(PHYSICS) **RAY OPTICS**

DPP – 1

CLASS – 12th

TOPIC – Relection of light from Plain and spherical surface

Q.1 A concave mirror of focal lengtth 20 cm is placed 50 cm from a wall. How far from the wall an object be placed to form its real image on the wall

Q.2 An object is placed at a distance of 40 cm from a concave mirror of focal lengtth 15 cm. If the object is displaced through a distance of 20 cm towards the mirror, by how much distance is the image displaced?

Q.3 An object is placed at a distance of 25 cm from a spherical mirror and its image is formed behind the mirror at a distance of 5 cm. Find the focal length of the mirror. Is the mirror concave or convex in nature?

Q.4 An object is placed at a distance of 36 cm from a convex mirror. A plane mirror is placed inbetween, so that the two virtual images so formed coincide. If the plane mirror is at a distance of 24 cm from f the object, find the radius of curvature of the convex e mirror.

Q.5 An object is placed in front of a concave mirror of radius of curvature 40 cm at a distance of 10 cm. Find the position, nature and magnification of the image.

Q.6 An object is placed 15 cm from a convex mirror of radius of curvature 90 cm. Calculate the image position and magnification.

Q.7 An object is placed in front of a convex mirror of focal length 30 cm. If the image formed is a quarter of the size of the object, find the position of the image.

Q.8 An object is kept in front of a concave mirror of focal length 15 cm. The image formed is three times the size of the object. Calculate two possible distances of the object from the mirror

Q.9 What is the difference between virtual image produced by a convex mirror and concave mirror?

Q.10 Why is the aperture of a spherical mirror taken as small?

Q.11 Why are convex mirrors used as side view mirrors in cars ?

SOLUTION

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Sol.1. Fig. 1.18 shows a concave mirror placed at a distance of 50 cm from the wall. Suppose that the object AB is placed at a distance x from the wall, to form its image A'B' on the wall.

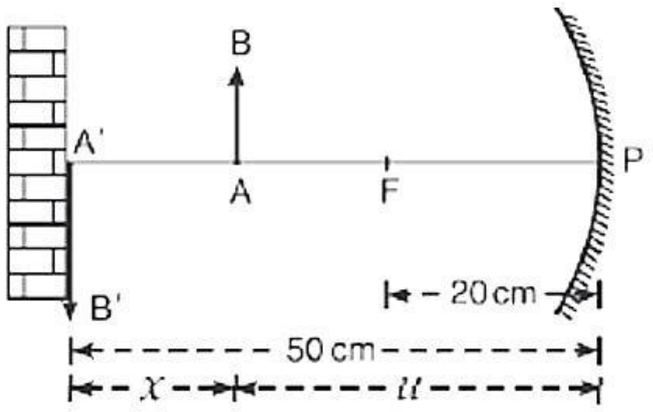

Fig. 1.18

Since the image is formed on the same side of the object,

$$v = -50 \text{ cm}$$

Also, $f = -20$ cm (concave mirror)

From the mirror formula, we have

$$\frac{1}{u} - \frac{1}{f} - \frac{1}{v} = \frac{1}{-20} - \frac{1}{-50} = -\frac{3}{100}$$

or $u = -33{\cdot}3$ cm

Therefore, the distance of the object from the wall,

$$x = 50 - |u| = 50 - |-33{\cdot}3|$$
$$= 16{\cdot}7 \text{ cm}$$

Sol.2. Here, $f = -15$ cm ; $u = -40$ cm

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

or $v = \frac{uf}{u - f}$

$$= \frac{(-40)\times(-15)}{(-40)-(-15)} = \frac{40\times 15}{25} = -24 \text{ cm}$$

When the object is displaced towards the mirror: Let u' be the distance of the object from the mirror in its new position.

Then, $u' = -(40-20) = -20$ cm

If the image is formed at a distance V from the mirror, then

$$v' = \frac{u' f}{u' - f}$$
$$= \frac{(-20)\times(-15)}{(-20)-(-15)} = -\frac{20\times 15}{5} = -60\,\text{cm}$$

Therefore, the image wil move away from the concave mirror through a distance

$$|v'|-|u| = |-60|-|-24| = \mathbf{36\ cm}$$

Sol.3. Here u. = - 25cm ; v = + 5 cm

from the mirror formula, we have

$$\frac{1}{f} = \frac{1}{u}+\frac{1}{v} = \frac{1}{-25}+\frac{1}{5} = \frac{4}{25}$$

or $f = \mathbf{+ 6{\cdot}25\ cm}$

As the focal length is positive, the mirror is convex in nature

Sol.4. Fig. 1.19 shows an object AB placed at a distance PA 36 cm from the convex mirror. The distance of the plane mirror from the object is MA = 24 cm. The image A'B' of the object in the plane mirror will be formed at a distance of 24 cm behind it i.e. MA' = 24 cm.

