CLASS X
PHYSICS
CHAPTER 11 – LIGHT

SOLUTIONS

TEXTUAL QUESTIONS AND ANSWERS
EXERCISES

1). **What are the properties of the principal focus of a concave mirror?**
Answer: *The properties are –*

i) *Principal focus of a concave mirror is a point on the principal axis.*
ii) *The rays incident on the concave mirror parallel to the principal axis, after reflection passes through the principal focus.*

2). **The image formed by a concave mirror is observed to be real, inverted and larger than the object. Where should be position of the object?**
Answer: *Between centre of curvature (C) and focus (F).*

3). **You are given three mirrors – convex, concave and plane appearing identical. How can you identify them without touching?**
Answer: *The mirror which produces virtual image of the same size as the object is the plane mirror.*

The mirror which produces a magnified, virtual image when the object is very closed to the mirror is the concave mirror.

The mirror which produces a diminished virtual image, independent of the position of the object is the convex mirror.

4). **Name a mirror that can give an erect and enlarged image of an object.**
Answer: *Concave mirror.*

5). **Name a mirror that can give an erect and diminished image of an object.**
Answer: *Convex mirror.*

6). **Can a convex mirror form a real image of a real object?**
Answer: *No.*

7). **Which spherical mirror is used for shaving?**
Answer: *Concave mirror.*

8). Why do we prefer a convex mirror as a rear view mirror in vehicles?

Answer: *Because,*

- ***i)*** *A convex mirror forms a diminished virtual image.*
- ***ii)*** *Its field of view is large.*
- ***iii)*** *The image is erect.*

9). The radius of curvature of a spherical mirror is 40cm. What is its focal length?

Answer: *Here, Radius of curvature, r = 40cm*

Focal length, f =?

We have, $\mathbf{f} = \frac{r}{2}$

$= \frac{40}{2}\text{cm}$

$= 20 \text{ cm}$

10). A concave mirror produce three times magnified real image of an object placed at 20cm in front of it. Where is the image formed?

Answer: *Here, object distance, u = -20 cm*

Magnification, m = -3 [since, the concave mirror forms a real image]

Image distance, v =?

We have,

$\mathbf{m} = -\frac{v}{u}$

$\Rightarrow -3 = -\frac{v}{-20}$

$\Rightarrow -v = (-3)(-20)$

$\Rightarrow v = \frac{(-3)(-20)}{-1}$

$= -60 \text{ cm}$

The –ve sign indicates that image is formed in front of the mirror at a distance of 60cm from it.

11). You are given a concave mirror, a scale and a screen. How will you determine the height of a tree?

Answer: *Image of the tree is adjusted to focus on a screen kept in between the centre of curvature (C) and focus (F) of a concave mirror. Using a scale, we measure the distance of the tree and the distance of the image from the mirror. Height of the image is also measured. Suppose,*

$$distance\ of\ the\ tree\ from\ the\ mirror = -u$$

$$distance\ of\ the\ image\ from\ the\ mirror = -v$$

$$height\ of\ the\ image = hi$$

$$height\ of\ the\ object\ (\ tree) = ho = ?$$

$$Then\ magnification\ ,\ \boldsymbol{m} = -\frac{-\boldsymbol{v}}{-\boldsymbol{u}} = -\frac{\boldsymbol{v}}{\boldsymbol{u}}$$

$$Also\ , m = \frac{hi}{ho}$$

$$\therefore \frac{hi}{ho} = -\frac{v}{u}$$

$$=> ho\ (-v) = hi\ (\ u)$$

$$\therefore ho = \frac{hi\ (u)}{-v}$$

12). 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?

Answer: *The light ray bends towards the normal because speed of light is different in different media.*

13). Light enters from air to glass having refractive index (1.5). What is the speed of light in the glass? The speed of light in vacuum is $3X10^8ms^{-1}$.

