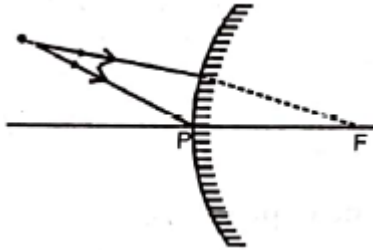


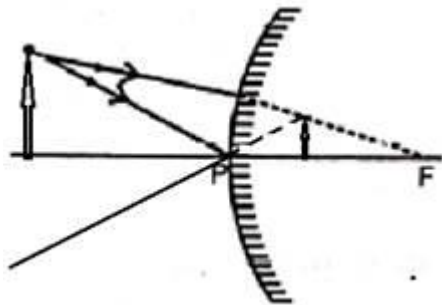
Light-Reflection And Refraction

Periodic Test

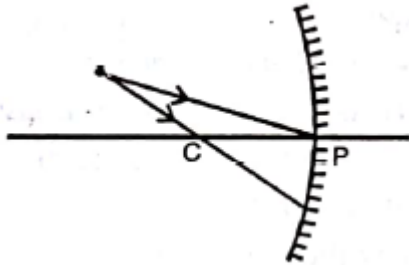
Q.1. Complete the following ray diagram by drawing suitable



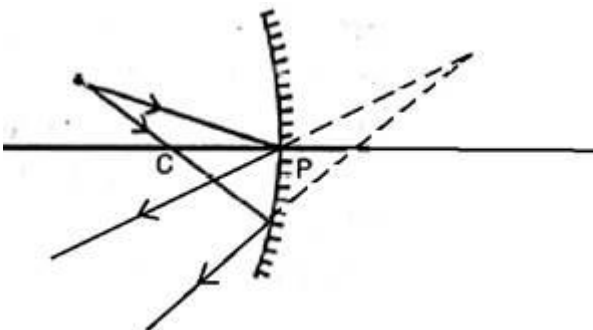
Answer:



Q.2 Complete the following ray diagram by drawing suitable rays.



Answer: For concave mirror,



Q.3. What is the difference between virtual images produced by concave, plane and convex mirrors?

Answer: The virtual image formed by concave mirror is magnified, that produced by plane mirror is of the same size and that by a convex mirror is diminished.

Q.4. For driving a car what type of mirror would you prefer to see the traffic at your back and why? Explain why it is preferred over a plane mirror?

Answer: A convex mirror is used to see the traffic at the back. It is because a convex mirror always forms an erect though diminished image of the object. It has a wider field of view. So, we will be able to much larger at the back than a plane mirror while driving the car.

Q.5. An erect image three times the size of the object is formed with a concave mirror of radius of curvature 36 cm. What is the position of the image?

Answer: For an erect image, magnification is positive. Thus, $m = 3$ for an erect image three times the size of the object.

$$m = 3$$

For a concave mirror,

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

Using Mirror formula, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$$\Rightarrow \frac{1}{v} + \frac{1}{u} = \frac{1}{f} = \frac{2}{R} \text{ Putting the value of } v = -3u$$

$$-\frac{1}{3u} + \frac{1}{u} = \frac{1}{f} = \frac{2}{R}$$

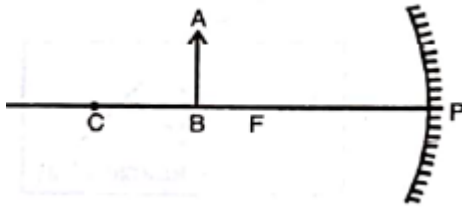
$$\Rightarrow \frac{2}{3u} = \frac{2}{-R}$$

$$\Rightarrow u = \frac{-R}{3} = \frac{-36}{3} = -12 \text{ cm } v = -3u$$

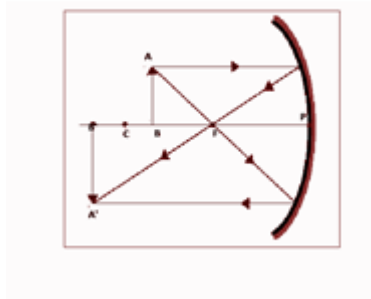
$$\Rightarrow v = 36 \text{ cm}$$

Thus, the image is formed behind the mirror at a distance of 36 cm.

