

**Question 1: Define the principal focus of a concave mirror.**

Solution: Light rays that are parallel to the principal axis of a concave mirror converge at a specific point on its principal axis after reflecting from the mirror. This point is known as the principal focus of the concave mirror

**Question 2: The radius of curvature of a spherical mirror is 20 cm. What is its focal length?**

Solution: Focal length =  $\frac{R}{2} = \frac{20\text{cm}}{2} = 10\text{cm}$

**Question 3: Why do we prefer a convex mirror as a rear-view mirror in vehicles?**

Solution: We prefer a convex mirror as a rear-view mirror in vehicles because it gives a wider field of view, which allows the driver to see most of the traffic behind him.

Convex mirrors always form a virtual, erect, and diminished image of the objects placed in front of it.

**Question 4: A concave mirror produces three times magnified (enlarged) real image of object placed at 10 cm in front of it. Where is the image located?**

Solution: Here a concave mirror produces three times magnified (enlarged) real image

So, and  $u = -10\text{cm}$   $m = -3 \Rightarrow -\frac{v}{u} = -3 \Rightarrow -\frac{v}{-10} = -3 \Rightarrow v = -30\text{ cm}$

Here, the negative sign indicates that an inverted image is formed in front of the given concave mirror at a distance of 30 cm

**Question 5: A ray of light travelling in air enters obliquely into water. Does the light ray bend towards the normal or away from the normal? Why?**

Solution: The light ray bends towards the normal because water is optically denser than air.

**Question 6: Light enters from air to glass having refractive index 1.50. What is the speed of light in the glass? The speed of light in vacuum is  $3 \times 10^8$  m/s.**

Solution: Speed of light in the glass = Speed of light in vacuums x refractive index of glass  
 $= 3 \times 10^8 \text{ m/s} \times 1.50 = 2 \times 10^8 \text{ m/s}$

Question 7: Find out, from Table (see NCERT Book), the medium having highest optical density. Also find the medium with lowest optical density.

Solution: As we know that Optical density of any medium is directly proportional to the refractive index of that medium. Therefore, diamond has the highest optical density and air has the lowest optical density.

Question 8: You are given kerosene, turpentine and water. In which of these does the light travel fastest? Use the information given in Table (see NCERT Book)

Solution: As we know that velocity of light is inversely proportional to the refractive index of that medium. It can be observed that water has the lowest refractive index Therefore; light travels the fastest in water.

Question 9: The refractive index of diamond is 2.42. What is the meaning of this statement?

Solution: The refractive index of diamond is 2.42. This suggests that the speed of light in diamond will decrease 2.42 times to the speed of light in air.

Question 10: Define 1 dioptre of power of a lens.

Solution: 1 Dioptre is the power of a lens having focal length 1 meter

Hence,  $1 \text{ D} = 1 \text{ m}^{-1}$

Question 11: 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 the object? Also, find the power of the lens.

Solution: We know that the convex lens form a real image of equal the size of the object if object placed at  $2F$  in front of lens.

Distance of object  $u = -50\text{cm}$  As Distance image = 50 cm

Using the lens formula you can find Focal length =  $25\text{cm} = 0.25\text{m}$

Then, the power of the given lens =  $1/f = 1/0.25 = +4 \text{ D}$

Question 12: Find the power of a concave lens of focal length 2 m.

Solution The power of the given lens  $= \frac{1}{f} = \frac{1}{-2} = -0.5 D$

Question 13: 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?

Solution: When an object is placed between the pole and focus of a concave mirror virtual, erect, and larger than the object image is formed.

Question 14: Where should an object is placed in front of a convex lens to get a real image of the size of the object?

Solution: An object is placed at the centre of curvature in front of a convex lens to get a real image of the equal size of the object at the centre of curvature.

Question 15: A spherical mirror and a thin spherical lens have each a focal length of -15 cm. The mirror and the lens are likely to be-----

Solution: Concave in nature because the focal length of a concave mirror and a concave lens are taken as negative.

16. Q. If an object of height 4 cm is placed at distance of 12 cm from a concave mirror having focal length 24 cm, find the position, nature and the height of the image.

Solution: Here, object height  $h = 4$  cm , object distance  $u = -12$  cm

focal length  $f = -24$  cm

Putting these values in mirror formula,

$$(1/u) + (1/v) = (1/f) \Rightarrow (-1/12) + (1/v) = (-1/24) \Rightarrow (1/v) = (1/12) - (1/24)$$

$$(1/v) = (1/24) \Rightarrow v = 24$$

Now, magnification  $m = (-u/v) = (-24)/(-12) = 2$

$$(h'/h) = 2 \Rightarrow \therefore h' = 2h = 2 \times 4 = 8 \text{ cm}$$

Since  $v$  is positive, the image is formed behind the mirror at the distance of 24 cm from the mirror. Image is virtual of height of 8 cm.

17. Q. An object of height 6 cm is placed at a distance of 10 cm from a convex mirror with radius of curvature 30 cm. Find the position, nature and the height of its image.

Solution:  $u = -10 \text{ cm}$  ,  $R = 30\text{cm} \Rightarrow f = (R/2) = 30/2 = +15$  ,  $h_o = 6 \text{ cm}$

Using mirror formula,  $(1/u) + (1/v) = (1/f) \Rightarrow (1/v) = (1/f) - (1/u)$

$$(1/v) = (1/15) - (1/-10) \Rightarrow (1/v) = (1/15) + (1/10) = (1/6) \Rightarrow v = 6 \text{ cm}$$

Also, magnification  $m = - (v/u) = - (6/-10) = 0.6 \Rightarrow (h_i/h_o) = 0.6$

$$\therefore h_i = m \times h_o = 0.6 \times 6 = 3.6 \text{ cm}$$

Thus, the image is formed behind the mirror(as  $v$  is positive), it is virtual and its height is 3.6 cm.

**18. Q. At what distance the object should be placed so that the image will be formed at a distance 10 cm from a concave lens ? Focal length of the lens is 20 cm.**

Solution: Since the lens is concave, the image will be formed on the same side as that of the object.

Here, Image distance  $v = -10 \text{ cm}$  , Focal length  $f = -20 \text{ cm}$  , Object distance  $u = ?$

Using lens formula,  $(1/f) = (1/v) - (1/u) \Rightarrow (1/u) = (1/v) - (1/f)$

$$\therefore (1/u) = (1/-10) - (1/-20) \Rightarrow (1/u) = (-2 + 1)/20$$

$$\Rightarrow (1/u) = - (1/20) \Rightarrow \therefore u = -20 \text{ cm}$$

Thus the object should be placed 20 cm from the concave lens on the left side of the lens.

**19. Q. Q.A ray of light enters from water to glass. Refractive index of glass with respect to water is 1.12. Find absolute refractive index of water if absolute refractive index of glass is 1.5.**

Solution: Taking water as "medium1" and glass as "medium2",

Absolute refractive index of water,  $\eta_1 = ?$

Absolute refractive index of glass,  $\eta_2 = 1.5$

$\eta_{21} = 1.12$  (given)

$$\Rightarrow \eta_2/\eta_1 = 1.12 \Rightarrow \eta_1 = \eta_2/1.12 \Rightarrow \eta_1 = (1.5)/(1.12) = 1.34$$

Hence, absolute refractive index of water = 1.34