

Perpendicular distance of A' from the mirror = 1.5 cm = Perpendicular distance $A'P$ of A' from the mirror.

Perpendicular distance BQ of B from the mirror = 1.1 cm = Perpendicular distance $B'Q$ of B' from the mirror.

3. An object is at a distance 25 cm in front of a plane mirror. The mirror is shifted 5 cm away from the object. Find : (i) the new distance

(ii) The new distance AB' between the object A and the image $B' = 30 \text{ cm} + 30 \text{ cm} = 60 \text{ cm}$.

(iii) Taking the position of the object A as reference point, the distance between the two positions of the image, $BB' =$ new distance of image from the object, $AB' -$ initial distance of image from the object, $AB = 60 - 50 = 10 \text{ cm}$.

EXERCISE-7(A)

(A) MULTIPLE CHOICE TYPE :

(Choose the correct answer from the options given below).

1. The angle which the ray makes with the at the point of incidence is called angle of incidence.
(a) reflected, mirror ~~(b)~~ incidence, mirror
(c) incidence, normal (d) reflected, normal
 2. Regular reflection occurs when a beam of light falls on a
(a) smooth surface (b) polished surface
(c) rough surface ~~(d)~~ Both (a) and (b)
 3. According to the law of reflection :
(a) $i/r = \text{constant}$ (b) $\sin i / \sin r = \text{constant}$
(c) $i + r = \text{constant}$ ~~(d)~~ $i = r$
4. The image formed due to the actual intersection of the reflected rays is :
(a) virtual (b) diminished
~~(c)~~ real (d) enlarged
 5. The image formed by a plane mirror is :
(a) erect and diminished
(b) erect and enlarged
(c) inverted and of same size
~~(d)~~ erect and of same size.
 6. The image formed by a plane mirror is :
(a) real
(b) virtual
(c) virtual with lateral inversion
(d) real with lateral inversion.

7. A concave mirror forms image whereas a convex mirror forms
 (a) real, real (b) virtual, real
 (c) virtual, virtual (d) real, virtual
8. Which of the following combination of letters does not show lateral inversion ?
 (a) A, C, I (b) M, T, V
 (c) D, L, A (d) X, Y, Z
9. If an object is shifted by a distance d towards a plane mirror, the image will shift by distance towards the mirror.
 (a) d (b) $2d$
 (c) $4d$ (d) None of the above

(B) VERY SHORT ANSWER TYPE :

- Select the luminous object(s) from the following :
 Sun, Moon, Earth, Shooting star, Fire
- What do you mean by reflection of light ?
- State which surface of a plane mirror reflects most of the light incident on it : the front smooth surface or the back silvered surface.
- A light ray is incident normally on a plane mirror.
 (a) What is its angle of incidence ?
 (b) What is the direction of reflected ray ? Show it on a diagram.
- For a ray reflected on a plane mirror, find the ratio of $\sin i / \sin r$.
- Light from a torch is reflected by a white sheet of paper and a black polished mica sheet. Which of the two will produce a stronger reflected beam ?
- A light ray strikes a mirror and retraces its path. What is the angle of incidence and angle of reflection ?

(C) SHORT ANSWER TYPE :

- Explain the following terms :
 (a) plane mirror, (b) incident ray,
 (c) reflected ray, (d) angle of incidence, and
 (e) angle of reflection.
 Draw diagram/diagrams to show them.
- Differentiate between reflection of light from a plane mirror and that from a plane wall.
- State the two laws of reflection of light.
- Draw a diagram to show the reflection of a ray of light by a plane mirror. In the diagram, label the incident ray, the reflected ray, the normal, the angle of incidence and the angle of reflection.

- 5.** (a) Write three characteristics of the image formed by a plane mirror ?
 (b) How is the position of image related to the position of the object ?

6. Differentiate between a real and a virtual image.
 7. What is meant by lateral inversion of an image in a plane mirror ? Explain it with the help of a ray diagram.
 8. The letters on the front of an ambulance are written laterally inverted like AMBULANCE. Give reason.