Q.6. Copy the figure and show the image formation with the help of rays. Write three characteristics of the image formed.



Answer:

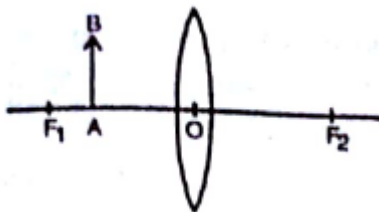


Q.7. Discuss the position and nature of the image formed by a concave mirror when the object is moved from infinity towards the pole of mirror.

Answer: As the object is moved from infinity towards the pole of a concave mirror, the image formed starts shifting from the focus of the mirror towards infinity.

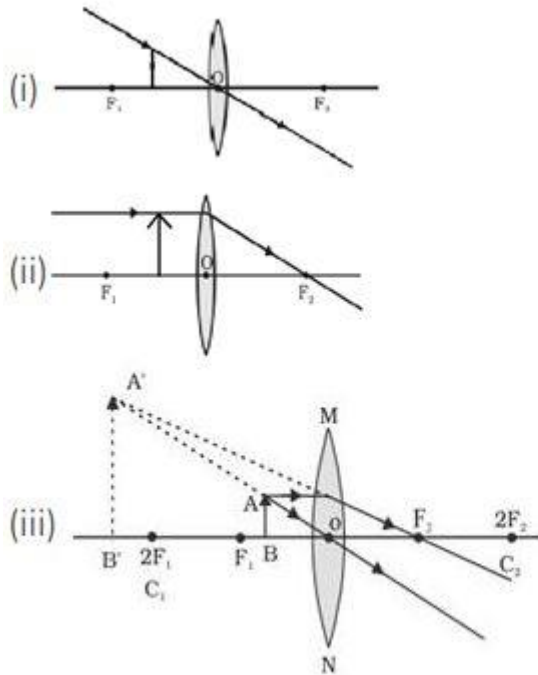
When the object is at infinity, the image is formed at the focus or in the focal plane. As the object is shifted, the image is formed between the focus and the centre of curvature, then at the centre of curvature, then beyond the centre of curvature, then at infinity and finally the image is formed behind the mirror.

Q.8 Figure below shows an object AB placed on the principal



axis of a convex lens placed in air. F₁ and F₂ are the two foci of the lens. Copy the diagram. (i) Draw a ray of light starting from B and passing through O. Show the same ray after refraction by the lens. (ii) Draw another ray from B which passes through F₂ after refraction by the lens. (iii) Locate the final image formed. (iv) Is the image real or inverted?

Answer:



The image is virtual, erect and larger than the object.

Q.9. Find the position, nature and size of the image of an object 3 cm high placed at a distance of 9 cm from a concave mirror of focal length 18 cm.

Answer: Given, height of object = + 3 cm object distance (v) = 9 cm focal length of concave mirror (f) = 18 cm Using Mirror formula, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ For concave mirror, $f = -18$ cm, $u = 9$ cm

$$\frac{1}{-9} + \frac{1}{v} = \frac{1}{-18}$$

$$\Rightarrow \frac{1}{v} = \frac{-1}{18} + \frac{1}{9}$$

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

$\Rightarrow v = 18$ cm Using Magnification equation,

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

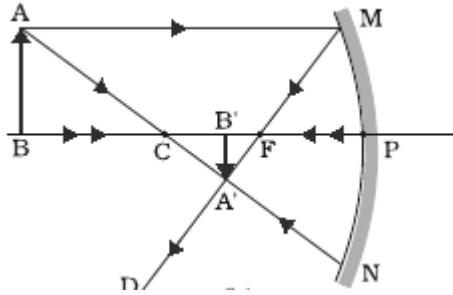
$$\Rightarrow h_i = \left(-\frac{v}{u}\right) \times h_o$$

