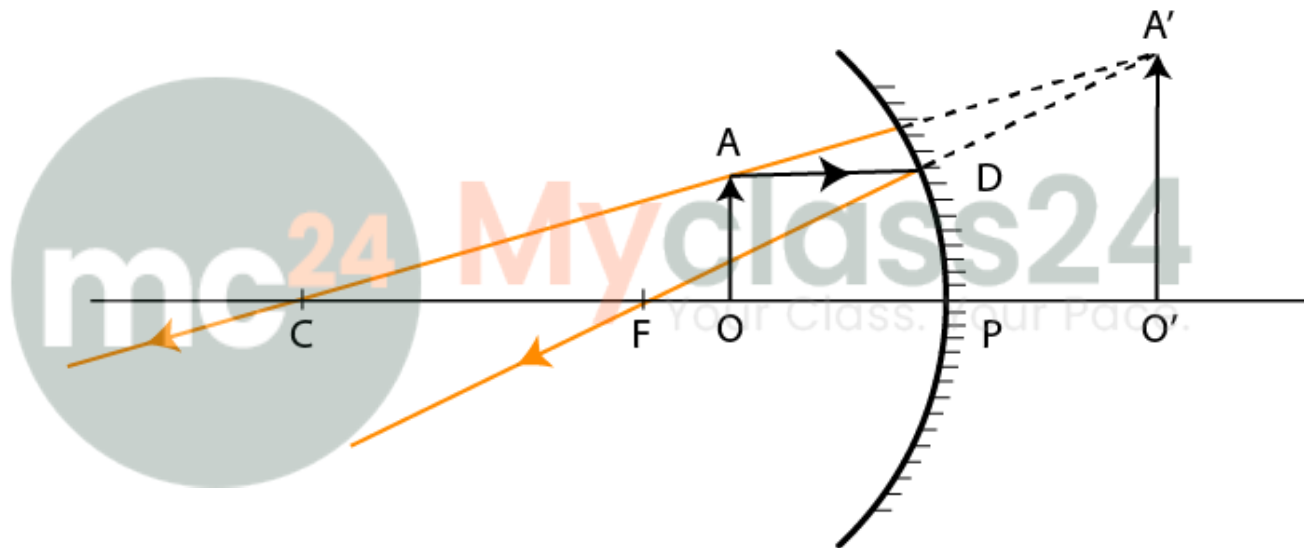
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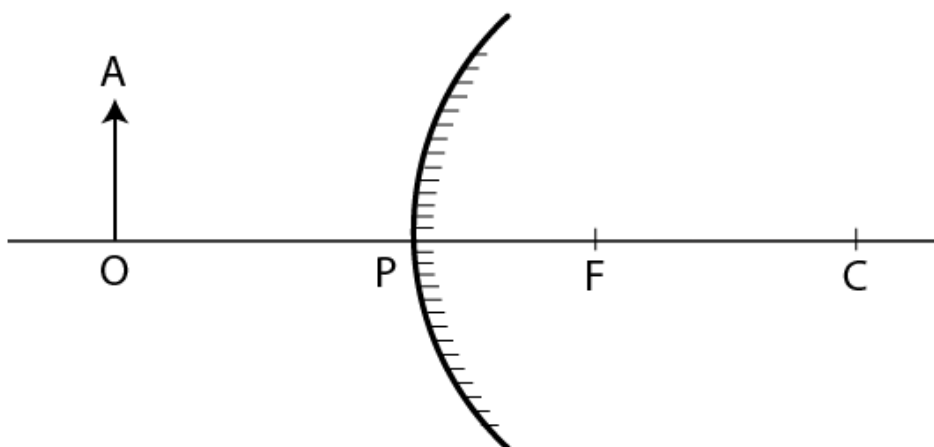
**Solution:**

The figure is as shown below:



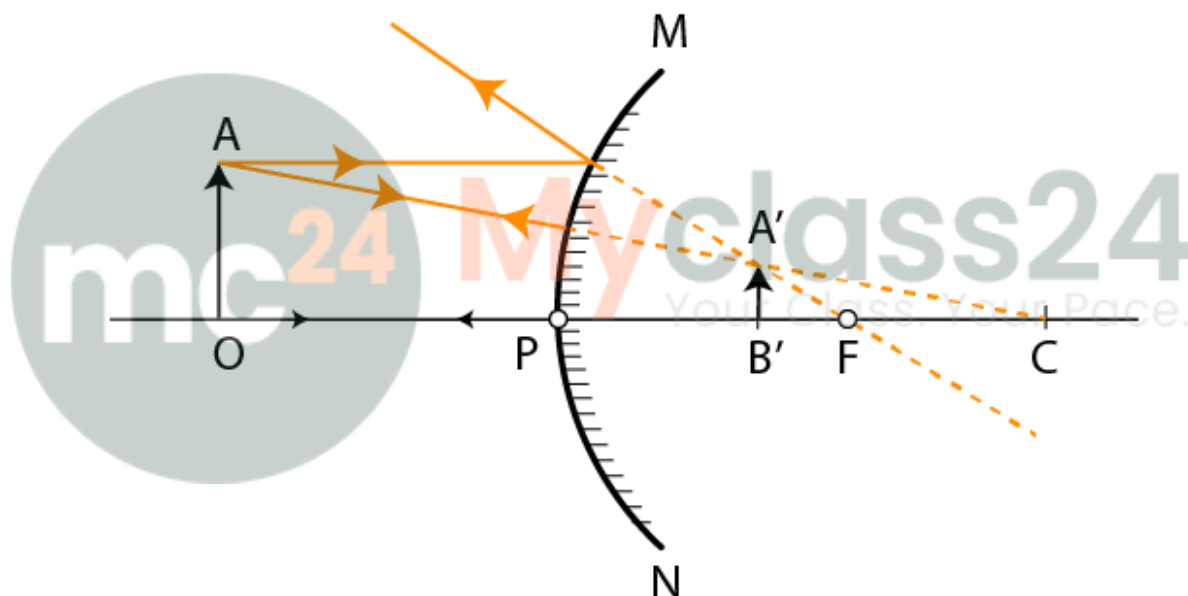
14. The diagram below in figure shows a convex mirror. C is its center of curvature and F is its focus. (i) Draw two rays from A and hence locate the position of image of object OA. Label the image IB.(ii) State three characteristics of the image.