(D) LONG ANSWER TYPE :

- With the help of diagrams, explain the difference between regular and irregular reflection.
- State the laws of reflection and describe an experiment to verify them.
- Fig. 7.15 shows an incident ray AO and the normal ON on a plane mirror. The angle which the incident ray AO makes with the mirror is 30° . (a) Find the angle of incidence. (b) Draw the reflected ray and then find the angle between the incident and reflected rays.

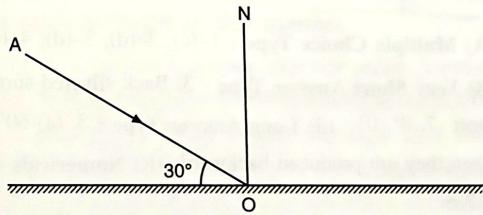


Fig. 7.15

- The diagram in Fig. 7.16 shows a point object P in front of a plane mirror MM_1 .

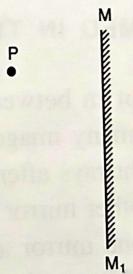


Fig. 7.16

- Complete the diagram by taking two rays from the point P to show the formation of its image.
- In the diagram, mark the position of eye to see the image.
- Is the image formed real or virtual ? Explain why ?
- The diagram below in Fig. 7.17 shows an object XY in front of a plane mirror MM_1 . Draw on the diagram, path

of two rays from each point X and Y of the object to show the formation of its image.

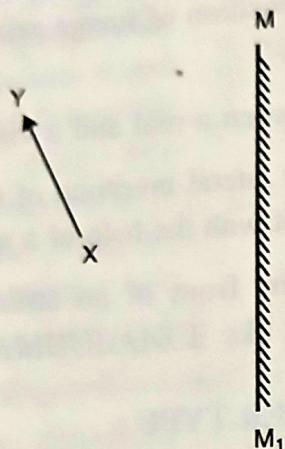


Fig. 7.17

(E) NUMERICALS :

1. A ray is incident on a plane mirror. Its reflected ray is perpendicular to the incident ray. Find the angle of incidence.

$$\angle i = 45^\circ$$

2. A man standing in front of a plane mirror finds his image at a distance 6 metre from himself. What is the distance of man from the mirror ? 3m
3. An insect is sitting in front of a plane mirror at a distance 1 m from it.
 - (a) Where is the image of the insect formed ? 1m behind the mirror
 - (b) What is the distance between the insect and its image ? 2m
4. An object is kept at 60 cm in front of a plane mirror. If the mirror is now moved 25 cm away from the object, how does the image shift from its previous position ? 50cm
5. An optician while testing the eyes of a patient keeps a chart of letters 3 m behind the patient and asks him to see the letters on the image of chart formed in a plane mirror kept at distance 2 m in front of him. At what distance is the chart seen by the patient ? 7m

EXERCISE-7(B)

(A) MULTIPLE CHOICE TYPE :

(Choose the correct answer from the options given below).

1. In a barber's shop, two plane mirrors are placed :
 - (a) perpendicular to each other
 - (b) parallel to each other
 - (c) at an angle of 60° between them
 - (d) at an angle of 45° between them.
2. For two mirrors kept parallel to each other, the number of images formed is :
 - (a) 5
 - (b) 7
 - (c) 0
 - (d) infinity

3. The number of images formed for two mirrors kept perpendicular to each other is :
 - (a) 1
 - (b) 2
 - (c) 3
 - (d) 5
4. A thick plane mirror, silvered at its back, forms multiple number of images. Out of these, the brightest image is :
 - (a) first image
 - (b) second image
 - (c) third image
 - (d) All are of equal brightness
5. How many plane mirrors are used in a periscope and a kaleidoscope ?
 - (a) 2 and 3 respectively
 - (b) 3 each
 - (c) 3 and 2 respectively
 - (d) 2 and 4 respectively

6. In a kaleidoscope, three plane mirrors are inclined with each other at an angle of :

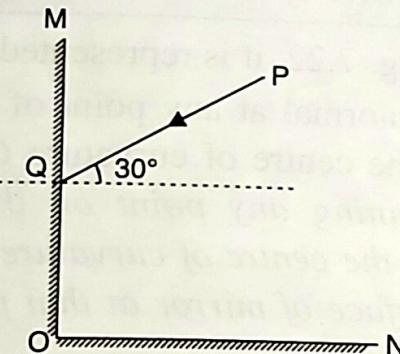
- (a) 0° (b) 30° (c) 60° (d) 90°

7. In a periscope, two plane mirrors are inclined at an angle of with the vertical walls.

- (a) 0° (b) 30° (c) 45° (d) 60°

8. Two mirrors are placed at right angles to each other as shown in the figure given below. A ray of light PQ strikes mirror OM at an angle of incidence 30° . What would be its angle of reflection from mirror ON ?

