NCERT QUESTIONS WITH SOLUTIONS

1. Define the principal focus of a concave mirror.

Solution

The principal focus of a concave mirror is a point on the principal axis, at which the incident rays parallel to the principal axis, after reflection, actually meet.

2. The radius of curvature of a spherical mirror is 20 cm. What is its focal length?

Solution

Given, radius of curvature, R = 20 cm

Focal length, $f = \frac{1}{2} \times$ radius of curvature

or $f = \frac{1}{2} \times R = \frac{1}{2} \times 20$ **= 10 cm**

3. Name a mirror that can give an erect and enlarged image of an object.

Solution

Concave mirror

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

Solution

Convex mirror is preferred as a rear-view mirror because it always gives an erect, though diminished image. Also, it has a wider field of view as it is curved outwards. Thus, convex mirror enables the driver to view much larger area than would be possible with a plane mirror.

5. Find the focal length of a convex mirror whose radius of curvature is 32 cm.

Solution

Given, radius of curvature, R = + 32 cm

Focal length, $f = \frac{1}{2} \times$ radius of curvature

or $f = \frac{1}{2} \times R = \frac{1}{2} \times (+32) =$ **+16 cm**

6. A concave mirror produces three times magnified (enlarged) real image of an object placed at 10 cm in front of it. Where is the image located?

Solution

Given, magnification, m = – 3

(negative sign is taken as image is real) ;

object distance, u = – 10 cm

Now, $m = -\frac{v}{u}$ or $v = - m \times u$

or v = – (–3) × (–10) = **– 30 cm**

7. The image formed by a concave mirror is observed to be virtual, erect and larger than the object. Where should be the position of the object?

(a) Between the principal focus and the centre of curvature

(b) At the centre of curvature

(c) Beyond the centre of curvature

(d) Between the pole of the mirror and its principal focus

Solution

Option (d) is correct. When an object is placed between the pole and principal focus of a concave mirror, the image formed is virtual, erect, and larger than the object.

8. No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be

(a) plane

(b) concave

(c) convex

(d) either plane or convex

Solution

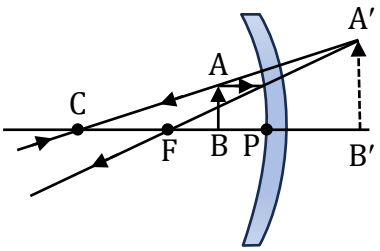
Option (d) is correct. A convex mirror always gives a virtual and erect image of smaller size of the object placed in front of it. Similarly, a plane mirror will always give a virtual and erect image of same size as that of the object placed in front of it. Therefore, the given mirror could be either plane or convex.

9. We wish to obtain an erect image of an object, using a concave mirror of focal length 15 cm. What should be the range of distance of the object from the mirror? What is the nature of the image? Is the image larger or smaller than the object? Draw a ray diagram to show the image formation in this case.

Solution

The object should be placed between pole and focus to get an erect image. Thus, the range of distance from the mirror will be in between 0 to 15 cm (or less than 15 cm) i.e., the range is **0 cm – 15 cm.**

The ray diagram for this is as given below:



10. Name the type of mirror used in the following situations

(a) Headlights of a car.

(b) Side/rear-view mirror of a vehicle.

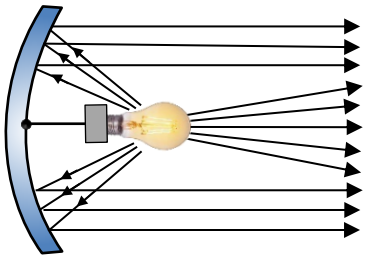
(c) Solar furnace.

Support your answer with reason.

Solution

(a) Concave mirror.

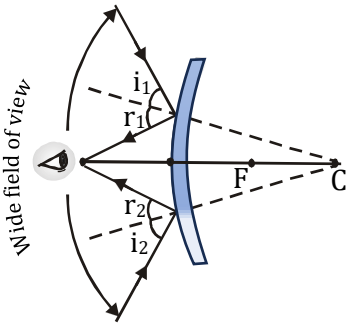
Concave mirror is used in the headlights of a vehicle because it produces powerful and almost parallel beam of light when the light source is placed at its principal focus.



A bulb placed at the focus of a concave mirror produces a strong, almost parallel beam.