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**Solution:**

(i) The diagram is as shown:



(ii) The three characteristics of the image are:

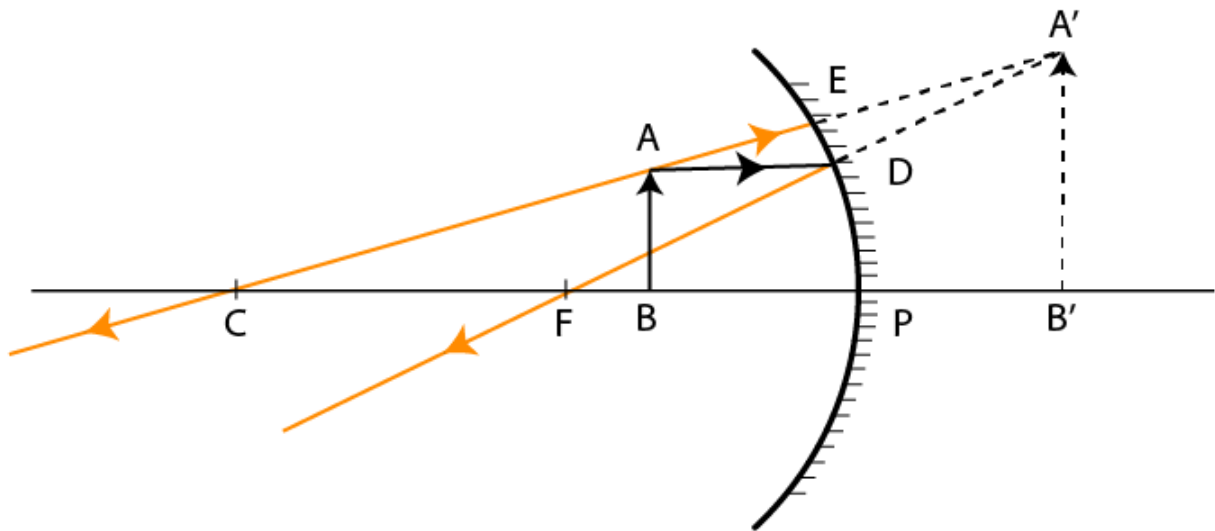
- Erect
- Virtual
- Diminished

**15. Draw a ray diagram to show the formation of image by a concave mirror for an object placed between its pole and focus. State three characteristics of the image.**

**Solution:**

The following ray diagram shows the formation of image by a concave mirror for an object placed between its pole and focus.

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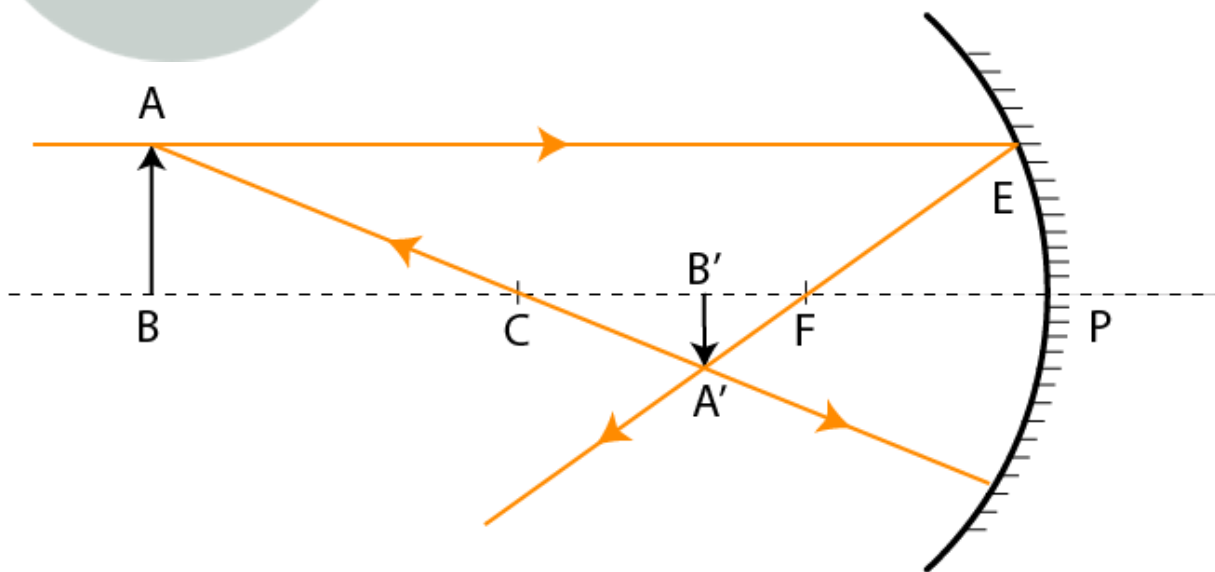
The image is formed behind the mirror when an object is placed between the focus F and the pole P. The three characteristics of the image are as follows:

- The images are virtual
- The images are upright
- The images are magnified

**16. Draw a ray diagram to show the formation of image by a concave mirror for an object beyond its center of curvature. State three characteristics of the image.**

**Solution:**

The following diagram shows the formation of image by a concave mirror for an object beyond its center of curvature.



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The image is formed between the center of curvature C and the focus F, when an object is placed beyond the center of curvature C.

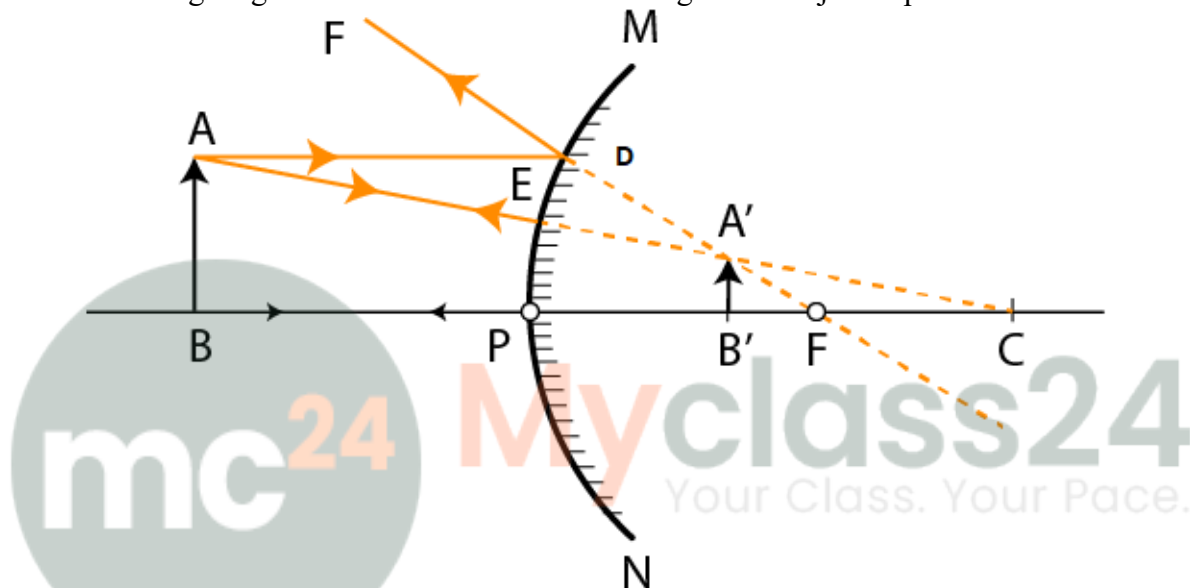
The three characteristics of the image are as follows:

- The images are real
- The images are diminished
- The images are inverted

**17. Draw a ray diagram to show the formation of image of an object kept in front of a convex mirror. State three characteristics of the image.**

**Solution:**

The following diagram shows the formation of image of an object kept in front of a convex mirror.



The three characteristics of the image are as follows:

- The images are erect
- The images are virtual
- The images are diminished

**18. Name the mirror which always produces an erect and virtual image. How is the size of image related to the size of object?**

**Solution:**

The mirror which always produces an erect and virtual image is a convex mirror.

The size of the image is shorter than the size of the object.

**19. (a) For what position of object, the image formed by a concave mirror is magnified and erect?  
(b) State whether the image in part (a) is real or virtual?**

**Solution:**

- (a) The image formed by a concave mirror is magnified and erect if the object is placed between the pole and focus of concave mirror.
- (b) The image formed of an object when placed between the pole and the focus of a concave mirror is virtual.

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- 20. (a) State the position of object for which the image formed by a concave mirror is of same size**  
**(b) Write two more characteristics of the image.**

**Solution:**

- (a) The position of object for which the image is formed by a concave mirror is of the same size is at the center of curvature.
- (b) The images so formed have the following two characteristics in addition, they are:
- The images formed are real
  - The images formed are inverted

- 21. (a) What is a real image?**  
**(b) What type of mirror can be used to obtain a real image of an object?**  
**(c) Does the mirror mentioned in part (b) form real image for all locations of the object?**

**Solution:**

- (a) An image that can be obtained on screen is a real image
- (b) To obtain a real image of an object, concave mirror can be used
- (c) No, concave mirror cannot form real image for all the locations of the object.

