LIGHT - REFLECTION & REFRACTION

Important Questions

MCQ Type questions (1 mark each)

1.An object is kept at a distance more than twice the focal length (F) from a concave mirror. The distance the image formed will be

(a) less than F (b) equal to F

(c) between F and 2 F (d) More than 2 F

Ans. (c) between F and 2 F

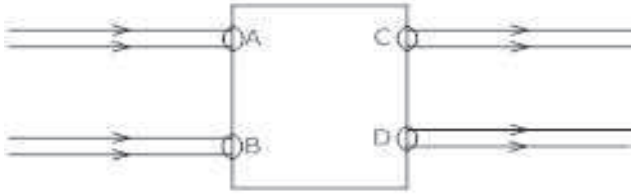
2. A ray passing through the centre of curvature of a concave mirror. The angle of reflection for this ray is-

(a) 0° (b) 60°

(c) 180° (d) 90°

Ans. (a) 0°

3. Beams of light are incident through the holes C and D respectively as shown in the figure. Which of the following could be inside the box?



(a) A rectangular glass slab (b) Convex lens

(c) Concave lens (d) Prism

Ans. (a) A rectangular glass slab

4. What are the values of (i) Angle of incidence and (ii) Angle of reflection for normal incidence on a plane surface?

(a) 0° (c) 45°

(b) 90° (d) 180°

Ans. (a) 0°

5. The power of a lens is -4.0 D. What is the nature of the lens?

(a) Plane (b) Concave

(c) Convex (d) Plano convex

Ans. (b) Concave

6. Where should an object be placed in front of a convex lens to get a real image of the same size of the object?

(a) At focus (b) At 2F

(c) At Infinity (d) Between optical centre and focus.

Ans. (b) At 2F

7. In torches, search lights and headlights of vehicles the bulb is placed

(a) Between pole and focus (b) Very near to the focus

(c) Between focus and centre of curvature (d) At centre of curvature

Ans. (b) Very near to the focus

8. When a ray of light goes from one medium to another, there is

(a) Always a change in its speed as well as direction (b) No change in speed and direction

(c) A change in speed but no change in direction (d) A change in direction but constant speed.

Ans. (a) Always a change in its speed as well as direction

9. Name the mirror that can give an erect and enlarged image of an object?

(a) plane mirror (b) concavemirror

(c) convex mirror (d) rear view mirror
Ans. Concave mirror
10. Which one of the following materials cannot be used to make a lens?
(a) Water (b) Glass
(c) Plastic (d) Clay
Ans. (d) Clay
11. 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.
Ans. (d) Between the pole of the mirror and its principal focus.
12. Where should an object be placed in front of a convex lens to get a real image at infinity?
(a) At the principal focus of the lens. (b) At twice the focal length
(c) At infinity (d) Between the optical centre of the lens and its principal focus.
Ans. (a) At the principal focus.
13. A spherical mirror and thin spherical lens have each of focal length of -15 cm. the mirror and lens are likely to be
(a) Both concave (b) Both convex
(c) The mirror is concave and the lens is convex (d) The mirror is convex and the lens is concave.
Ans. (a) Both concave
14. 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 concave or convex.
Ans. (d) Either concave or convex.
15. Which of the following lenses would you prefer to use while reading small letters found in a dictionary?
(a) A convex lens of focal length 50 cm (b) A concave lens of focal length 50 cm
(c) A convex lens of focal length 5 cm (d) A concave lens of focal length 5 cm
Ans. (c) A convex lens of focal length 5 cm
16. Which of the following can make a parallel beam of light when light from a point source is incident on it?
(a) Concave mirror as well as convex lens (b) Convex mirror as well as a concave lens
(c) Two plane mirrors placed at 90° to each other (d) Concave mirror as well as a concave lens
Ans. (a) Concave mirror as well as convex lens
17. A 10 mm long pin is placed vertically in front of a concave mirror. A 5 mm long image of the all pin is formed at 30 cm in front of the mirror. The focal length of this mirror is
(a) – 30 cm (b) – 20 cm
(c) – 40 cm (d) – 60 cm
Ans. (b) – 20 cm (**hint:** find u from magnification formula, then find f using mirror formula)
18. Which of the following statements is true?
(a) A convex lens has 4 dioptre power having a focal length 0.25 m
(b) A convex lens has –4 dioptre power having a focal length 0.25 m
(c) A concave lens has 4 dioptre power having a focal length 0.25 m
(d) A concave lens has –4 dioptre power having a focal length 0.25 m
Ans. (a) A convex lens has 4 dioptre power having a focal length 0.25 m
19. Magnification produced by a rearview mirror fitted in vehicles
(a) is less than one (b) is more than one

(c) is equal to one (d) can be more than or less than one, depending upon the position of the object in front of it

Ans. (a) is less than one

20. Rays from the Sun converge at a point 15 cm in front of a concave mirror. Where should an object be placed, so that the size of its image is equal to the size of the object?

