



**h) Image distance:** The distance from the pole of spherical mirror to image is called image distance. It is denoted by 'v'.

**i) Magnification:** The relative ratio of size of image formed by spherical mirror to the size of object is known as magnification. It is denoted by 'm'.

$$m = \frac{\text{height of image}}{\text{height of object}} = \frac{\text{image distance}}{\text{object distance}}$$

**6. Write the rules for sign convention.**

**A. Sign convention for the parameters related to the mirror equation**

- (i) All distances should be measured from the pole.
- (ii) The distances measured in the direction of incident light, to be taken positive and those measured in the direction opposite to incident light to be taken negative.
- (iii) Height of object (H<sub>o</sub>) and height of image (H<sub>i</sub>) are positive if measured upwards from the axis and negative if measured downwards.

**7. What do you infer from the experiment which you did with concave mirrors and measured the distance of object and distance of image?**

- A. (i) If the object moves towards the concave mirror, the image moves away from the mirror.  
 (ii) If the object moves towards the concave mirror, the size of the image also increased. (Except when it is placed before F).

**\*Application of Concepts\***

**1. Find the distance of the image when an object is placed on the principal axis at a distance of 10cm in front of a concave mirror whose radius of curvature is 8cm.**

A. Distance of the object (u) = -10cm

Radius of curvature (R) = -8cm

$$\text{Focal length (f)} = \frac{R}{2} = \frac{-8}{2} = -4\text{cm}$$

Distance of the image (v) = ?

$$\text{Mirror Formula : } \frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-4} - \frac{1}{-10} = \frac{-10+4}{40} = \frac{-6}{40} = \frac{-3}{20}$$

$$v = \frac{-20}{3} = -6.6 \text{ cm ( on the object side)}$$

**2. The magnification produced by a plane mirror is +1. What does this mean?**

A.  $m = \frac{\text{height of image}}{\text{height of object}} = \frac{\text{image distance}}{\text{object distance}}$

The magnification produced by a plane mirror is +1. This means the size of image is equal to the size of the object. '+' sign represents the image is erect.

**3. If the spherical mirrors were not known to human beings, Guess the consequences.**

- A. If the spherical mirrors are known to human beings then
- (i) Many optical instruments were not invented.
  - (ii) We can not solve the problem of inverted images.
  - (iii) We can not use spherical mirrors in head lights of vehicles, side mirrors and rear view mirrors.
  - (iv) Dentists can not perform their treatment easily with out spherical mirrors.
  - (v) Solar cookers were not yet invented.

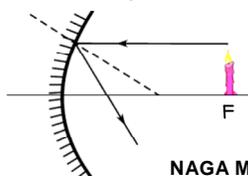
**4. By observing steel vessels and different images in them; Surya, a third class student, asked his elder sister Vidya some questions. What may be those questions?**

A. **Surya may asked the following questions:**

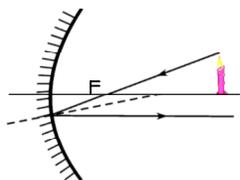
- (i) How can steel vessels form images?
- (ii) The image on the plate is different from the image on a bowl. Why?
- (iii) When we move some distance, why the size of image in vessel changes?
- (iv) Are steel vessels mirrors?

**5. Draw suitable rays by which we can guess the position of the image formed by a concave mirror.**

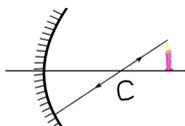
- A. The following are the suitable rays by which we can guess the position of the image formed by a concave mirror.
- (i) All rays that are parallel to the axis get reflected such that they pass through the focal point of the mirror.



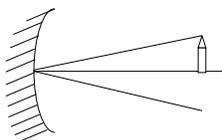
- (ii) A ray that passes through the focal point of the mirror will travel parallel to the axis after reflection.



- (iii) a ray coming from the tip of the object going through the centre of curvature to meet the mirror, it will get reflected along the same line.

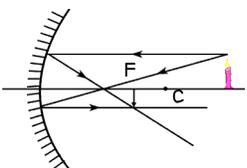


- (iv) Along with these three Rays 'the ray which comes from the object and reaches the pole of the mirror' is also useful in drawing ray diagrams. For this ray, the principal axis is the normal.



6. Show the formation of image with a ray diagram when an object is placed on the principal axis of a concave mirror away from the centre of curvature.

- A. When an object placed on the principal axis of a concave mirror and away from the centre of curvature, the image is formed between focus and centre of curvature. It is real, inverted and diminished in size.



7. Why do we prefer a convex mirror as a rear-view mirror in the vehicles?

- A. Convex mirrors always forms virtual, erect and diminished image of the object irrespective of the distance of the object. So It is used as rear view or side view mirror in vehicles, so that It enables the driver to see most of the traffic behind him/her.

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**\*Higher Order Thinking Questions\***

1. A convex mirror with a radius of curvature of 3m is used as rear view in an automobile. If a bus is located at 5m from this mirror, find the position, nature and size of the image.

- A. (for convex mirror u taken with negative sign)

Distance of the object (u) = -5m

Radius of curvature (R) = 3m

$$\text{Focal length (f)} = \frac{R}{2} = \frac{3}{2} = 1.5\text{m}$$

Distance of the image (v) = ?

$$\text{Formula : } \frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{1.5} - \frac{1}{-5} = \frac{2}{3} + \frac{1}{5} = \frac{10+3}{15} = \frac{13}{15}$$

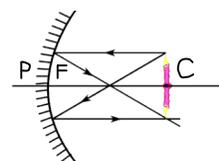
$$v = \frac{15}{13} = 1.15\text{ m}$$

Image formed behind the mirror and it is virtual, erect, diminished.

2. To form the image on the object itself, how should we place the object in front of a concave mirror?

Explain with a ray diagram.

- A. To form the image on the object itself, we place the object at the centre of curvature of a concave mirror.



**\*Multiple Choice Questions\***

- If an object is placed at C on the principal axis in front of a concave mirror, the position of the image is ..... [      ]  
 A. at infinity  
 B. between F and C  
 C. at C  
 D. beyond C
- We get a diminished image with a concave mirror when the object is placed ..... [      ]  
 A. at F  
 B. between the pole and F  
 C. at C  
 D. beyond C
- We get a virtual image in a concave mirror when the object is placed ..... [      ]  
 A. at F  
 B. between the pole and F  
 C. at C  
 D. beyond C