Answer:

$$Speed\ of\ the\ light\ in\ air\ ,\ v_o = 3 \times 10^8 ms^{-1}$$

$$Speed\ of\ the\ light\ in\ glass,\ v_g = ?$$

$$Refractive\ index\ of\ glass,\ \eta_g = 1.5$$

$$We\ have, \boldsymbol{\eta_g} = \frac{\boldsymbol{vo}}{\boldsymbol{vg}}$$

$$\Rightarrow 1.5 = \frac{3\times 10^8\ ms^{-1}}{v_g}$$

$$\Rightarrow 1.5 \times\ v_g = 3 \times 10^8 ms^{-1}$$

$$\therefore v_g = 3 \times 10^8/1.5$$

$$= \frac{3\times 10^8 \times 10}{1.5\times 10}$$

$$= 30\ \times \frac{10^8}{15}$$

$$= 2\ \times\ 10^8\ \ ms^{-1}$$

14). What is refraction of light? Illustrate with example.

Answer: *When the light passes from one medium to another obliquely on the interface, its path gets deviated at the interface of the two media. This is known as refraction of light.*

A straight pole inserted slantly in water appears to be bent at the surface of water. This is because the speed of light in air is different from the speed of light in water and to enable to negotiate the change of speed , the path of light is bent starting from the interface. Thus refraction takes place.

15). What is refractive index of a medium?

Answer: *The ratio of the speed of light in vacuum to the speed of light in a medium is called refractive index of the medium.*

16). Refractive indices of kerosene and crown glass are 1.44 and 1.52 respectively. In which medium will light propagate faster and how much faster?

Answer: *We have,* $\boldsymbol{refractive\ index\ of\ kerosene} = \frac{\boldsymbol{speed\ of\ light\ in\ air}}{\boldsymbol{speed\ of\ light\ in\ kerosene}}$

$$\Rightarrow 1.44 = \frac{3 \times 10^5\ km/sec}{speed\ of\ light\ in\ kerosene}$$

$$\Rightarrow 1.44 \times Speed\ of\ light\ in\ kerosene = 3 \times 10^5$$

$$\therefore Speed\ of\ light\ in\ kerosene = \frac{3 \times 10^5}{1.44}$$

$$= \frac{300}{144} \times 10^5$$

$$= 2.08 \times 10^5\ km/s$$

$$Also,\ refractive\ index\ of\ crown\ glass = \frac{speed\ of\ light\ in\ air}{speed\ of\ light\ in\ crown\ glass}$$

$$\Rightarrow 1.52 = \frac{3 \times 10^5\ km/sec}{speed\ of\ light\ in\ crown\ glass}$$

$$\Rightarrow 1.52 \times Speed\ of\ light\ in\ crown\ glass = 3 \times 10^5$$

$$\therefore Speed\ of\ light\ in\ crown\ glass = \frac{3 \times 10^5}{1.52}$$

$$= \frac{300}{152} \times 10^5$$

$$= 1.97 \times 10^5\ km/s$$

$$\therefore Light\ will\ propagate\ faster\ in\ kerosene\ by\ (2.08 - 1.97) \times 10^5\ km/sec$$

$$i.e.\ 0.11 \times 10^5 km/sec$$

17). Which one is optically denser, water of refractive index 1.33 or kerosene of refractive index 1.44?

Answer: *Kerosene*

18). What is total internal reflection?

Answer: *When a light ray is moving from a denser medium to a rarer medium with an angle of incidence greater than the critical angle, it is reflected back to the denser medium. This phenomenon is called total internal reflection.*

19). What is critical angle? How is it related to the refractive index?

Answer: *The angle of incidence for which the angle of refraction is 90° is called critical angle.*

The refractive index of the denser medium (η) is equal to the reciprocal of the sine of the critical angle (c).

$$i.e.\, \boldsymbol{\eta} = \frac{\mathbf{1}}{\boldsymbol{Sin\ c}}$$

20). A convex lens forms a real and inverted image of a needle at a distance of 40cm from it. Where is the needle placed in front of the convex lens if the size of the image is equal to that of the object? Also, find the power of the lens.

Answer:

$$Here,\ \boldsymbol{image\ distance = 2f}$$

$$\Rightarrow 2f = 40\ cm$$

$$\therefore f = \frac{40\ cm}{2} = 20cm = \frac{20}{100}m$$

$$Power\ of\ the\ lens, \boldsymbol{P} = \frac{\mathbf{1}}{\boldsymbol{f}}$$

$$= \frac{1}{\frac{20}{100}m}$$

$$= 1 \times \frac{100}{20}$$

$$= 5\ dioptre$$

21). Define 1 dioptre?

Answer: One *dioptre is the power of a lens whose focal length is 1 metre.*

22). Find the power of a concave lens of focal length 50cm?

