Reflection of Light

Exercises

Q. 1 A. Answer the following questions.

Explain the difference between a plane mirror, a concave mirror and a convex mirror with respect to the type and size of the images produced.

Answer : Plane Mirror: The image formed by plane mirror is Virtual (can't be taken on the screen), Upright. And size of image is same as the size of the object. Also distance between object and mirror is same as the distance between mirror and image.

Concave Mirror: The image formed by concave mirror is both

real(can be taken on screen) and virtual. If image is real than it is

inverted and is found in front of mirror. If image is virtual than

image is upright and is formed behind the mirror. The size of

image can be smaller and larger than the object size depending on the position of the object.

Convex Mirror: The image formed by convex mirror is always

virtual, upright and smaller than size of the object.

Q. 1 B. Answer the following questions.

Describe the positions of the source of light with respect to a concave mirror in

1. Torch light .
2. Projector lamp.
3. Floodlight.

Answer : 1.) Torch Light : The Source of light is placed at the Focus of the Concave Mirror because in Concave Mirror if the object is placed at Focus than its image is formed at the infinity hence we can get a light to longer distances .

2.) Projector Lamp: The source of light is placed at the Center Of Curvature because if object is placed at the center of curvature than its image is same as the size of the

object, real. Hence image can be taken on the screen Like Whiteboard etc due to its real nature and size will also be sufficient not too large and too small.

3.) Flood Light: The Source of light is placed Beyond The Centre Of Curvature because the image formed is real and Magnified. hence we can get wider area of light.

Q. 1 C. Answer the following questions.

Why are concave mirrors used in solar devices?

Answer : Concave Mirrors are used in the solar devices like Solar Cooker, Solar Furnace etc. because they are the only mirror which reflects the light towards the focus (Plane mirrors don't have focus, convex mirrors have imaginary focus behind the mirror which reflects light away from the focus).

The light collected at the Focus has lot of thermal energy which can be used in many ways.

Q. 1 D. Answer the following questions.

Why are the mirrors fitted on the outside of cars convex?

Answer : Mirrors fitted outside of cars are convex because convex mirrors always formed virtual and very diminished image. Hence we can see large traffic in a smaller area of the mirror.

Q. 1 E. Answer the following questions.

Why does obtaining the image of the sun on a paper with the help of a concave mirror burn the paper?

Answer : The paper is burnt because the rays of the sun which comes from infinite distance forms the image at the focus of the concave mirror hence large amount of heat is generated due to infinite rays of sun meeting at the focus which in turn burns the paper.

Q. 1 F. Answer the following questions.

If a spherical mirror breaks, what type of mirrors are the individual pieces?

Answer : The individual pieces of the broken spherical mirror are the spherical mirror itself. It may be of two types:

a.) Concave (reflecting surface curved inwards).

b.) Convex (reflecting surface curved outwards).

Q. 2. What sign conventions are used for reflection from a spherical mirror?

Answer : Pole (P) of the mirror is taken as the origin and the Principal axis is taken as the horizontal X- axis. The sign conventions are as follows:

1. The object is always placed on the left side of the mirror.

2. All the distances measured to the right side of the origin are taken as positive, while the distances measured to the left side of the origin are taken as negative.

3. All the distances parallel to the principal axis of the mirror are measured from the pole of the mirror.

4. Distances measured vertically upwards from the principal axis of the mirror are taken as positive.

5. Distances measured vertically downwards from the principal axis of the mirror are taken as negative.

6. The focal length of Concave mirror is negative while that of convex mirror is positive.

Q. 3. Draw ray diagrams for the cases of images obtained in concave mirrors as described in the table on page 122.

Images formed by concave mirrors

No.	Position of the object	Position of the image	Nature of image	Size of the image
1	Between pole and focus	Behind the mirror	Erect, virtual	Magnified
2	At the focus	At infinity	Inverted, real	Very large
3	Between focus and centre of curvature	Beyond the centre of curvature	Inverted, real	Magnified
4	At the centre of curvature	At the centre of curvature	Inverted, real	Same as the object
5	Beyond the centre of curvature	Between the centre of curvature and focus	Inverted, real	Diminished
6	At a very large (infinite) distance	At focus	Inverted, real	Point image