$$\Rightarrow h_i = \left(-\frac{18}{9}\right) \times 3$$

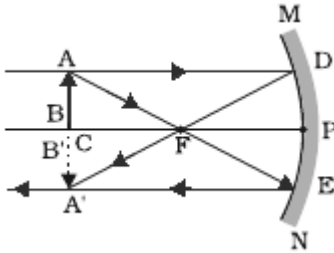
$\Rightarrow h_i = -6$ cm Thus, the image will be real, inverted and larger than the object.

Q.10. With the help of ray diagrams, show the formation of image of an object by a concave mirror. When it is placed: (i) beyond the centre of curvature (ii) at the centre of curvature.

Answer: (i) When object is beyond the centre of curvature



(ii) When the object is at the centre of curvature



Comprehensive Exercises (MCQ)

Q.1. Multiple images are formed by a thick plane mirror. Which of the following is the brightest of all the images?

- A. First
- B. second
- C. third
- D. fourth

Answer: For a thick plane mirror, first reflection will take place through the glass surface and the second through the silvered surface. The silvered surface is much more reflective than the glass surface. The third reflection will be after reflection from front and then from the silvered surface. So, the second reflection will be more effective and the second image will be the brightest.

Q. 2. A plane mirror is placed vertically facing due north. An arrow pointing north-east is kept in front of the mirror. In which direction will the arrow point in this image?

- A. north-east**
- B. south-east**
- C. south-west**
- D. north-west**

Answer: The arrow pointing north-east will have be resultant of two directions- north and east. The horizontal component of arrow facing east will be same on reflection. But the vertical component of arrow facing the plane mirror will be reflected and be reversed. Thus, the image will have an arrow resultant of south and east direction.

Q. 3. When a plane mirror is rotated through a certain angle, the reflected ray turns through twice as much and the size of the image:

- A. is doubled**
- B. is halved**
- C. becomes infinite**
- D. remains same**

Answer: The size of the image does not change when the mirror is rotated by a certain angle. But the reflected ray rotates twice the angle of rotation of incident ray.

Q.4. The image formed by a convex mirror is only one-third of the size of the object. If the focal length of the mirror is 12 cm, the image formed will be

- A. 8 cm behind the mirror**
- B. 10 cm behind the mirror**
- C. 8 cm in front of the mirror**
- D. 10 cm in front of the mirror**

Answer:

Given,

$$\text{height of image}(h_i) = \frac{\text{height of object}(h_o)}{3} \text{ focal length of mirror}(f) = 12 \text{ cm}$$

$$m = \frac{h_i}{h_o} = \frac{-v}{u} = \frac{1}{3} \Rightarrow u = -3v$$

$$\text{Using Mirror formula, } \Rightarrow \frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{v} + \frac{1}{-3v} = \frac{1}{12}$$

$$\Rightarrow \frac{2}{3v} = \frac{1}{12}$$

$\Rightarrow v = 8 \text{ cm}$ As v is positive, so image is formed at 8 cm behind the mirror.

Q.5. A beam of light incident on a plane mirror forms a real image on reflection. The incident beam is:

- A. parallel
- B. convergent
- C. divergent
- D. not certain

Answer: A real image is formed when the rays of light are convergent and a virtual image is formed when the rays of light diverge. The convergent rays meet to form a real image and the divergent rays appear to meet to form a virtual image.

Q.6. If an object is placed symmetrically between two plane mirrors, inclined at an angle of 72° , then total number of images formed is:

- A. 5
- B. 4
- C. 2
- D. infinite

Answer: The number of images formed if two plane mirrors are kept at an angle θ is given by,

$\frac{360^\circ}{\theta}$ if $\frac{360^\circ}{\theta}$ is odd and it is given by $\frac{360^\circ}{\theta} - 1$ if $\frac{360^\circ}{\theta}$ is even.