Answer: -

$$Here, f = -50cm$$
$$= \frac{-50}{100} m$$
$$\boldsymbol{Power\ of\ the\ lens, P = \frac{1}{f}}$$
$$= \frac{1}{-\frac{50}{100} m}$$
$$= 1 \times \frac{(-100)}{50}$$
$$= -2\ dioptre$$

23). What is meant by power of accommodation of the eye?

Answer: *The ability of the eye lens to adjust its focal length is called power of accommodation.*

24). When an object is placed before a lens, the lens forms a virtual image for any position of the object. Is the lens convex or concave?

Answer: *Concave lens.*

25). Name four common defects of vision. Give the causes and remedial measure.

Answer: *Four common defects of vision are –*

1. *Myopia (or nearsightedness)*
2. *Hypermetropia (or farsightedness)*
3. *Presbyopia.*
4. *Astigmatism.*

Myopia *is caused due to the elongation of the eye ball or shortening of the focal length of the eye lens. It is corrected by using a concave lens of proper focal length.*

Hypermetropia *is caused due to the shortening of eye ball length or elongation of the focal length of the eye lens. It can be corrected by using a convex lens of suitable focal length.*

Presbyopia *is caused due to decrease in the power of accommodation of the eye. It can be corrected by using bifocal lens.*

Astigmatism *is caused due to the irregular curvature of the eye lens. It can be corrected by using suitable cylindrical lens.*

26). A person has to use concave lens in his spectacle. Whish defect of vision is he suffering from?
Answer: *Myopia.*

27). What type of lens is used to correct (a) myopia, (b)hypermetropia?
Answer: *a) Concave lens is used to correct myopia.*
b) Convex lens is used to correct hypermetropia.

28). Distinguish between real image and virtual image?
Answer: *The difference between real image and virtual image are as follows:*

DIFFERENCE	
Real image	Virtual image
i) It can be focussed on a screen. ii) It is always inverted.	i) It cannot be focussed on a screen. ii) It is always erect.

29). Convex mirrors are used as side mirror in motorcycles. Explain how they are useful.
Answer: Convex mirrors are used as side mirror in motorcycles *because,*
i) *A convex mirror forms a diminished virtual image.*
ii) *Its field of view is large.*
iii) *The image is erect.*

30). Why is a convex lens called converging lens?
Answer: *A convex lens always converges or tends to converge, any beam of light passing through it. So, this type of lens is called converging lens.*

31). Why can you not see an object clearly if it is placed very close to your eyes?
Answer: *If the object is brought much closer, the eye lens may not be able to adjust its focal length anymore to enable to focus the image on the retina. So, we cannot see an object clearly if it is placed very close to our eye.*

32). A person with a myopic eye cannot see object beyond 2m distinctly. What should be the type of corrective lens used to restore proper vision?
Answer: *Concave lens.*

33). A student has difficulty of reading black board while sitting in the last bench. What could be the defect? How can it be corrected?
Answer: *Myopia. It can be corrected by using a concave lens of proper focal length.*

34). What are the far point and near point of the human eye with normal vision?
Answer: *The far point of normal eye is infinity and near point is 25cm.*

35). What is dispersion of light?
Answer: *Splitting of a composite light into its constituent colours is known as dispersion of light.*

36). Explain the reason of twinkling of stars?
Answer: *The twinkling of star is also due to the refraction caused by the atmosphere. There are always irregular currents of hot air in the atmosphere. This causes the refractive index of the atmosphere vary continually. As a result the position of the star appears to fluctuate to an observer on earth. Further, when a sudden current of hot air crosses the line of vision, the light from the star suddenly gets deflected away and the star is temporarily lost from view. Thus, the stars twinkle.*

37). Why does sun appear reddish during sunset in the month of February and March particularly?
Answer: *During sunset the light rays from the sun passes through thicker layers of air and larger distance in the earth's atmosphere before reaching our eyes. Almost violet and blue part of the solar light are scattered away on the way leaving only red portion having longer wavelength undisturbed and reaches our eyes . This gives rise to the reddish appearance of the sun at sunset.*

38). To an astronaut outside the atmosphere, how would the sky appear?
Answer: *The sky would appear dark.*

39). Why do we see distant object very small?
Answer: *The crystalline convex lens of the human eye forms a real, inverted and diminished sized image of the distant object at its focus. So, we see distant object very small.*