(b) Convex mirror.

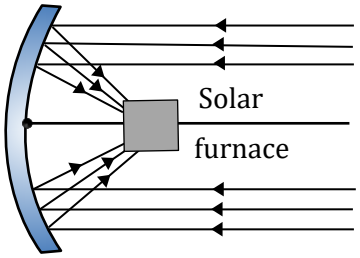
Convex mirror is used in rear-view mirror of a vehicle. Convex mirror gives a virtual, erect, and diminished image of the object placed in front of it. Because of this, it has a wide field of view. It enables the driver to see most of the traffic behind him.



A convex mirror has a wide field of view

(c) Concave mirror.

Concave mirrors are converging mirrors. That is why they are used to construct solar furnaces. Concave mirrors converge the parallel light incident on them at a single point which is called principal focus. Hence, they can be used to produce a large amount of heat at that point.



A solar furnace placed at the focus of a concave mirror.

11. An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position and nature of the image.

Solution

Given, object distance, u = – 10 cm ;
focal length, f = + 15 cm ;
image distance, v =? ; magnification, m =?
Mirror formula,

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f} \text{ or } \frac{1}{v}+\frac{1}{(-10)}=\frac{1}{(+15)}$$

$$\text{or } \frac{1}{v}=\frac{1}{10}+\frac{1}{15}=\frac{3+2}{30}=\frac{5}{30}=\frac{1}{6} \text{ or } v=\mathbf{+6\ cm}$$

Now, magnification,

$$m=-\frac{v}{u}=-\frac{(+6)}{(-10)}=\mathbf{+\ 0.6}$$

The image is located 6 cm behind the mirror ; it is a virtual, erect and diminished image.

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

Solution

Magnification for a plane mirror is + 1. The positive sign means the image is virtual and erect. The numerical value (magnitude) '1' means that the size of the image is exactly equal to the size of the object.

13. An object 5.0 cm in length is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position of the image, its nature and size.

Solution

Given, object distance, u = – 20 cm ;
radius of curvature, R = + 30 cm ;
height of object, h_1 = + 5 cm ;
image distance, v =? ; magnification, m =?;
height of image, h_2 =?

$$\text{Focal length, } f=\frac{R}{2}=\frac{+30}{2}=+15 \text{ cm}$$

Mirror formula,

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f} \text{ or } \frac{1}{v}+\frac{1}{(-20)}=\frac{1}{(+15)}$$

$$\text{or } \frac{1}{v}=\frac{1}{20}+\frac{1}{15}=\frac{3+4}{60}=\frac{7}{60}$$

$$\text{or } v=+\frac{60}{7} \text{ cm} = \mathbf{+\ 8.57\ cm}$$

Now, magnification,

$$m=-\frac{v}{u}=-\frac{(+60/7)}{(-20)}=+\frac{3}{7}$$

or m = **+ 0.428**

$$\text{Also, } m=\frac{h_2}{h_1} \quad \text{or} \quad +\frac{3}{7}=\frac{h_2}{(+5)}$$

$$\text{or } h_2=+\frac{15}{7}=\mathbf{+\ 2.14\ cm}$$

The image is located at a distance of 8.57 cm behind the mirror ; it is virtual, erect and diminished of size 2.14 cm.

14. 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, focussed image can be obtained? Find the size and the nature of the image.

Solution

Given, object height, h_1 = + 7 cm ;
object distance, u = – 27 cm ;
focal length, f = – 18 cm ;
image distance, v =? ; image height, h_2 =?
Mirror formula,

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f} \quad \text{or} \quad \frac{1}{v}+\frac{1}{(-27)}=\frac{1}{(-18)}$$

$$\text{or } \frac{1}{v}=\frac{1}{27}-\frac{1}{18}=\frac{2-3}{54}=\frac{-1}{54} \text{ or } v=\mathbf{-\ 54\ cm}$$

Now, magnification,

$$m=-\frac{v}{u}=-\frac{(-54)}{(-27)}=\mathbf{-\ 2}$$

$$\text{Also, } m=\frac{h_2}{h_1} \text{ or } -2=\frac{h_2}{(+7)}$$

or h_2 = **– 14 cm**

The image is located at a distance of 54 cm in front of the mirror ; it is real, inverted and magnified of size 14 cm