(a) 15 cm in front of the mirror (b) 30 cm in front of the mirror

(c) between 15 cm and 30 cm in front of the mirror (d) more than 30 cm in front of the mirror

Ans. (b) 30 cm in front of the mirror

Assertion Reason type questions

Following questions consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

1. **Assertion(A) :** The centre of curvature is not a part of the mirror. It lies outside its reflecting surface.
Reason (R) : The reflecting surface of a spherical mirror forms a part of a sphere. This sphere has a centre.
Answer: (a)

2. **Assertion (A) :** A ray passing through the centre of curvature of a concave mirror after reflection, is reflected back along the same path.
Reason (R) : The incident rays fall on the mirror along the normal to the reflecting surface.
Answer: (a)

3. **(A) :** A ray of light travelling from a rarer medium to a denser medium slows down and bends away from the normal. When it travels from a denser medium to a rarer medium, it speeds up and bends towards the normal.
Reason (R) : The speed of light is higher in a rarer medium than a denser medium.
Answer: (d)

4. **Assertion(A) :** Light travels faster in glass than in air.
Reason (R) : Glass is denser than air.
Answer: (d)

5. **Assertion(A) :** Refractive index has no units.
Reason (R) : The refractive index is a ratio of two similar quantities.
Answer: (a)

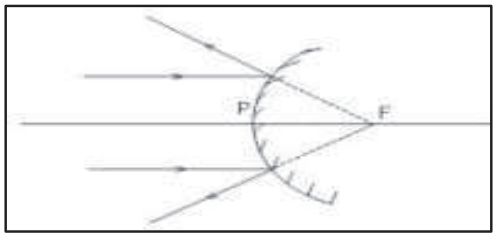
Very Short Answer Type questions (02 marks each)

1. A ray of light is incident at an angle of 35° to a plane surface. What will the angle of Reflection? (Ans: 55°)

2. A person uses concave mirror for shaving, where should he position his face in front of it? (Ans: Between pole and principal focus.)

3. A beam of rays, parallel to the principal axis, is incident on a convex mirror. Show diagrammatically, the path of these rays after reflection from the mirror.

Ans.