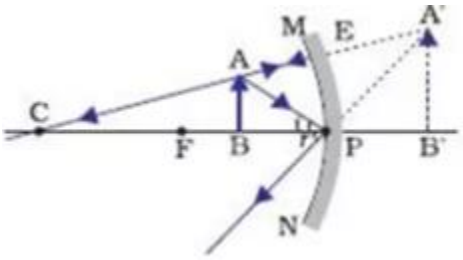
Answer : 1. When Object is between pole and focus.

Ø Position of Image => Behind the mirror.

Ø Nature of Image => Erect and Virtual.

Ø Size of Image => Magnified.

Ø Diagram =>



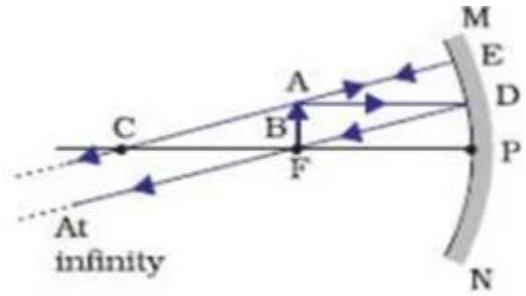
2. When Object is at focus.

Ø Position of Image => At Infinity

Ø Nature of Image => Real and Inverted.

Ø Size of Image => Very Large.

Ø Diagram =>



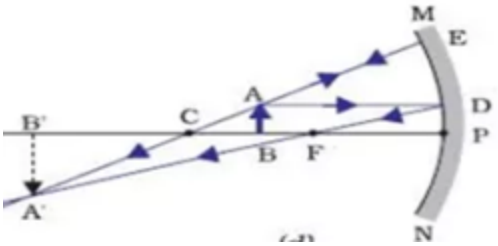
3. When Object is between focus and center of curvature.

Ø Position of Image =>Beyond the center of curvature.

Ø Nature of Image => Inverted and real.

Ø Size of Image => Magnified.

Ø Diagram =>



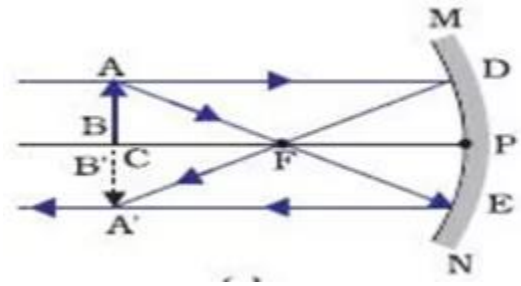
4. When Object is at center of curvature.

Ø Position of Image =>At center of curvature.

Ø Nature of Image => Inverted and real.

Ø Size of Image => Same as Object.

Ø Diagram =>



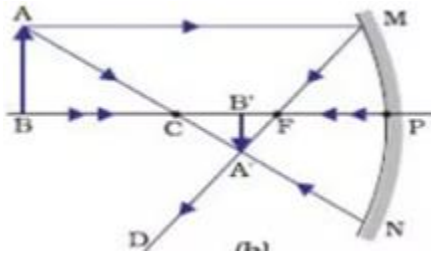
5. When Object is beyond center of curvature.

Ø Position of Image =>Between center of curvature and focus.

Ø Nature of Image => Inverted and real.

Ø Size of Image => Diminished.

Ø Diagram =>



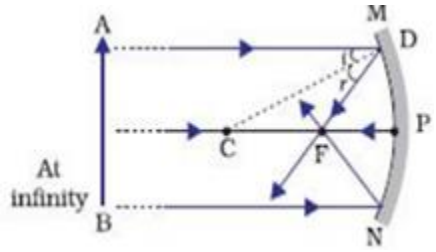
6. When Object is at very large distance(Infinity).