- (a) 30°
(b) 60°
(c) 45°
(d) 90°



(B) VERY SHORT ANSWER TYPE :

1. What is the most common use of a plane mirror ?
2. How does an optician increase the effective length of his room by using a mirror ? Where does he place the sign board ?
3. What relationship do the images formed by two inclined plane mirrors have for their location with respect to the object placed between them ?

(C) SHORT ANSWER TYPE :

1. Two plane mirrors are placed making an angle θ in between them. Write an expression for the number of images formed if an object is placed in between the mirrors. State the condition, if any.

+ 2. Two plane mirrors are placed making an angle θ° in between them. For an object placed in between the mirrors, if angle is gradually increased from 0° to 180° , how will the number of images change: increase, decrease or remain unchanged ?

3. State two uses of a plane mirror.

(D) LONG ANSWER TYPE :

1. How many images are formed for a point object kept in between the two plane mirrors at right angles to each other ? Show them by drawing a ray diagram.

2. Two plane mirrors are arranged parallel and facing each other at some separation. How many images are formed for a point object kept in between them ? Show the formation of images with the help of a ray diagram.

(E) NUMERICALS:

1. State the number of images of an object placed between the two plane mirrors, formed in each case when the mirrors are inclined to each other at (a) 90° , and (b) 60° .
2. An object is placed (i) asymmetrically (ii) symmetrically, between two plane mirrors inclined at an angle of 50° . Find the number of images formed.

EXERCISE-7(C)

(A) MULTIPLE CHOICE TYPE :

1. (Choose the correct answer from the options given below).

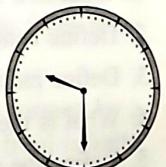
(i) A mirror is made by silvering the surface of a piece of a hollow sphere.

- (a) convex, outer (b) plane, outer

- (e) concave, outer (d) concave, inner
(ii) A mirror is made by silvering the surface of a piece of a hollow sphere.
(a) concave, inner (b) convex, inner
(c) convex, outer (d) None of the above

- (iii) The correct statement(s) is/are :
- The radius of a sphere of which the spherical mirror is a part is called the radius of curvature.
 - The geometric centre of the spherical surface of a mirror is called the centre of curvature.
 - Principal axis is the straight line joining the pole of the mirror to its aperture.
- ~~(1)~~ (1) (2)
~~(c)~~ (3) None of the above
- (iv) The focus of a concave mirror is a point on the through which the light rays incident to the principal axis pass after reflection from the mirror.
- centre of curvature, perpendicular
 - principal axis, parallel
 - principal axis, perpendicular
 - aperture, parallel
- (v) For an incident ray directed towards centre of curvature of a spherical mirror, the reflected ray :
- ~~(a)~~ retraces its path
 (b) passes through the focus
 (c) passes through the pole
 (d) becomes parallel to the principal axis.
- (vi) A ray either incident from the focus (or converging at the focus), after reflection from a spherical mirror :
- becomes perpendicular to the principal axis
 - ~~(b)~~ becomes parallel to the principal axis
 - becomes normal to the focus
 - passes through the centre of curvature
- (vii) For a concave mirror, when the object is at infinity, the nature of the image formed at focus is :
- virtual, inverted
 - virtual, diminished to a point
 - real, enlarged, inverted
 - ~~(d)~~ real, inverted, diminished to a point
- (viii) For a concave mirror, when the object is at the centre of curvature, the place and nature of the image formed is :
- at focus, real, inverted
 - at focus, virtual, inverted
 - at centre of curvature, real, inverted, diminished
 - ~~(d)~~ at centre of curvature, real, same size as that of the object
- (ix) For a concave mirror, when the object is at focus, the size of the image formed is :
- magnified
 - ~~(b)~~ highly magnified
 - diminished
 - of the same size