- 22. Discuss the position and nature of image formed by a concave mirror when an object is moved from infinity towards the pole of mirror.**

**Solution:**

The image formed moves away from the mirror when an object is moved from infinity towards the pole of mirror. In addition, the image formed is real and inverted.

- 23. Discuss the position and nature of image formed by a convex mirror when an object is moved from infinity towards the pole of mirror.**

**Solution:**

The images formed by a convex mirror are

- Upright
- Virtual
- Diminished

The image of the object is always located between the pole and the focus of the convex mirror, regardless of the distance of the object when placed in front of the mirror.

- 24. Name the kind of mirror used to obtain:**

- (a) A real and enlarged image,**  
**(b) A virtual and enlarged image,**  
**(c) A virtual and diminished image,**  
**(d) A real and diminished image.**

**Solution:**

The types of mirrors used to obtain the following are:

- (a) A real and enlarged image – concave mirror
- (b) A virtual and enlarged image - concave mirror
- (c) A virtual and diminished image – convex mirror
- (d) A real and diminished image - concave mirror

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**25. How is the focal length of a spherical mirror related to its radius of curvature?**

**Solution:**

The focal length 'f' is related to the radius of curvature 'R' in the following way:

$$f = \frac{1}{2} R$$

**26. Write the spherical mirror's formula and explain the meaning of each symbol used in it.**

**Solution:**

The spherical mirror's formula is as follows:

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

where 'u' is the distance of the object

'v' is the distance of the image

'f' focal length for the spherical mirror

**27. What is meant by magnification? Write its expression. What is its sign for the (a) real and (b) virtual, image?**

**Solution:**

Linear magnification is the ratio of the length of the image to the length of the object.

Magnification 'm' can be given by;

$$m = \frac{I}{O} = -\frac{v}{u}$$

where 'I' is the length of the image

'O' is the length of the object

'v' is the distance of the image

'u' is the distance of the object

**28. Upto what maximum distance from the pole the image in a convex mirror can be obtained? What will be the location of object then?**

**Solution:**

The maximum distance from the pole, at which the image in a convex mirror can be obtained is the focal length, as the image formed of an object by a convex mirror is always between the pole and the focus. The object would be located at infinity then.

**29. Upto what maximum distance from a concave mirror, the image can be obtained? What will be the location of object for it?**

**Solution:**

The maximum distance from the concave mirror, where the image can be obtained is at infinity. The object would be located at the focus.

**30. How will you distinguish between a plane mirror, a concave mirror and a convex mirror, without touching them?**

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**Solution:**

In order to distinguish between a plane mirror, a concave mirror and a convex mirror, the chosen mirror is held close to the face and the image obtained is observed.

One of the following three cases can be observed depending upon the type of mirror chosen:

Type of mirror	Position of the mirror	Change in size of image when moved away or towards
Plane	Upright	Size remains the same
Concave	Upright	Size increases when the mirror is moved away
Convex	Upright	Size decreases when the mirror is moved away

**31. State two uses of a concave mirror.**

**Solution:**

The two uses of a concave mirror are as follows:

- It can be used as a shaving mirror – when it is held closer to the face, produces an upright, magnified image hence even tiny hair on the face can be seen easily. Hence, a concave mirror with a large focal length and large aperture is used
- It can be used as a reflector – in search light, torch, head light of automobiles, cycles etc. A polished metallic surface of the concave is used as a reflector to get a parallel beam of light. Source of light is placed at the focus of concave reflector. Rays of light are incident on the concave reflector from the bulb which form a parallel beam after reflection.

**32. State the kind of mirror used**

- (a) By a dentist  
(b) As a search- light reflector

**Solution:**

- (a) By a dentist – concave mirror  
(b) As a search- light reflector – concave mirror

**33. (a) When a concave mirror is used as a shaving mirror, where is the person's face in relation to the focus of mirror?**

**(b) State three characteristics of the image seen in part (a)**

**Solution:**

- (a) The person's face in relation to the focus of the mirror is between the pole and the focus  
(b) The three characteristics of the image so formed are as follows:
- The images are erect
  - The images are virtual
  - The images are magnified

**34. Which mirror will you prefer to use as a rear view mirror in a car: plane mirror or convex mirror? Give one reason.**

**Solution:**

A convex mirror would be preferred. It is because convex mirrors offer a wider field of view in comparison to the plane mirror of the same size.

