Light : Reflection and Refraction

Question 1:

Select the proper choice from the given multiple choices :

Question 1.1:

What is the wavelength range of visible light ?

Solution :

A. 4×10^{-7} m to 8×10^{7} m
The wavelength range of visible light is 4×10^{-7} m to 8×10^{7} m, which is very short compared to the size of a normal object.

Question 1.2:

What is the relation between radius of curvature (R) and the focal length (f) of a spherical mirror ?

Solution :

A. R = f/2
The distance of the principal focus from the pole of the mirror is called the focal length of the mirror. If R is the radius of curvature, then we can write R = 2f.

Question 1.3:

Which type of reflection will be represented by a light reflected from a book ?

Solution :

B. Irregular

A book has an irregular surface;hence a parallel beam incident on it does not remain parallel but spreads over wide region after reflection.

Question 1.4:

Through which of the following points, a ray passing through a centre of curvature and reflected by concave mirror will pass through ?

Solution :

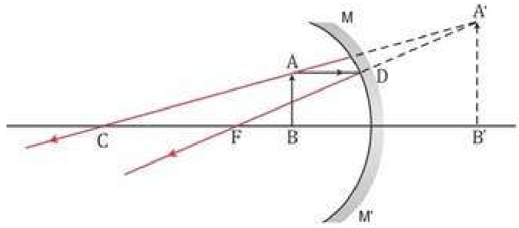
B. Centre of curvature
Any ray that passes through the centre of curvature of the mirror will reflect back along the same path because the radius of a circle always hits the edge of the circle normally, so the angle of incidence and reflection will both be zero.

Question 1.5:

At what distance in front of the concave mirror should an object be placed to get its virtual and erect image ?

Solution :

C. Between focus and pole
When an object is placed between focus and pole of a concave mirror, the mirror forms a virtual, erect and magnified image of the object behind the mirror.



Question 1.6:

The magnification of plane mirror is always…………..

Solution :

B. 1
Since the size of the image formed by a plane mirror is equal to the size of the object, its magnification is always 1.

Question 1.7:

The focal length of plane mirror is………………..

Solution :

B. Infinity
Plane mirror can be considered a part of a sphere with infinite radius. Hence, its focal length will be infinity.

Question 1.8:

The distance between the object at 2 m from a plane mirror and its image is…………………

Solution :

A. 4m
Image distance = Object distance = 2 m
Therefore, distance between object and its image =
(2 + 2) = 4 m

Question 1.9:

At what distance should an object be placed to obtain its real, inverted and of same height as the object by a convex lens ?

Solution :

C. At the centre of curvature
When the object is placed at the centre of curvature of a convex lens, the lens forms its real, inverted image on the other side of the lens, which is of the same size as that of the object.

Question 1.10:

Which of the following materials has maximum optical density ?

Solution :

D. Diamond
Diamond has the highest refractive index of 2.42. Larger the refractive index of a medium, greater is its optical density.

Question 1.11:

The absolute refractive index of any medium is always………

Solution :

B. > 1
The absolute refractive index (n = c/v) of any medium is always greater than 1, because speed of light in any medium is always less than that in vacuum (i.e., v < c).

Question 1.12:

Which of the lenses with focal length 10 cm, 20 cm, 25 cm, and 50 cm has maximum power ?

Solution :

D. 10 cm

$$\text{Power (in D)} = \frac{1}{f\text{ (in m)}}$$

Power is thus inversely proportional to the focal length.

$\therefore$ The lens with the minimum focal length shall have the maximum power.

Here, lens with focal length 10 cm has the maximum power.

Question 1.13:

What is the focal length of a convex lens having power + 5.0 D ?

Solution :

D. + 20 cm

$$\text{Power (in D)} = \frac{1}{f\text{ (in m)}}$$

$$\therefore\ f = \frac{1}{5} = 0.2\text{ m} = 20\text{ cm}$$

Question 1.14:

If the absolute refractive indices of water, benzene, and saphire are 1.33,1.50 and 1.77 respectively, then which medium has maximum relative refractive index ?

Solution :

A. Sapphire relative to water

The relative refractive index between a pair of media is the ratio of their absolute refractive indices. Consider 1 for water, 2 for benzene and 3 for sapphire.

$$n_{21} = \frac{n_2}{n_1} = \frac{1.5}{1.33} = 1.13$$

$$n_{31} = \frac{n_3}{n_1} = \frac{1.77}{1.33} = 1.33$$

$$n_{32} = \frac{n_3}{n_2} = \frac{1.77}{1.5} = 1.18$$

$$\therefore\ n_{31} > n_{32} > n_{21}$$

Hence, refractive index of sapphire with respect to water is maximum.

Question 1.15:

Which type of an image is formed by a plane mirror ?

Solution :

C. Virtual and erect

A plane mirror always forms a virtual and erect image of the same size as that of the object.

Question 1.16:

If the absolute refractive indices of water and glass are 4/3 and 3/2 respectively, then what will be the ratio of velocity of light in water to that of glass ?

Solution :

C. 9/8

We know that,

$$\mu = \frac{c}{v}$$

$$\therefore \frac{\text{R.I. of glass}}{\text{R.I. of water}} = \frac{c}{\text{Velocity of light in glass}} \times \frac{\text{Velocity of light in water}}{c}$$

$$\Rightarrow \frac{3/2}{4/3} = \frac{\text{Velocity of light in water}}{\text{Velocity of light in glass}}$$

$$\Rightarrow \frac{\text{Velocity of light in water}}{\text{Velocity of light in glass}} = \frac{9}{8}$$

Question 1.17:

The absolute refractive indices of water glass and diamond are 1.77, 1.50 and 2.72 respectively, which medium is most optically denser ?