- (x) The image formed by a convex mirror is :
- ~~(a)~~ erect and diminished
 - erect and enlarged
 - inverted and diminished
 - inverted and enlarged.
- (xi) For a convex mirror, when the object is in front of the mirror, the image formed is :
- real, upright and magnified
 - real, inverted and diminished
 - virtual, upright and magnified
 - ~~(d)~~ virtual, upright and diminished
- (xii) The wrong rule of sign convention is :
- All distances are measured from the centre of curvature of the mirror taken as origin.
 - The distances measured along the principal axis in the direction of incident light are positive.
 - The distances above the principal axis are taken positive.
- ~~(a)~~ (1) (2)
~~(c)~~ (3) both (1) and (2)
- (xiii) For a convex mirror, the value of u is always and the value of v is
- positive, positive
 - positive, negative
 - negative, negative
 - ~~(d)~~ negative, positive
- (xiv) A real and enlarged image can be obtained by using a:
- convex mirror
 - plane mirror
 - ~~(c)~~ concave mirror
 - either convex or plane mirror.
- (xv) The type of mirror used as a reflector in the street lights is :
- plane mirror
 - ~~(b)~~ convex mirror
 - concave mirror
 - parabolic mirror
- (xvi) The type of mirror used as a shaving mirror in daily life is :
- plane mirror
 - convex mirror
 - ~~(c)~~ concave mirror
 - parabolic mirror
- (xvii) Which mirror always forms a diminished image for all positions of the object placed in front of it ?
- plane mirror
 - ~~(b)~~ convex mirror
 - concave mirror
 - parabolic mirror
- (xviii) The figure shows the image of a clock as seen in the plane mirror. The correct time is :
- 4:30
 - 6:30
 - ~~(c)~~ 2:30
 - 3:30



(xix) We use a concave polished metallic surface as a reflector in a torch to obtain a parallel beam of light. The position of the bulb is :

- (a) at the centre of curvature of the reflector.
- (b)** at the focus of the reflector
- (c) between the focus and centre of curvature of the reflector
- (d) can be any of the above options

2. The following questions are Assertion-Reason based questions. Choose the answer based on the codes given below.

- (a) both A and R are true and R is the correct explanation of A
 - (b) both A and R are True and R is not the correct explanation of A
 - (c) assertion is false but reason is true
 - (d) assertion is true but reason is false
- (i) **Assertion (A)** : For a ray of light incident at an angle of incidence $i = 0^\circ$, angle of reflection is $r = 0^\circ$.
Reason (R) : The angle of incidence i is equal to angle of reflection r . **(a)**
- (ii) **Assertion (A)** : The image of an object placed close to a concave mirror is a real image.
Reason (R) : A real image is formed due to the actual intersection of the reflected rays. **(c)**
- (iii) **Assertion (A)** : For a real image formed by a spherical mirror, linear magnification (m) is positive.
Reason (R) : Both u and v are negative for a real image. **(c)**
- (iv) **Assertion (A)** : For an object placed symmetrically when the angle θ between the mirrors is 72° , the number of images formed is 4.
Reason (R) : If $n = 360^\circ/\theta$ is odd, the number of images for an object placed symmetrically is equal to n . **(d)**

- (v) **Assertion (A)** : Concave mirror is used as doctor's head mirror.
Reason (R) : If a parallel beam of light is incident on a concave mirror, the mirror focuses the beam to a point. **(a)**
- (vi) **Assertion (A)** : A student is given a spherical mirror of focal length - 10 cm. He identifies it as a concave mirror.
Reason (R) : Focal length of a concave mirror is always positive. **(d)**

(B) VERY SHORT ANSWER TYPE :

1. What is a spherical mirror ?
2. Define centre of curvature of a spherical mirror.
3. Define radius of curvature of a spherical mirror.
4. What is the aperture of a spherical mirror ?
5. Define the pole of a spherical mirror.