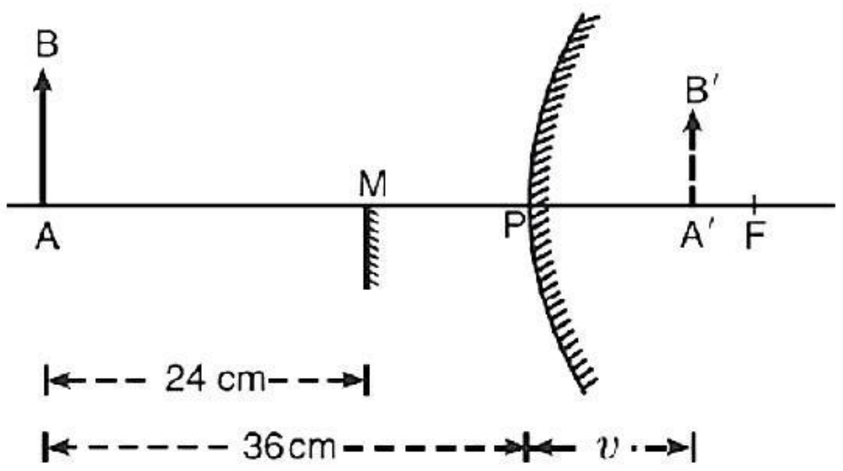

Fig. 1.19

Since the image formed in the plane mirror coincides

$$v = PA' = (MA + MA') - PA$$
$$= 2\,MA - PA$$
$$= 2\times 24 - 36 = 12\ \text{cm}$$

Also, $u = -36$ cm

Now, $\frac{2}{R} = \frac{1}{u} + \frac{1}{v} = \frac{1}{-36} + \frac{1}{12} = \frac{1}{18}$

or $R = \mathbf{36\ cm}$

Sol.5. Here u = -10cm R =-40cm (concave mirror)

$\therefore$ $f = R/2 = -40/2 = -20$ cm

From the mirror formula, we have

$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-20} - \frac{1}{-10} = \frac{1}{20}$

or $v = \mathbf{+20\ cm}$

As v is positive, a ***virtual*** and ***erect*** image will be formed on the other side of the object *i.e.* ***behind the mirror.***

Now, $m = -\frac{v}{u} = -\frac{+20}{-10} = \mathbf{2}$

Sol.6. Here, u = -15 cm ; R = + 90 cm (convex mirror)

$\therefore$ $f = R/2 = +90/2 = +45$ cm

From the mirror formula, we have

$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{+45} - \frac{1}{-15} = \frac{4}{45}$

or $v = 45/4 = \mathbf{+11{\cdot}25\ cm}$

As v is positive, a ***virtual*** and ***erect*** image will be formed on the other side of the object *i.e.* ***behind the mirror.***

Now, $m = -\frac{v}{u} = -\frac{+11{\cdot}25}{-15} = \mathbf{0{\cdot}75}$

Sol.7. Here, F = + 30 cm (Convex mirror) ; M = ¼

Now, $m = \frac{f - v}{f}$

$\therefore$ $\frac{1}{4} = \frac{+30 - v}{+30}$ or $30 = 120 - 4v$

or $v = 90/4 = \mathbf{+22{\cdot}5\ cm}$

As v is positive, a virtual and erect image will be formed on the other side of the object i.e. behind the

mirror

Sol.8. Here, f = - 15cm and $f = -15$ cm and $|m| = 3$

When the image formed is real : Then, $m = -3$

Now, $m = -\frac{v}{u} = -3$

or $v = 3u$

From the mirror formula, we have

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

or $\frac{1}{u} + \frac{1}{3u} = \frac{1}{-15}$ or $\frac{4}{3u} = -\frac{1}{15}$

or $u = -20$ **cm**

When the image formed is virtual : Then, $m = +3$

Now, $m = -\frac{v}{u} = 3$

or $v = -3u$

From the mirror formula, we have

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

or $\frac{1}{u} + \frac{1}{-3u} = \frac{1}{-15}$

or $\frac{2}{3u} = -\frac{1}{15}$

or $u = -10$ **cm**

Sol.9. The virtual image formed by a concave mirror is larger than the size of the object, whereas the virtual image formed by a convex mirror is smaller than the size of the object.

Sol.10. The mirror formula has been derived on the assumption that the aperture of the mirror is small.

Sol.11. The convex mirror is used as side view mirrors in cars as it gives a wide field of view of the traffic.