Ø Position of Image => At focus.

Ø Nature of Image => Inverted and real.

Ø Size of Image => Point size.

Ø Diagram =>



Q. 4. Which type of mirrors are used in the following?

Periscope, floodlights, shaving mirror, kaleidoscope, street lights, head lamps of a car.

Answer : 1.) Periscope: Simple Periscope uses Plane Mirrors because light just strikes the mirror to reach viewer eye.

2.) Flood Lights: Concave Mirrors are used in the floodlights.

3.) Shaving Mirror: Concave Mirrors are used in shaving mirrors because when the face is kept between the focus and pole of the mirror the magnified, erect and virtual image is formed.

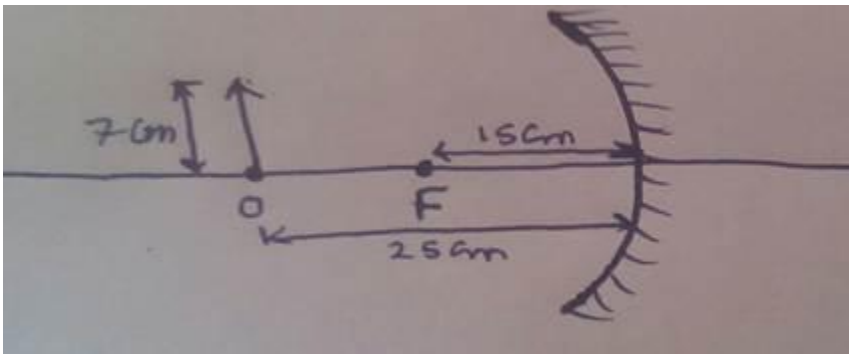
4.) Kaleidoscope: Plane Mirrors are used in the Kaleidoscope because only reflecting surface is needed.

5.) Street Light: Convex Mirrors are used in the street light because it diverges the rays of the light upto large distance .

6.) Head Lamp of car: Concave mirrors are used in the Head Lamp of car because if the bulb is kept at focus of the mirror the rays from bulb will go to a larger distances (infinity).

Q. 5 A. Solve the following examples

An object of height 7 cm is kept at a distance of 25 cm in front of a concave mirror. The focal length of the mirror is 15 cm. At what distance from the mirror should a screen be kept so as to get a clear image? What will be the size and nature of the image?



Answer : s According to the question,

Object distance (u) = -25 cm;

Height of object (H_o) = + 7 cm;

Focal length (f) = -15 cm;

Image distance = v cm;

By Mirror Formula:

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

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

Putting values we get,

$$\frac{1}{v} + \left(\frac{1}{-25\ \text{cm}}\right) = \frac{1}{-15\ \text{cm}}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{-15\ \text{cm}} - \left(\frac{1}{-25\ \text{cm}}\right)$$

$$\Rightarrow \frac{1}{v} = \frac{1}{-15\ \text{cm}} + \frac{1}{25\ \text{cm}}$$

Taking the lcm, we get,

$$\Rightarrow \frac{1}{v} = \frac{-5+3}{75\text{cm}}$$

$$\Rightarrow \frac{1}{v} = -\frac{2}{75}\text{cm}$$

$$\Rightarrow v = -\frac{75}{2}\text{cm}$$

⇒ v = -37.5 cm

∴ the image distance = 37.5 cm (The negative sign indicates that the image is formed on the left side of the mirror)

Now, image distance (v) = -37.5 cm

Magnification =

$$\frac{H_i}{H_o} = -\frac{v}{u}$$

H_i is the image height.

H_O is the object height.

“v” is the image distance

“u” is the object distance

$$\Rightarrow \frac{H_i}{7\text{ cm}} = -\left(\frac{-37.5\text{ cm}}{-25\text{ cm}}\right)$$

$$\Rightarrow H_i = -\left(\frac{-37.5\text{ cm}}{-25\text{ cm}}\right) \times 7\text{ cm}$$

⇒ H_i = -10.5 cm.

Size of image is 10.5 cm which is negative hence image is real .