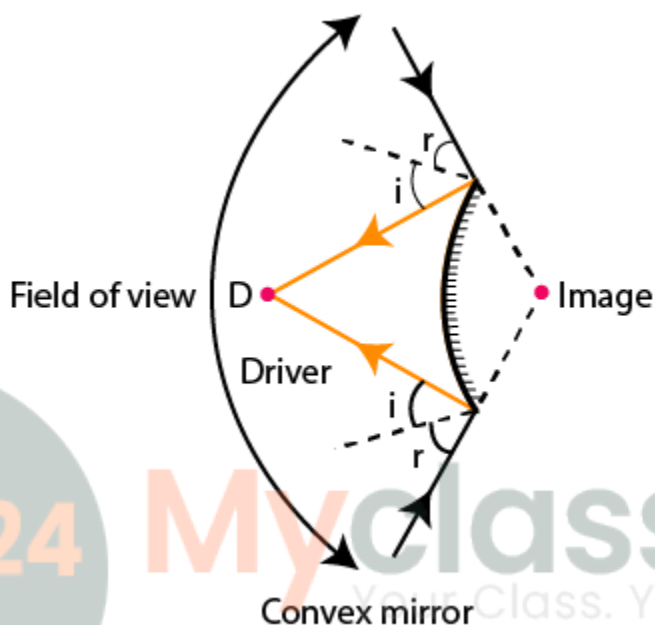
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**35. Why does a driver use a convex mirror instead of a plane mirror as a rear view mirror? Illustrate your answer with the help of a ray diagram.**

**Solution:**

It is the property of a convex mirror to diverge the incident beam, forming images that are virtual, erect, and small forming between focus and pole. Hence the driver can see the traffic that is behind him, which enables the driver to use it as a rear view in vehicles to see all the traffic that approaches from behind.



**Multiple choice type:**

1. For an incident ray directed towards center of curvature of a spherical mirror, the reflected ray:
  - (a) Retraces its path
  - (b) Passes through the focus
  - (c) Passes through the pole
  - (d) Becomes parallel to the principal axis

**Solution:**

- (a) Retraces its path

2. The image formed by a convex mirror is:
  - (a) Erect and diminished
  - (b) Erect and enlarged
  - (c) Inverted and diminished
  - (d) Inverted and enlarged

**Solution:**

- (a) Erect and diminished

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3. A real and enlarged image can be obtained by using a:

- (a) Convex mirror
- (b) Plane mirror
- (c) Concave mirror
- (d) Either convex

Solution:

- (c) Concave mirror

**Numericals:**

1. The radius of curvature of a convex mirror is 40cm. find its focal length.

Solution:

Given:

$$R = 40\text{cm}$$

$$\text{We know that, } f = \frac{1}{2} R$$

$$= \frac{1}{2} \times 40 = 20\text{cm}$$

2. The focal length of a concave mirror is 10cm. find its radius of curvature.

Solution:

Given:

$$F=10\text{cm, } R=?$$

$$\text{We know that, } f = \frac{1}{2} R$$

$$10 = \frac{1}{2} R$$

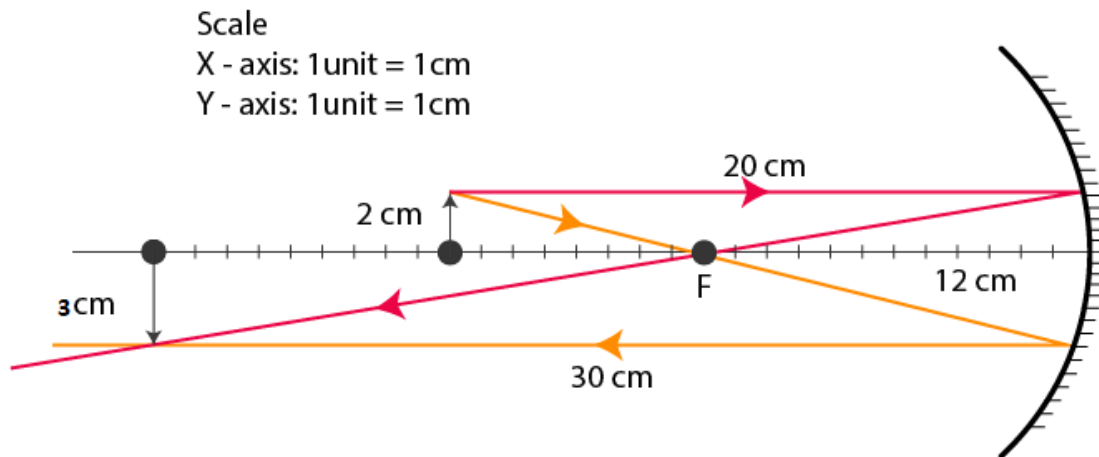
$$R=20\text{cm}$$

3. An object of height 2cm is placed at a distance 20cm in front of a concave mirror of focal length 12cm. Find the position, size and nature of the image.