40). Explain the reason of advance sunrise and delayed sunset.
Answer: *The rays of the solar light coming from space undergo refraction as they penetrate the atmosphere of the earth. Further, the density of the atmosphere decreases with altitude. Thus, as the ray travels from the top of the atmosphere to the surface of the earth, the density of the air medium gradually increases. As a result the path of the ray is slightly curved and the rising sun which is actually lying below the horizon appears to be a little raised and becomes visible. Because of this, the sun is visible slightly before it actually rises and slightly after it sets.*

TRY TO ANSWER

1). You see your image through a plane mirror at a distance of 2m from you. What is the distance of the mirror from you?

Answer: *Suppose, distance of the mirror from you = x m*

Distance of the mirror from the image = x m

We have, $x+x = 2\ m$

$2x = 2$

$\therefore x = \frac{2}{2} = 1m$

Therefore, the distance of the mirror from you is 1m.

2). A brick wall reflects the rays of light emitted from a candle lamp. But you do not see the image of the candle through the wall. What is the reason?

Answer: *Here, only diffused reflection occurs. The rays are reflected in different directions irregularly and they will not appear to be emitted from any single imaginary point. Hence, no images will be seen.*

3). A concentrated image of the sun can be focussed at 50cm away from a mirror. What is the focal length of the mirror?

Answer: *Only a concave mirror can form the image of an object placed at infinity at its focus.*

$$\therefore focal\ length\ of\ the\ concave\ mirror = -50\ cm$$

4). A concave mirror forms a real image having the same size as the object at a distance of 40cm in front of the mirror. What is the focal length of the mirror?

Answer: *Only a concave mirror forms a real image having the same size as the object at the centre of curvature when the object is placed at the centre of curvature.*

$$Here, Image\ distance, v = -40cm$$

$$Radius\ of\ curvature, r = -40cm$$

$$\therefore The\ focal\ length\ of\ the\ concave\ mirror, f = \frac{r}{2}$$

$$= -\frac{40}{2}$$

$$= -20cm.$$

5). **An object is placed at a distance of 50cm in front of a concave mirror of focal length 25cm. Find the image distance. If the object is 10cm high, what will be the nature and size of the image?**

Answer:

$$Here, object\ distance, u = -50cm$$

$$focal\ length, f = -25cm$$

$$image\ distance = v = ?$$

$$Size\ of\ the\ image, h_i = ?$$

$$We\ have, \frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$$\Rightarrow \frac{1}{-25cm} = \frac{1}{v} + \frac{1}{-50cm}$$

$$\Rightarrow \frac{1}{-25cm} = \frac{1}{v} + \frac{1}{-50cm}$$

$$\Rightarrow -\frac{1}{25} + \frac{1}{50} = \frac{1}{v}$$

$$\Rightarrow \frac{-2+1}{50} = \frac{1}{v}$$

$$\Rightarrow -\frac{1}{50} = \frac{1}{v}$$

$$\Rightarrow -1 \times v = 50$$

$$\therefore v = \frac{50}{-1} = -50cm$$

The –ve sign indicates that image is formed at a distance of 50cm in front of the mirror. Hence, image is real and inverted.

$$We\ have, magnification, m = -\frac{v}{u} = -\frac{-50cm}{-50cm} = -1$$

$$Also, m = \frac{h_i}{h_o}$$

$$\Rightarrow -1 = \frac{h_i}{10cm}$$

$$\therefore h_i = -1 \times 10 = -10\ cm$$

The –ve sign indicates that the image is inverted. Size of the image = 10cm

6). An object is placed at a distance of 50cm in front of a convex mirror of focal length 25cm. Find the image distance. What will be its nature?

Answer: -

$$Here,\ object\ distance, u = -50cm$$

$$Focal\ length\ , f = 25cm$$

$$Image\ distance\ , v = ?$$

$$We\ have, \frac{\mathbf{1}}{\boldsymbol{f}} = \frac{\mathbf{1}}{\boldsymbol{u}} + \frac{\mathbf{1}}{\boldsymbol{v}}$$

$$\Rightarrow \frac{1}{25cm} = \frac{1}{-50cm} + \frac{1}{v}$$

$$\Rightarrow \frac{1}{25} + \frac{1}{50} = \frac{1}{v}$$

$$\Rightarrow \frac{(2+1)}{50} = \frac{1}{v}$$

$$\Rightarrow \frac{3}{50} = \frac{1}{v}$$

$$\Rightarrow 3 \times v = 50$$

$$\Rightarrow v = \frac{50}{3} = 16.666cm = 16.67cm$$

The +ve sign indicates that the image is formed at a distance of 16.67cm from the mirror behind it. Hence the image is virtual and erect.