4. Find the power of a concave lens of focal length 2 m?
Ans. f=2m

$$P = \frac{1}{f}$$

$$P = \frac{1}{2} = 0.5 \text{ Dioptre}$$

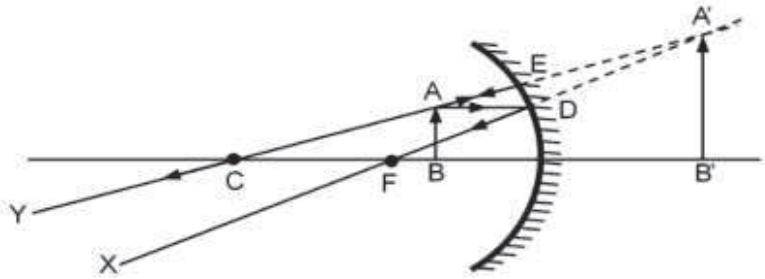
5. Three mirrors, one plane, one concave and one convex are lying on the table. How can a person identify them without touching them or using any other apparatus or device?
Ans. Plane mirror produces the image of the same size. Concave mirror produces the magnified image while the convex mirror will produce a diminished image.
6. In what S.I unit is the power of lens stated? A convex lens has a focal length of 50 cm. Calculate its power?
Ans. S.I unit of power is Dioptre (D)
Power = 1/f
7. Why do we prefer a convex mirror as a rear-view mirror in vehicles?
Ans. Convex mirror is preferred as rear-view mirror is vehicles because it always forms a virtual erect and diminished image. It also covers the wider field of view.
8. A doctor has prescribed a corrective lens of power 1.5 D. Find the focal length of this lens. Is the prescribed lens diverging or converging?
Ans: f = 1/P
Positive sign of power means it is a converging lens.
9. Define the principle focus of a concave mirror.
Ans. Principal focus of a concave mirror is the point on its principal axis, where light rays coming parallel to the principal axis actually converge after reflection from the mirror.
10. The radius of curvature of a spherical mirror is 20 cm. What is its focal length? Ans.
Focal length (f)= R/2 = 20 cm/2 = 10 cm.
11. Name a mirror that can give an erect and enlarged image of an object.
Ans. Only a concave mirror can give an erect and enlarged image of an object.
12. Why do we prefer a convex mirror as a rear-view mirror in vehicles?
Ans. We prefer a convex mirror as a rear-view mirror in vehicles because a convex mirror gives an erect and diminished image. As a result, convex mirrors help the driver to have a much wider field view.
13. If the focal length of a convex mirror is 16cm, what is the radius of curvature?
Ans. Radius of curvature of (R) = ?
Focal length(f) = 16 cm. , F = R/2: therefore R = 2F = 32cm.
14. A concave mirror produces three times magnified real image of an object placed at 10 cm in front of it. Where is the image located?
Ans. Distance of object from concave mirror (u)= -10 cm.
Magnification (m) = -3
m = -v/u
v = -mu = -(3) x (-10) = -30 cm.
15. A ray of light travelling in air enters obliquely into water. Does the light ray bend towards or away from the normal? Why?
Ans. The light bends towards the normal when entering water. Because the speed of light decreases in denser mediums.
16. Write the medium having the highest optical density. Also, write the medium with lowest optical density.

Ans. Diamond has the highest optical density (2.42). Medium with lowest optical density is air (1.0003)
17. Define absolute refractive index. What is its unit?
Ans. Absolute Refractive Index: The refractive index of a transparent medium is the ratio of the speed of light in vacuum to the speed of light in other medium. It has no unit as it is a ratio of two same quantities.
18. The refractive index of diamond is 2.42. What is the meaning of this statement? Ans.
It means that the speed of light in diamond is 2.42 times slower than speed of light in air.
19. If the refractive index of glass is 1.65, What is the speed of light in glass?
Ans. Given Refractive index = n = 1.65
speed of light in vacuum = $3x10^8$ m s^{-1}
Using, Refractive Index= speed of light in vacuum/ speed of light in glass
1.65 = $3x10^8$ ms^{-1}/ speed of light in glass
speed of light in glass = $3x10^8/1.65$
= $1.8x10^8$ m s^{-1}
Therefore, speed of light in glass is 1.8 $x10^8$ ms^{-1}
20. An object 1 cm high produces a real image 1.5 cm high, when placed at a distance of 15 cm from concave minor. Calculate the position of the image.
Ans. —v/u=h'/h, -v/-15-l.5
v = 15x 1.5 = -22.5 cm.

Short Answer Type Questions (03 marks each)

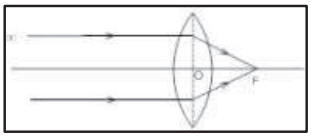
1. A rod of length 10 cm lies along the principal axis of a concave mirror of 10 cm in such a way that the end closer to the pole is 20 cm away from it. Find the length of the image?
Ans. R =2f=2O cm. Thus the nearer end B of the rod AB is at C and hence its image will be formed at B itself For end A u = -30 cm, f= -10 cm, v = -15 cm Length of image will be at 5 cm
2. 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 focused image can be obtained? Find the size and the nature of the image. Ans.
u = - 27 cm, f = - 18 cm.
1/v = 1/f- 1/u
1/v = -1/18 + 1/27 = -1/54
V = - 54 cm.
Screen must be placed at a distance of 54 cm from the mirror in front of it. (draw ray diagram)
3. 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.
Ans. Radius of curvature (R) = 30 cm
f = R/2 = 30/2 = 15 cm
u = -20 cm, h= 5 cm.
1/v +1/u = 1/f
1/v = 1/15+ 1/20 = 7/60
v = 60/7 = 8.6 cm.
the image is virtual and erect and formed behind the mirror. (draw ray diagram)
4. 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.
Ans. (a) Headlights of a car- concave mirror to give parallel beam of light after reflection from concave mirror.
(b) Side/rear-view mirror of vehicle- convex mirror as it forms a virtual erect and diminished image to give a wider view field.
(c) Solar furnace- concave mirror to concentrate sunlight to produce heat in solar furnace.
5. 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.
Ans. f = +15 cm, u = -10 cm.
$1/f = 1/v + 1/u$
$1/v = 1/15 + 1/10$
$1/v = 5/30$
v = + 30 cm.
The image is formed 6 cm behind the mirror, it is a virtual and erect image.
6. The magnification produced by a plane mirror is +1. What does this mean?
Ans. Magnification produced by a plane mirror is +1 which means that the size of the image formed is exactly equal to the size of the object behind the mirror.
7. If you want 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 image? Is the image larger or smaller than the object? Draw a ray diagram to show the image formation in this case.
Ans. Object must be placed in front of a concave mirror between its pole and principal focus at a distance less than 15 cm. The image formed will be virtual and erect. The size of the image is larger than the object. The ray diagram is as follows:

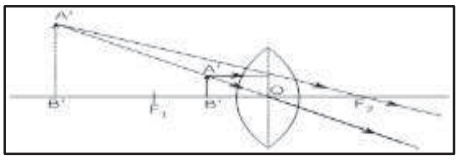


8. An object is kept at a distance of 15 cm from a
(a) convex mirror
(b) concave lens
(c) Plane mirror.
The focal length of the convex mirror and the concave lens are 10 cm each. Draw the appropriate ray diagrams, showing the formation of image, in each of the three cases.
Ans (draw ray diagrams)
9. Draw a ray diagram to represent the nature, position and size of the image formed by a convex lens for the object placed at
(a) infinity
(b) Between F1 and optical centre (O)

Ans-
(a) Size – Point sized
Position – At focus
Nature – Real & Inverted



(b) Size – highly magnified
Position – same side of the lens where the object is placed
Nature – virtual & erect.



10. An object 5 cm is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position, nature and size of the image.
Answer-
Object distance (u) = – 20 cm
Object height (h) = 5 cm
Radius of curvature (R) = 30 cm
Radius of curvature = 2 × Focal length
R = 2f
f = 15 cm

According to the mirror formula,

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

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

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

$$v = 8.57cm$$

$$The\ positive\ value\ of\ v\ indicates\ that\ the\ image\ is\ formed\ behind\ the\ mirror$$

$$Magnification, m = -\frac{Image\ Distance}{Object\ Distance} = \frac{-8.57}{-20} = 0.428$$

$$The\ positive\ value\ of\ magnification\ indicates\ that\ the\ image\ formed\ is\ virtual$$

$$Magnification, m = \frac{Height\ of\ the\ image}{Height\ of\ the\ object} = \frac{h^1}{h}$$

$$h^1 = m \times h = 0.428 \times 5 = 2.14cm$$

The positive value of image height indicates that the image formed is erect.
Hence, the image formed is erect, virtual, and smaller in size.

Long Answer Type Questions (05 marks each)

1. A convex lens has a focal length of 10 cm. At what distance from the lens should the object be placed so that it forms a real and inverted image 20 cm. away from the lens? What would be the size of the image formed if the object is 2 cm high? With the help of a ray diagram show the formation of the image by the lens in this case?

Ans. $f = +10cm$

$v = +20cm$

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

$\frac{1}{10} = \frac{1}{20} + \frac{1}{V}$

$\frac{1}{V} = \frac{1}{20}\frac{-1}{10}$

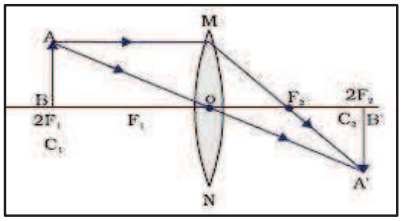
$\frac{1}{V} = \frac{1-2}{20}$

$\frac{1}{V} = \frac{-1}{20}$

$V = -20cm$

$m = \frac{-v}{V} = \frac{-20}{-20}$

$m = +1$



The image formed is real.

Object at 2F1 forms image at 2F2 Same size & Real & inverted.

2. A convex lens forms a real and inverted image of a needle at a distance of 50 cm. from it. Where is the needle placed in front of the convex lens if the image is equal to the size of objects? Also, find the power of lens.

Ans: In this solution we will use the lens formula 1/v−1/u=1/f …… (i).