For $\theta = 72^\circ$, number of images is $\frac{360^\circ}{72^\circ} = 5$ as $\frac{360^\circ}{72^\circ} = 5$ is an odd number.

Q.7. A plane mirror produces a magnification of:

- A. -1
- B. + 1
- C. zero
- D. between 0 and infinity

Answer: A plane mirror produce an image of the same size as the object. Thus, the value of magnification is 1 for a plane mirror.

The formed image is virtual. The magnification is positive for a virtual image. Thus, the magnification by a plane mirror is + 1.

Q. 8. A dice is place with one of its edges parallel to the principal axis between the principal focus and the centre of curvature of concave mirror. Then the final image has the shape of:

- A. cube
- B. rectangular parallelepiped
- C. barrel shape
- D. spherical

Answer: The final image will have the edges perpendicular to principal axes larger than that of the dice. Thus, the shape of dice will be same but with different dimensions like a rectangular parallelepiped.

Q.9. Two adjacent walls and the ceiling of a rectangular room are mirror surfaced. The number of images of himself that an observer sees is:

- A. 3
- B. 9
- C. 6

D. 8

Answer:

The number of images formed if two plane mirrors are kept at an angle θ is given by, $\frac{360^\circ}{\theta}$ if $\frac{360^\circ}{\theta}$ is odd and it is given by $\frac{360^\circ}{\theta} - 1$ if $\frac{360^\circ}{\theta}$ is even.

For $\theta = 90^\circ$, number of images is $\frac{360^\circ}{90^\circ} - 1 = 4 - 1 = 3$ as $\frac{360^\circ}{90^\circ} = 4$ is an even number.

So, 3 images will be formed for each perpendicular mirror pair. Thus, 6 images will be formed, 3 for adjacent walls and 3 for wall and ceiling mirrors.

Q. 10. Image formed by a convex spherical mirror is:

A. virtual

B. real

C. enlarged

D. inverted

Answer: A convex spherical mirror always produces a virtual, erect and diminished image of an object.

Q.11. A diminished virtual image can be obtained only in:

A. plane mirror

B. concave mirror

C. convex mirror

D. all of these

Answer: A convex mirror always produces a diminished virtual and erect image for a real object.

Q. 12. A convex mirror has a focal length f . A real object is placed at a distance f in front of it. The mirror produces an image at:

A. infinity

B. f

C. $f/2$

D. $2f$

Answer: The image is formed between the pole and the focus of a convex mirror for an object placed between infinity and the pole of the mirror.

Q. 13. A light ray incident normally on a plane mirror suffers deviation of:

A. zero

B. 90°

C. 180°

D. 360°

Answer: A light ray incident normally on a plane surface traces back its path. The angle of deviation is the angle between produced incident ray and reflected ray.

The angle of deviation is 180° for the above case.

Q. 14. A convex mirror is used to form the image of a real object. Then tick the wrong statement:

A. image lies between the pole and the focus

B. image lies is diminished in size

C. image is erect

D. image is real

Answer: A convex mirror always forms a virtual, erect and diminished image for a real object irrespective of its position.

Q.15. An object is placed at a distance of 40 cm in front of a concave mirror of focal length 20 cm. The image produced is:

A. virtual and inverted

B. real and erect

C. real, inverted and diminished

D. real, inverted and of same size

Answer: The radius of curvature of the mirror is double the focal length ($R = 2f$). The image formed at the centre of curvature of the concave mirror is real, inverted and of the same size.

For the given mirror, the center The object distance is equal to the centre of curvature of the concave mirror.

Q. 16. Two plane mirrors are at right angles to each other. A man stands between them and combs his hair with the right hand. In how many images will he be seen using his left hand?