7). An object is placed at a distance of 15cm in front of a concave mirror of focal length 30cm. Find the nature and position of the image?

Answer:

$$Here, object\ distance, u = -15cm$$

$$Focal\ length\ , f = -30cm$$

$$Image\ distance\ , v = ?$$

$$we\ have, \frac{\mathbf{1}}{\boldsymbol{f}} = \frac{\mathbf{1}}{\boldsymbol{u}} + \frac{\mathbf{1}}{\boldsymbol{v}}$$

$$\Rightarrow \frac{1}{-30cm} = \frac{1}{-15cm} + \frac{1}{v}$$

$$\Rightarrow -\frac{1}{30} + \frac{1}{15} = \frac{1}{v}$$

$$\Rightarrow \frac{(-1+2)}{30} = \frac{1}{v}$$

$$\Rightarrow \frac{1}{30} = \frac{1}{v}$$

$$\Rightarrow v = 30cm$$

The +ve sign indicates that the image is formed at a distance of 30cm from the mirror behind it. Hence, image is virtual and erect.

8). **An object is placed at a distance of 15cm in front of a convex mirror of focal length 30cm. Find the nature and position of the image.**

Answer: -

$$Here,\ object\ distance, u = -15cm$$

$$Focal\ length, f = 30cm$$

$$Image\ distance, v = ?$$

$$we\ have, \frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$$\Rightarrow \frac{1}{30cm} = \frac{1}{v} + \frac{1}{-15cm}$$

$$\Rightarrow \frac{1}{30} + \frac{1}{15} = \frac{1}{v}$$

$$\Rightarrow \frac{(1+2)}{30} = \frac{1}{v}$$

$$\Rightarrow \frac{3}{30} = \frac{1}{v}$$

$$\Rightarrow 3v = 30cm$$

$$\therefore v = \frac{30}{3} = 10cm$$

The +ve sign indicates that image is formed at a distance of 10cm behind the mirror. Hence, the image is virtual and erect.

9). **In which medium will light travel faster water or kerosene?**

Answer: *Water.*

10). **If the refractive index of glass is 1.5. What will be the apparent thickness of glass plate of 1.5cm thick?**

Answer:

$$Here,\quad the\ refractive\ index\ of\ glass, \eta = 1.5$$

$$Apparent\ thickness = ?$$

$$Real\ Thickness = 1.5cm$$

$$We\ have, \boldsymbol{refractive\ index\ \eta} = \frac{\textbf{Real thickness}}{\textbf{Apparent thickness}}$$

$$\Rightarrow 1.5 = \frac{1.5cm}{Apparent\ thickness}$$

$$\therefore Apparent\ thickness = \frac{1.5}{1.5} = 1\ cm$$

11). A lens can focus an image having the same size as the object on the screen 1m away from the lens. What is the focal length of the lens?

Answer : *Only a convex lens can form an image equal in size to that of the object at $2F_2$, when the object is placed at $2F_1$.*

$$Here, Image\ distance = 2f$$
$$\Rightarrow 2f = 1m$$
$$\Rightarrow 2f = 100cm$$
$$\therefore f = \frac{100}{2}cm = 50cm$$
$$\therefore The\ focal\ length\ of\ the\ lens = 50cm.$$

12). An object is seen magnified through a lens. What is the type of lens, convex or concave?

Answer: *Convex lens.*

13). An object is placed at a distance of 15cm in front of a convex lens of focal length 30cm. Find the nature and position of the image?

Answer:

$$Here,\ \ Object\ distance, u = -15cm$$
$$focal\ length, f = 30cm$$
$$Image\ distance, v = ?$$
$$We\ have, \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$
$$\Rightarrow \frac{1}{30cm} = \frac{1}{v} - \frac{1}{-15cm}$$
$$\Rightarrow \frac{1}{30} - \frac{1}{15} = \frac{1}{v}$$
$$\Rightarrow \frac{1-2}{30} = \frac{1}{v}$$
$$\Rightarrow -\frac{1}{30} = \frac{1}{v}$$
$$\therefore v = -30cm$$

The –ve sign indicates that the image is formed at a distance of 30cm in front of the lens. Hence, the image is virtual.