Q. 5 B. Solve the following examples

A convex mirror has a focal length of 18 cm. The image of an object kept in front of the mirror is half the height of the object. What is the distance of the object from the mirror?

Answer : According to the question;

Focal length (f) = + 18cm;

Height of Image = H_i ;

Height of object = H_o ;

Given That;

$$H_i = \frac{H_o}{2}$$

$\frac{H_i}{H_o} = \frac{1}{2}$ = Magnification;

We Know that

Magnification $= -\left(\frac{v}{-u}\right) = \frac{v}{u}$ (Since object is always kept to left side of mirror hence u is negative)

$$\Rightarrow \frac{v}{u} = \frac{1}{2}$$

Hence

$v = \frac{u}{2}$

By Mirror Formula;

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

$\frac{2}{u} + \frac{1}{-u} = \frac{1}{18}$ Since $v = \frac{u}{2}$

$$\Rightarrow \frac{2}{u} - \frac{1}{u} = \frac{1}{18}$$

$$\Rightarrow \frac{2-1}{u} = \frac{1}{18}$$

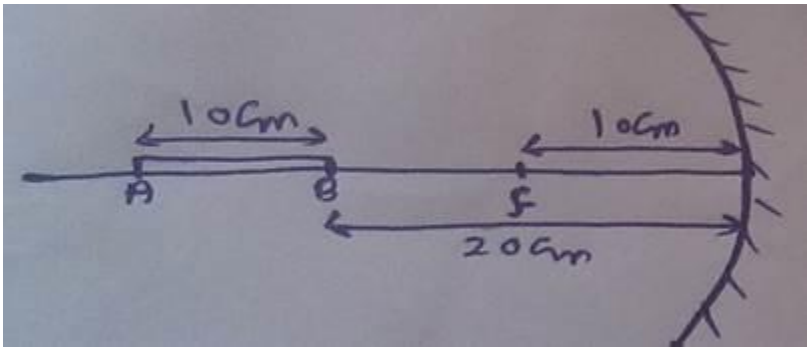
$$\Rightarrow \frac{1}{u} = \frac{1}{18}$$

$$\Rightarrow u = 18 \text{ cm}$$

Hence distance of the object from mirror is 18 cm.

Q. 5 C. Solve the following examples

A 10 cm long stick is kept in front of a concave mirror having focal length of 10 cm in such a way that the end of the stick closest to the pole is at a distance of 20 cm. What will be the length of the image?



Answer : According to the question;

Focal length (f) = -10cm;

Length of stick (L_o) = 10cm;

Length of image = L_i;

Object distance (u) = -20cm;

By mirror formula;

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

$$\Rightarrow \frac{1}{v}+\frac{1}{-20}=\frac{1}{-10}$$

$$\Rightarrow \frac{1}{v}=\frac{1}{20}-\frac{1}{10}$$

$$\Rightarrow \frac{1}{v}=\frac{1-2}{20}$$

$$\Rightarrow \frac{1}{v}=-\frac{1}{20}$$

⇒ v = -20.

Since v = - 20 cm which is negative hence image is at left side of mirror.

Now

$$\text{Magnification} = \frac{L_i}{L_c} = -\frac{v}{u}$$

Putting values of v and u .

$$\text{Magnification} = -\left(-\frac{20}{-20}\right)$$

= - 1

Negative sign means image is inverted.

$$\text{Magnification} = \frac{L_i}{L_o} = 1$$

Hence $L_i = L_o$.

Hence length of image is 10 cm

Q. 6. Three mirrors are created from a single sphere. Which of the following - pole, center of curvature, radius of curvature, principal axis - will be common to them and which will not be common?

Answer : 1.) Radius of Curvature = It will be common because the radius of the sphere of which the mirror is a part will be same for every part of the mirror.

2.) Principal Axis = It will not be common.

3.) Pole = It will not be common.

4.) Center of curvature = It will be common because the center of the sphere of which the mirror is a part will be same for every part of the mirror.