6. Name the spherical mirror which always produces an erect and virtual image. How is the size of image related to the size of object ?
7. (a) For what position of object, the image formed by a concave mirror is magnified and erect ?
(b) State whether the image in part (a) is real or virtual?
8. (a) State the position of object for which the image formed by a concave mirror is of same size.
(b) Write two more characteristics of the image.
9. (a) What is a real image ?
(b) What type of mirror can be used to obtain a real image of an object ?
(c) Does the mirror mentioned in part (b) form real image for all locations of the object ?

10. Name the kind of mirror used to obtain :
 - (a) a real and enlarged image,
 - (b) a virtual and enlarged image,
 - (c) a virtual and diminished image,
 - (d) a real and diminished image.
 11. How is the focal length of a spherical mirror related to its radius of curvature ?
 12. Write the spherical mirror's formula and explain the meaning of each symbol used in it.
 13. State the kind of mirror used
 - (a) by a dentist, (b) as a search-light reflector.
 14. Which mirror will you prefer to use as a rear view mirror in a car : plane mirror or convex mirror ? Give one reason.
 15. How is magnification (m) related to the distance of the object (u) and the distance of the image (v) ?
- (C) SHORT ANSWER TYPE :
1. Name the two kinds of spherical mirrors and distinguish between them.
 2. Define the terms pole, principal axis and centre of curvature with reference to a spherical mirror.
 3. Name the spherical mirror which (i) diverges (ii) converges the beam of light incident on it. Justify your answer by drawing a ray diagram in each case.
 4. Define the terms focus and focal length of a concave mirror. Draw a diagram to illustrate your answer.
 5. State the direction of incident ray which after reflection from a spherical mirror retraces its path. Give a reason to your answer.
 6. What is meant by magnification ? Write its expression. What is its sign for the (a) real (b) virtual, image ?
 7. Upto what maximum distance from the pole, the image in a convex mirror can be obtained ? What will be the location of object then ?
 8. Upto what maximum distance from a concave mirror, the image can be obtained ? What will be the location of object for it ?

9. How will you distinguish between a plane mirror, a concave mirror and a convex mirror, without touching them ?

10. State two uses of a concave mirror.

11. (a) When a concave mirror is used as a shaving mirror, where is the person's face in relation to the focus of mirror ?

(b) State three characteristics of the image seen in part (a).

(D) LONG ANSWER TYPE :

1. Draw suitable diagrams to illustrate the action of (i) concave mirror, and (ii) convex mirror, on a beam of light incident parallel to the principal axis.

2. Explain the meaning of the terms focus and focal length in case of a convex mirror, with the help of a suitable ray diagram.

3. (i) Name the mirrors shown in Fig. 7.49 (a) and (b).

(ii) In each case (a) and (b), draw the reflected rays for the given incident rays and mark focus by the symbol F .

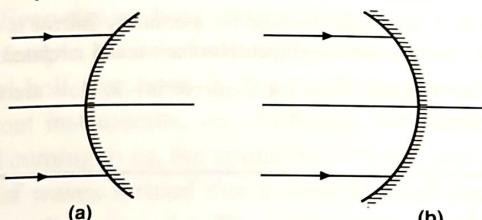


Fig. 7.49

4. Complete the following diagrams in Fig. 7.50 by drawing the reflected rays for the incident rays 1 and 2.

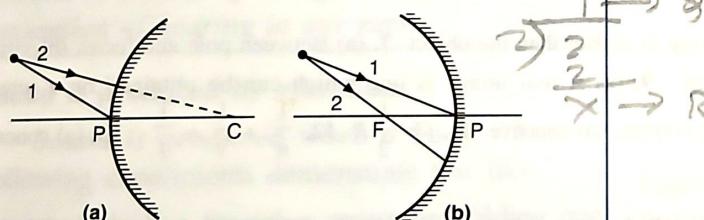


Fig. 7.50

5. Complete the following diagrams shown in Fig. 7.51 by drawing the reflected ray for each of the incident ray A and B .

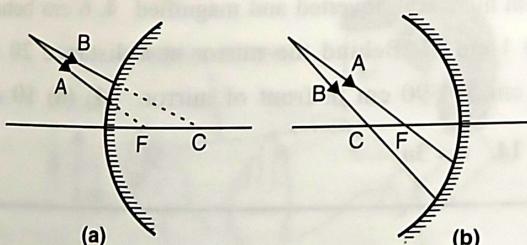


Fig. 7.51

6. State the two convenient rays that are chosen to construct the image by a spherical mirror for a given object ? Explain your answer with the help of suitable ray diagrams.