A. none

B. 1

C. 2

D. 3

Answer: Total number of images formed by two mirrors at right angles is $\frac{360^\circ}{90^\circ} - 1 = 4 - 1 = 3$. But only one image will have the man with comb in his right hand. This image is produced by the imaginary mirror created between dual reflection. Thus, two images will have the man combing with left hand.

Comprehensive Exercises (T/F)

Q.1. Write true or false for the following statements:

Laws of reflection are true only for plane mirror and not for curved mirrors.

Answer: False

The Laws of reflection are valid for any reflecting surface including spherical surfaces. So, they are valid for both plane and curved mirrors.

Q.2. Write true or false for the following statements:

The radius of curvature of a spherical mirror is half of the focal length.

Answer: False

The radius of curvature of a spherical mirror is twice of its focal length. ($R = 2f$)

Q.3. Write true or false for the following statements:

The rays travelling parallel to the principal axis after reflecting from the concave mirror pass or appear to pass through the focus.

Answer: True

Q.4. Write true or false for the following statements:

Convex mirror can be used to see large image of small object.

Answer: False

A convex always produces a diminished image of the object. It can never produce an image larger than the size of the object.

Q. 5. Write true or false for the following statements:

A convex mirror always forms a virtual and erect image.

Answer: True

Q.6. Write true or false for the following statements:

A concave mirror can be used to obtain a parallel beam of light from a small lamp.

Answer: True

When a small lamp is kept at the focus of the concave mirror, the rays of light emitted from the lamp after reflection on its surface pass parallel to the principal axis.

Q.7. Write true or false for the following statements:

A plane mirror can be used to form a real image equal in size as of the object.

Answer: False

A plane mirror always produces a virtual image for a real object.

Q.8. Write true or false for the following statements:

A virtual, magnified and erect image can be formed by a concave mirror.

Answer: True

When an object is kept between the focus and pole of a concave mirror, a virtual, magnified and erect image is obtained behind the mirror.

Q.9. Write true or false for the following statements:

When a plane mirror is turned by a angle θ , the reflected rays turns by an angle θ .

Answer: False

When a plane mirror is turned by a angle θ , the reflected rays turns by an angle 2θ .

Q.10. Write true or false for the following statements:

In a plane mirror, the distance between image and the mirror is the same as distance between object and the mirror.

Answer: True

In a plane mirror, the image distance is equal to the object distance.

Q.11. Write true or false for the following statements:

If an object is placed in between two plane mirrors inclined at and angle 45° , then the number of image formed will be 9.

Answer: False

The number of images formed if two plane mirrors are kept at an angle θ is given by, $\frac{360^\circ}{\theta}$ if $\frac{360^\circ}{\theta}$ is odd and it is given by $\frac{360^\circ}{\theta} - 1$ if $\frac{360^\circ}{\theta}$ is even.

For $\theta = 45^\circ$, number of images is $\frac{360^\circ}{45^\circ} - 1 = 8 - 1 = 7$ as $\frac{360^\circ}{45^\circ} = 8$ is an even number.

Q.12. Write true or false for the following statements:

The frequency, wavelength or speed of light does not change on reflection.

Answer: True

Q. 13. Write true or false for the following statements:

Mirror formula is relation between height of the image and the height of the object.

Answer: False

Mirror formula is a relation between the object distance, image distance and the focal length of a mirror. Magnification formula deals with the height of the image and the height of the object.

Q.14. Write true or false for the following statements:

Mirror formula is the same irrespective of convex mirror or a concave mirror.

Answer: True

Mirror formula does not change for concave and convex mirror. The sign conventions are changed according to the nature of mirror.

Q.15. Write true or false for the following statements:

Magnification equation is a relation between image distance and object distance.

Answer: True

Magnification formula deals with the height of the image and the height of the object.

Q.16. Write true or false for the following statements:

Magnification equation is the same irrespective of convex mirror and concave mirror.

Answer: True

The Magnification equation is not changed for convex and concave mirror. The height of the object and the height of the image are taken positive or negative as per the nature of mirror.