Solution:

Given:

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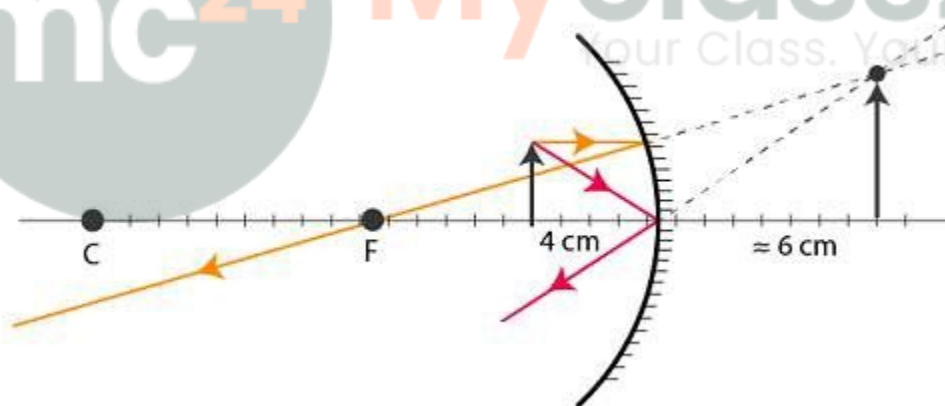
The image is 30cm in front of the mirror.

The image is 3cm high with the following characteristics:

- Real
- Inverted
- Magnified

4. An object is placed at 4cm distance in front of a concave mirror of radius of curvature 24cm. Find the position of image. Is the image magnified?

Solution:



The image is formed 6cm behind the mirror.

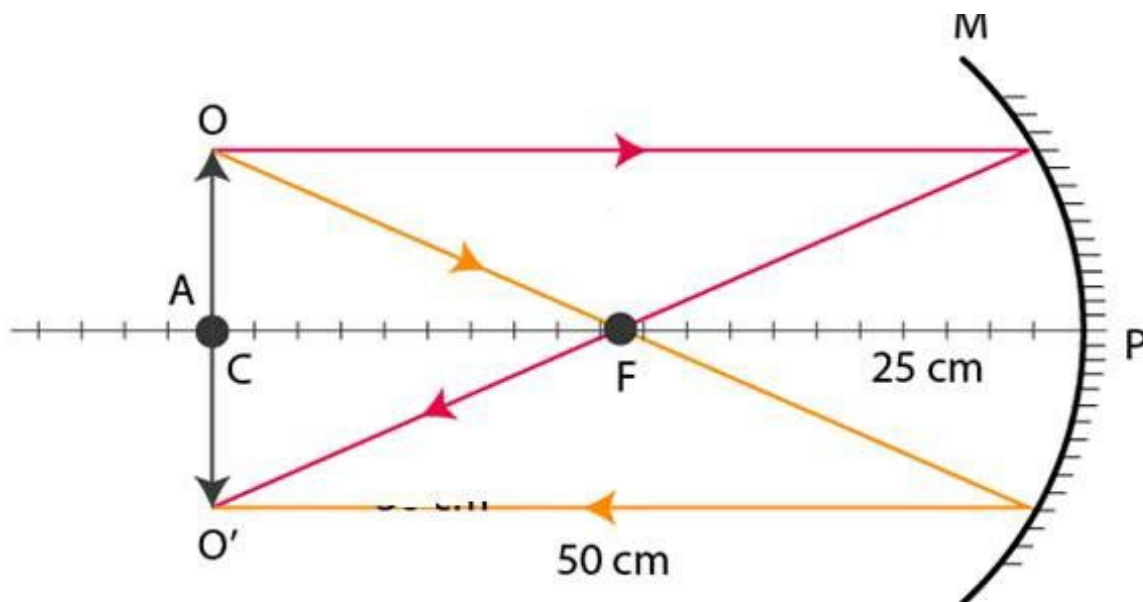
Yes, the image is magnified.

5. At what distance from a concave mirror of focal length 25cm should an object be placed so that the size of image is equal to the size of the object. Draw a ray diagram to show this.

Solution:

If the object is placed at the center of the curvature of a concave mirror, the size of the image is equal to the size of the object.

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Therefore, the object should be kept at 50cm.

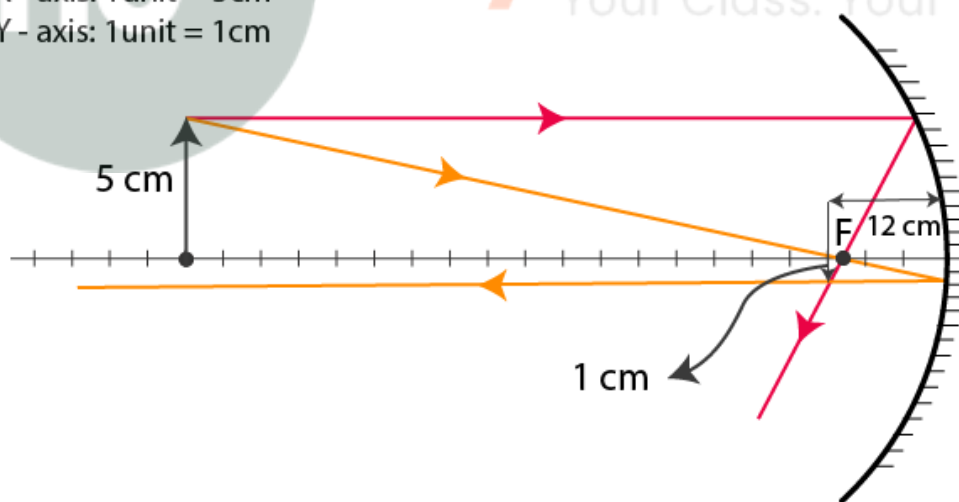
6. An object 5cm high is placed at a distance 60cm in front of a concave mirror of focal length 10cm. Find (i) the position and (ii) size, of the image.