14). An object is placed at a distance of 50cm in front of a convex lens of focal length 25cm. Find the image distance. If the object is 10cm high, what will be the nature and size of the image?

Answer:

$Here,\ u = -50cm, f = 25cm, v = ?$

$We\ have, \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\Rightarrow \frac{1}{25cm} = \frac{1}{v} - (-\frac{1}{50cm})$

$\Rightarrow \frac{1}{25} = \frac{1}{v} + \frac{1}{50}$

$\Rightarrow \frac{1}{25} - \frac{1}{50} = \frac{1}{v}$

$\Rightarrow \frac{2-1}{50} = \frac{1}{v}$

$\Rightarrow \frac{1}{50} = \frac{1}{v}$

$\therefore v = 50cm$

$+ve$ *sign indicates that the image is formed ata a distance of* $50cm$ *from it behind the lens.*

$We\ have,\ m = \frac{v}{u} = \frac{50cm}{-50cm} = -1$

$Also, m = \frac{h_i}{h_o} = \frac{h_i}{10cm}$

$Then, \frac{h_i}{10} = -1$

$\therefore h_i = -10cm$

$Size\ of\ the\ image = 10cm$

Image is real and inverted.

15). An object is placed at a distance of 50cm in front of a concave lens of focal length 25cm. Find the image distance. What will be its nature?

Answer: $Here, u = -50cm, f = -25cm, v = ?$

$We\ have, \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\Rightarrow \frac{1}{-25cm} = \frac{1}{v} - (-\frac{1}{50cm})$

$\Rightarrow -\frac{1}{25} = \frac{1}{v} + \frac{1}{50}$

$\Rightarrow -\frac{1}{25} - \frac{1}{50} = \frac{1}{v}$

$\Rightarrow \frac{-2-1}{50} = \frac{1}{v}$

$\Rightarrow \frac{-3}{50} = \frac{1}{v}$

$\Rightarrow -3v = 50$

$\therefore v = \frac{50cm}{-3} = -16.66 = -16.67\ cm$

The –ve sign indicates that image is formed on the same side of the object. So, image is virtual and erect.

16). An object is placed at a distance of 15cm in front of a convex lens of focal length 30cm. Find the nature and position of the image?

Answer:

$$Here, u = -15cm, f = 30cm, v = ?$$

$$We\ have, \frac{\mathbf{1}}{\boldsymbol{f}} = \frac{\mathbf{1}}{\boldsymbol{v}} - \frac{\mathbf{1}}{\boldsymbol{u}}$$

$$\Rightarrow \frac{1}{30cm} = \frac{1}{v} - (-\frac{1}{15cm})$$

$$\Rightarrow \frac{1}{30} = \frac{1}{v} + \frac{1}{15}$$

$$\Rightarrow \frac{1}{30} - \frac{1}{15} = \frac{1}{v}$$

$$\Rightarrow \frac{1-2}{30} = \frac{1}{v}$$

$$\Rightarrow \frac{-1}{30} = \frac{1}{v} \Rightarrow v = -30\ cm$$

The –ve sign indicates that image is formed on the same side of the object. Hence, the image is virtual and erect.

17). An object is placed at a distance of 15cm in front of a concave lens of focal length 30cm. Find the nature and position of the image?

Answer :

$$Here, u = -15cm, f = -30cm, v = ?$$

$$We\ have, \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow \frac{1}{-30cm} = \frac{1}{v} - (-\frac{1}{15cm})$$

$$\Rightarrow \frac{1}{-30} = \frac{1}{v} + \frac{1}{15}$$

$$\Rightarrow -\frac{1}{30} - \frac{1}{15} = \frac{1}{v}$$

$$\Rightarrow \frac{-1-2}{30} = \frac{1}{v}$$

$$\Rightarrow \frac{-3}{30} = \frac{1}{v} \Rightarrow 3v = -30$$

$$\therefore v = \frac{30}{-3} = -10cm$$

The –ve sign indicates that image is formed at a distance of 10cm in front of the lens. Hence, image is virtual.