Here, v and u are the positions of the image and the object with respect to the lens, according to the sign convection. f is the focal length of the lens.

It is said that when the needle is placed in front of the lens, a real and inverted image is formed and the size of the image is equal to the size of the needle.

The magnification is defined as the ratio of the size of the image to the size of the object. The value of magnification is given as m=vu

In this case, m= -1 because the image is inverted.

⇒− 1 = v/u

⇒v = −u

It is given that the image is formed at a distance of 50cm from the lens. And since the image is real,

v = +50cm.

This means that u = -50cm.

Therefore, the needle must be placed at a distance of 50cm from the lens.

Substitute the values of v and u in (i).

⇒1/50 −1/(−50) = 1/f

⇒1/f = 2/50 = 1/25

⇒f = 25cm

Therefore, the **focal length of the convex lens is 25cm.**

Power of a lens is given as P=1f

⇒P = 1/25cm−1

⇒P = 1/25 x (100)m-1 = 100/25 m−1= 4m−1

Since, 1m−1=1D

⇒P=4D

This means that the **power of the given lens is 4D (dioptre).**

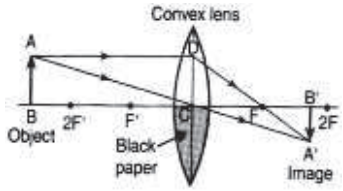
3. One-half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object? Verify your answers experimentally. Explain your observations.

Ans. When one-half of a convex lens is covered with a black paper, this lens produces a complete image of

the object. To prove it we perform experiment:

Take a concave mirror and cover half part of it by using black paper. Place it vertically in a stand. On one side of it is placed a burning candle. On the opposite side of the lens, fix a white screen. Adjust the position of the candle or screen till a clear image of the burning candle is formed on the screen. We observe that the image is a complete image of the object.

From the experimental observations, we find that image formation does not depend upon the size of a lens. A similar lens can also form a complete image of an object placed in front of it. However, the brightness of the image decreases when some part of the lens is blocked. It is because now a lesser number of rays pass through the lens.



Competency Based Questions (04 marks each)

Question 1: ***Read the following and answer any four questions from (i) to (iv).***

The spherical mirror forms different types of images when the object is placed at different locations. When the image is formed on screen, the image is real and when the image does not form on screen, the image is virtual. When the two reflected rays meet actually, the image is real and when they appear to meet, the image is virtual.

A concave mirror always forms a real and inverted image for different positions of the object. But if the object is placed between the focus and pole. the image formed is virtual and erect.

A convex mirror always forms a virtual, erect and diminished image. A concave mirror is used as a doctor's head mirror to focus light on body parts like eyes, ears, nose etc., to be examined because it can form an erect and magnified image of the object. The convex mirror is used as a rear view mirror in automobiles because it can form a small and erect image of an object.

(i) When an object is placed at the centre of curvature of a concave mirror, the image formed is

Answer: same size as that of the object

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

Answer: either plane or convex.

(iii) A child is standing in front of a magic mirror. She finds the image of her head bigger, the middle portion of her body of the same size and that of the legs smaller. The following is the order of combinations for the magic mirror from the top.

Answer: Concave, plane and convex

(iv) To get an image larger than the object, one can use

Answer: a concave mirror but not a convex mirror

Question 2: ***Read the following and answer any four questions from (i) to (v).***

The lenses form different types of images when objects are placed at different locations. When a ray is incident parallel to the principal axis, then after refraction, it passes through the focus or appears to come from the focus.

When a ray goes through the optical centre of the lens, it passes without any deviation. If the object is placed between the focus and optical centre of the convex lens, an erect and magnified image is formed.

As the object is brought closer to the convex lens from infinity to focus, the image moves away from the convex lens from focus to infinity. Also the size of the image goes on increasing and the image is always real and inverted.

A concave lens always gives a virtual, erect and diminished image irrespective of the position of the object.

(i) The location of image formed by a convex lens when the object is placed at infinity is

Answer: at focus

(ii) When the object is placed at the focus of concave lens, the image formed is

Answer: virtual and inverted

(iii) The size of image formed by a convex lens when the object is placed at the focus of convex lens is
Answer: highly magnified
(iv) When the object is placed at 2F in front of convex lens, the location of image is
Answer: at 2 F on the other side.