Solution:

Scale

X - axis: 1 unit = 5cm

Y - axis: 1 unit = 1cm



- (i) The position of the object is 12cm in front of the mirror  
(ii) The size of the image is 1cm

7. A point light source is kept in front of a convex mirror at a distance of 40cm. The focal length of the mirror is 40cm. Find the position of image.

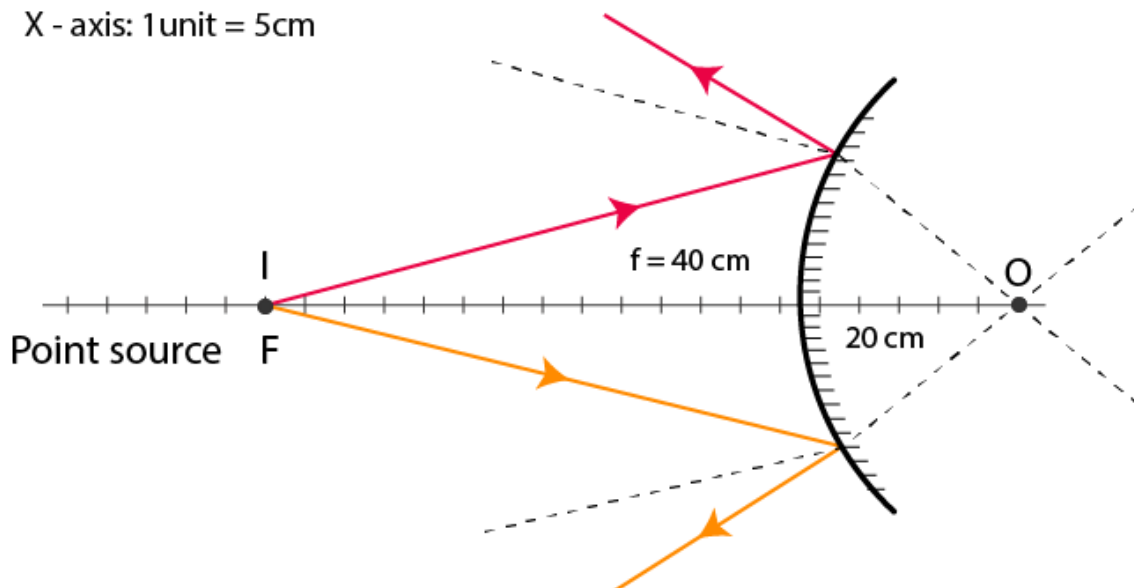
Solution:

The image is positioned behind the mirror at a distance of 20cm.

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Scale

X - axis: 1 unit = 5 cm



8. When an object of height 1cm is kept at a distance 4cm from a concave mirror, its erect image of height 1.5cm is formed at a distance 6cm behind the mirror. Find the focal length of the mirror.

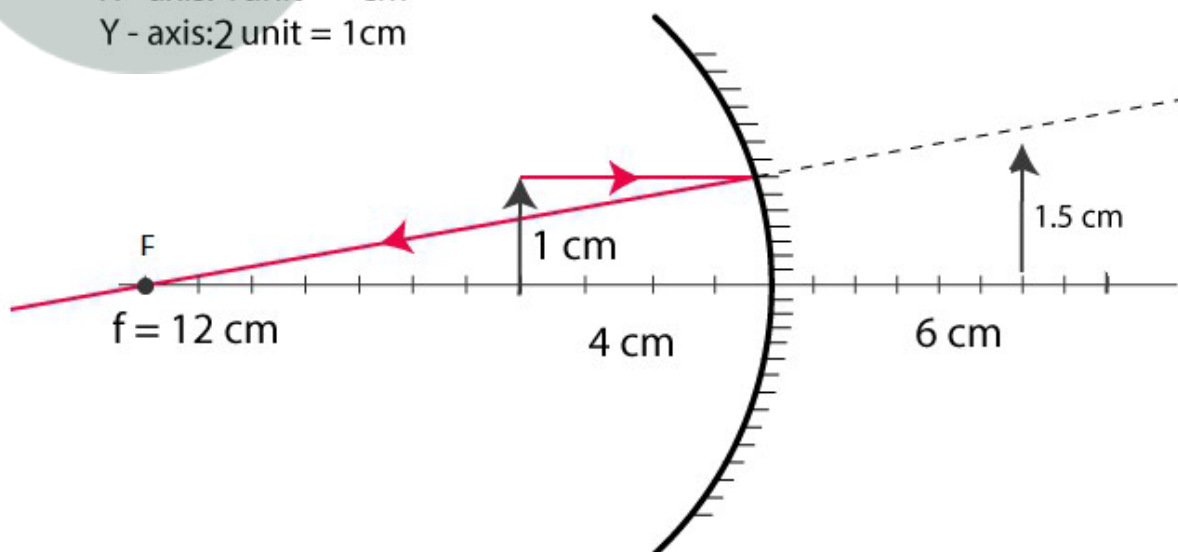
**Solution:**

After reflection, a ray that passes parallel to the principal axis through the focal point. Therefore, the focal length is 12cm.