18). **An eye feels comfortable in reading the book keeping at a distance of 15cm. What is the defect? What type of lens will be used to rectify the defect?**

Answer: *Myopia. Concave lens will be used.*

19). **A defective eye cannot see distinctly the object beyond 1m clearly. What is the defect? What is the power of the lens required to rectify the defect?**

Answer: *Myopia. Concave lens will be used.*

$$focal\ length = -1m$$

$$power\ of\ the\ lens,\ \boldsymbol{p} = \frac{\boldsymbol{1}}{\boldsymbol{f}} = \frac{1}{-1m} = -1\ dioptre.$$

20). **In the morning, in which direction you may observe a rainbow?**

Answer: *West*

EXTRA QUESTIONS & ANSWERS

1). **State the laws of reflection of light.**

Answer: *The laws are –*

1. *The angle of incidence and the angle of reflection are always equal to each other.*
2. *The incident ray, the reflected ray and the normal at the point of incidence are always in the same plane.*

2). **Draw a ray diagram showing the nature and position of image formed by a concave mirror when an object is placed beyond c.**

Answer:

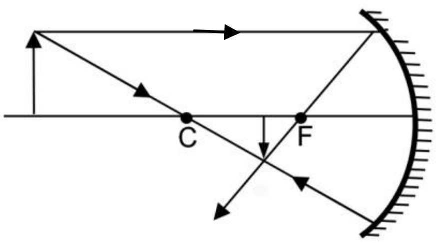

Fig. Object beyond C

Position – Images is formed between C and F.

Nature – Real, inverted and diminished in size.

3). **Draw a ray diagram showing the nature and position of image formed by a concave mirror when an object is placed between C and F?**

Answer :

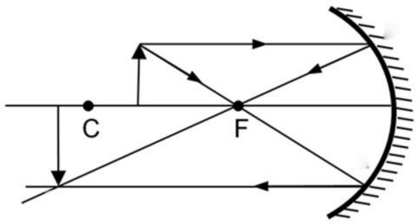

Fig. Object between C and F

Position – Image is formed beyond C.
Nature – Real, inverted and enlarged in size.

4). **State laws of refraction of light?**

Answer: *The laws are –*

i) *The incident ray, refracted ray and normal on the refracting surface at the point of incidence lie in a plane.*

ii) *The sine of the angle of incidence bears a constant ratio to the sine of angle of refraction.*

$$i.e. \frac{\sin i}{\sin r} = \boldsymbol{a\ constant}$$

5). **State the conditions to obtain total internal reflection.**

Answer : *The conditions are –*

i) *The ray must approach a rarer medium from a denser one.*

ii) *The angle of incidence must be greater than the corresponding critical angle.*

6). **Draw a ray diagram showing the nature and position of image formed by a convex lens when an object is placed beyond $2F_1$.**

Answer :

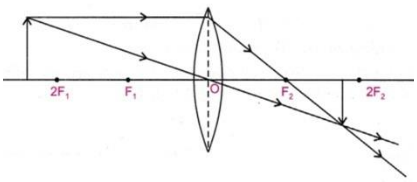

Fig. 3 Object beyond $2F_1$

Position – Image is formed between F_2 and $2F_2$.
Nature – Real, inverted and diminished in size.

7). **Draw a ray diagram showing the nature and position of image formed by a convex lens when the object is placed between $2F_1$ and F_1.**

Answer:

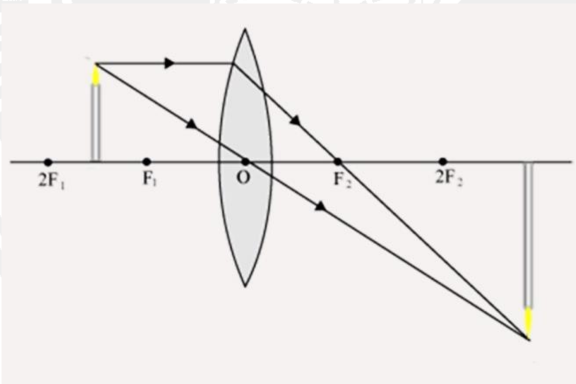

Fig. 4 Object between $2F_1$ and F_1

Position – Image is formed beyond $2F_2$.
Nature – Real, inverted and magnified in size

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