7. Fig. 7.52 shows a concave mirror with its pole at P , focus F and centre of curvature C . Draw ray diagram to show the formation of image of an object OA .

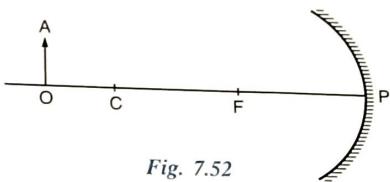


Fig. 7.52

8. Fig. 7.53 shows a concave mirror with its pole at P , focus F and centre of curvature C . Draw ray diagram to show the formation of image of an object OA .

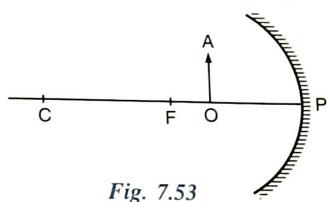


Fig. 7.53

9. The diagram below in Fig. 7.54 shows a convex mirror. C is its centre of curvature and F is its focus. (i) Draw two rays from A and hence locate the position of image of object OA . Label the image IB . (ii) State three characteristics of the image.

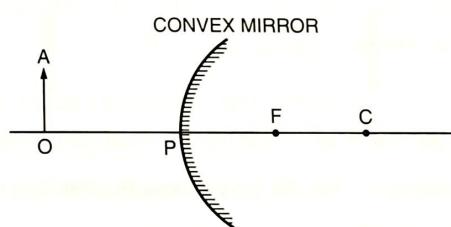


Fig. 7.54

10. Draw a ray diagram to show the formation of image by a concave mirror for an object placed between its pole and focus. State three characteristics of the image.

11. Draw a ray diagram to show the formation of image by a concave mirror for an object beyond its centre of curvature. State three characteristics of the image.

12. Draw a ray diagram to show the formation of image of an object kept in front of a convex mirror. State three characteristics of the image.

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

14. Discuss the position and nature of image formed by a convex mirror when an object is moved from infinity towards the pole of mirror.
15. Why does a driver use a convex mirror instead of a plane mirror as a rear view mirror ? Illustrate your answer with the help of a ray diagram.

(E) NUMERICALS :

1. The radius of curvature of a convex mirror is 40 cm. Find its focal length.
2. The focal length of a concave mirror is 10 cm. Find its radius of curvature.
3. An object of height 2 cm is placed at a distance 20 cm in front of a concave mirror of focal length 12 cm. Find the position, size and nature of the image.
4. An object is placed at 4 cm distance in front of a concave mirror of radius of curvature 24 cm. Find the position of image. Is the image magnified ?
5. At what distance from a concave mirror of focal length 25 cm should an object be placed so that the size of image is equal to the size of the object.
6. An object 5 cm high is placed at a distance 60 cm in front of a concave mirror of focal length 10 cm. Find (i) the position and (ii) size, of the image.

7. A point light source is kept in front of a convex mirror at a distance of 40 cm. The focal length of the mirror is 40 cm. Find the position of image.
8. When an object of height 1 cm is kept at a distance 4 cm from a concave mirror, its erect image of height 1.5 cm is formed at a distance 6 cm behind the mirror. Find the focal length of mirror.
9. An object of length 4 cm is placed in front of a concave mirror at distance 30 cm. The focal length of mirror is 15 cm. (a) Where will the image form ? (b) What will be the length of image ?
10. A concave mirror forms a real image of an object placed in front of it at a distance 30 cm, of size three times the size of object. Find (a) the focal length of mirror (b) position of image.
11. A concave mirror forms a virtual image of size twice that of the object placed at a distance 5 cm from it. Find: (a) the focal length of the mirror (b) position of image.
12. The image formed by a convex mirror is of size one-third the size of object. How are u and v related ?
13. The erect image formed by a concave mirror is of size double the size of object. How are u and v related ?
14. The magnification for a mirror is -3. How are u and v related ?