Scale

X - axis: 1 unit = 1 cm

Y - axis: 2 unit = 1 cm



9. An object of length 4cm is placed in front of a concave mirror at a distance 30cm. The focal length of mirror is 15cm. (a) where will the image form? (b) What will be the length of image?

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**Solution:**

Given:

Distance of the object ( $u$ ) = 30cm (negative)

Focal length = 15cm (negative)

(a)

We know that mirror formula,

$$\begin{aligned}\frac{1}{u} + \frac{1}{v} &= \frac{1}{f} \\ \Rightarrow \frac{1}{v} &= \frac{1}{f} - \frac{1}{u} \\ \Rightarrow \frac{1}{v} &= \frac{1}{-15} - \frac{1}{-30} \\ \Rightarrow \frac{1}{v} &= \frac{1}{30} - \frac{1}{15} \\ \Rightarrow \frac{1}{v} &= -\frac{1}{30} \\ \Rightarrow v &= -30\text{cm}\end{aligned}$$

Therefore, the image is formed in front of the mirror at a distance of 30cm

(a) To find the length of the image

We know that,

$$m = \frac{1}{0} = \frac{-v}{u} = \frac{-(-30)}{-30} = -4\text{cm}$$

Negative sign represents that the image is inverted.

$$\therefore I = 4\text{cm}$$

Length of the image is 4cm

**10. A concave mirror forms a real image of an object placed in front of it at a distance 30cm, of size three times the size of object. Find (a) the focal length of mirror (b) position of image.**

**Solution:**

Given:

(a) Distance of the object ( $u$ ) = 30cm (negative)

We know that,

$$m = \frac{1}{0} = \frac{30}{0} = 3$$

For a real object, the value of 'm' is negative

$$m = -3$$

$$\text{As, } m = -\frac{v}{u}$$

$$-\frac{v}{u} = -3$$

$$\Rightarrow v = 3u$$

$$\Rightarrow v = 3 \times 30 = 90 \text{ cm}$$

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Therefore, the image is formed 90cm in front of the mirror.

Mirror formula can be given by:

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$
$$\Rightarrow \frac{1}{f} = \frac{1}{30} + \frac{1}{90} = -\frac{4}{90}$$
$$\Rightarrow f = -22.5\text{cm}$$

The focal length of the mirror is 22.5cm

- 11. A concave mirror forms a virtual image of size twice that of the object placed at a distance 5cm from it. Find: (a) the focal length of the mirror (b) position of the image.**

**Solution:**

Given:

Distance of the object ( $u$ ) = 5 (negative),  $m = 2$ , focal length = ?

We know that,

$$m = -\frac{v}{u}$$
$$\Rightarrow 2 = -\frac{v}{5}$$
$$\Rightarrow v = -10$$

The image is formed 10cm behind the mirror.

To find the focal length;

We know that,

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$
$$\Rightarrow \frac{1}{f} = \frac{1}{5} - \frac{1}{10}$$
$$\Rightarrow f = -10\text{cm}$$

Therefore, the focal length of the mirror is 10cm

- 12. The image formed by a convex mirror is of size one-third the size of object. How are  $u$  and  $v$  related?**

**Solution:**

We know that, magnification 'm' can be given by:

$$m = \frac{I}{O} = \frac{\frac{1}{3}O}{O} = \frac{1}{3}$$

As the images formed by a convex images are always upright and virtual,

$$m = -\frac{v}{u}$$
$$\Rightarrow \frac{1}{3} = -\frac{v}{u}$$
$$\Rightarrow v = -\frac{1}{3}u$$
$$\Rightarrow \text{Since 'u' is always negative, } u = 3v$$

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This is the relation between u and v.

- 13. The erect image formed by a concave mirror is of size double the size of object. How are u and v related?**

**Solution:**

Magnification can be given by:

$$m = \frac{h'}{h} = \frac{20}{10} = 2$$

We know that:

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

Therefore,  $-\frac{v}{u} = 2$

$$v = -2u$$

Since 'u' is always negative

$$v = 2u$$

The above equation shows how u and v are related.

- 14. The magnification for a mirror is -3. How are u and v related?**

**Solution:**

We know that,

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

Given:  $m = -3$

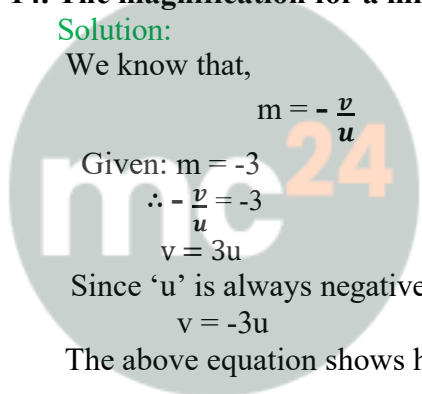
$$\therefore -\frac{v}{u} = -3$$

$$v = 3u$$

Since 'u' is always negative

$$v = -3u$$

The above equation shows how u and v are related.



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