Solution :

C. Diamond

The optically denser medium has larger refractive index as compared to optically rarer medium.

Question 1.18:

Which of the following always forms virtual image ?

Solution :

C. Convex mirror and concave lens

For all positions of object, a convex mirror and concave lens always forms virtual image.

Question 1.19:

What will be the angle of refraction for the light ray incident normal at the surface ?

Solution :

D. 0^{o}

Angle of incidence = Angle of refraction

Here, since the ray is incident normally, angle of incidence is equal to 0^{o}.

Question 1.20:

The compound mirroscope consists of two convex lenses of 5 cm and 20 cm focal length, then which of them will be object lens and eye piece ?

Solution :

B. Object lens with 5 cm focal length and eyepiece with 20 cm focal length.

For a compound microscope, the focal length of objective lens is small compared to the eyepiece.

Question 2:

Answer the following questions in brief :

Question 2.1:

What is called regular and irregular reflection of light ?

Solution :

Regular reflection of light occurs when a parallel beam of light incident on a smooth and polished surface remains parallel after reflection in a specific direction.
When a parallel beam of light is incident on a rough or irregular surface, the beam does not remain parallel but spreads over a wide region after reflection. Such a reflection of light is called irregular reflection.

Question 2.2:

Write the laws of reflection of light.

Solution :

Laws of reflection:

1. The angle of incidence is equal to the angle of reflection.
2. The incident ray, the reflected ray and the normal at the point of incidence, lie in the same plane.

Question 2.3:

What are called centre of curvature and radius of curvature of mirror ?

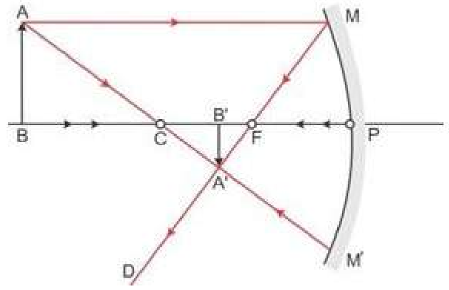
Solution :

Centre of curvature: The centre of the spherical shell from which the mirror is made, is called the centre of curvature.
Radius of curvature: The radius of the spherical shell from which the mirror is made, is called the radius of curvature.
Previous

Question 2.4:

Draw a ray diagram showing position, nature and size of an image formed by concave mirror when the object is placed beyond the centre of curvature.

Solution :

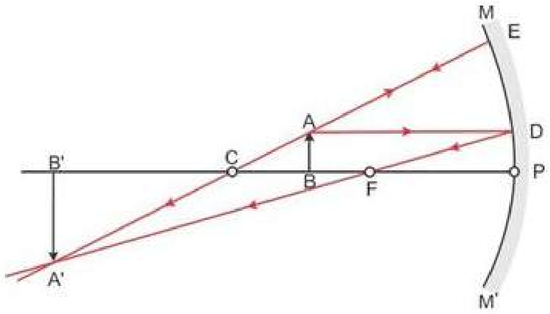


A real, inverted and diminished image is formed between the centre of curvature and focus, when the object is placed beyond the centre of curvature of a concave mirror.

Question 2.5:

Draw a ray-diagram showing position, nature and size of an image formed by concave mirror when the object is placed between pole and principal focus.

Solution :

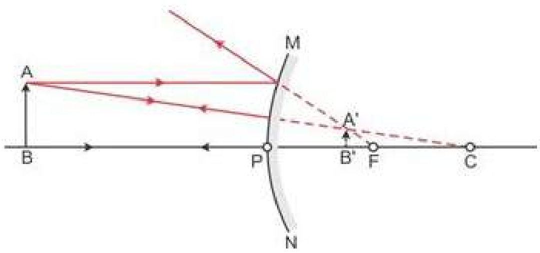


A real, inverted and magnified image is formed beyond the centre of curvature when the object is placed between the pole and principal focus of a concave mirror.

Question 2.6:

Draw a ray-diagram showing position, nature and size of an image formed by convex mirror when the object is placed between infinite distance and pole.

Solution :



A virtual, erect and diminished image is formed between the pole and focus, behind the mirror, when the object is placed between infinite distance and pole of a convex mirror.

Question 2.7:

Obtain the position, nature and size of an image formed by a plane mirror from the formula of magnification.

Solution :

In case of a plane mirror, the magnification, m = + 1

Positive magnification indicates that image formed by plane mirror is erect.

As we know, m = Image height / object height,

We can say, Image height = object height.

Therefore, the image formed by a plane mirror of the same size as the object.

Again we know that,

M = – (v/u)

Or, v = -u

This shows that the image formed by a plane mirror is at the same distance as the object but behind the mirror, i.e. the image formed is virtual.

Hence, we conclude that a virtual and erect image of the same size as that of the object is formed by a plane mirror at the same distance as the object behind the mirror.

Question 2.8:

Write laws of refraction of light.

Solution :

Laws of refraction:

1. The incident ray, the refracted ray and the normal to the surface separating two media at the point of incidence all lie in the same plane.
2. The ratio of sine of angle of incidence to the sine of angle of refraction remains constant subject to certain situations. This is also known as Snell's law of refraction.

Question 2.9:

What is called the absolute refractive index of a medium ? Obtain the general form of Snell's law in terms of refractive indices of two media ?

Solution :

The refractive index of the transparent medium with respect to vacuum is called the absolute refractive index of a medium.

Let,

n_1 = absolute refractive index of medium 1

n_2 = absolute refractive index of medium 2

v_1 = velocity of light in medium 1

v_2 = velocity of light in medium 2

and, c = velocity of light in vacuum, then

$$n_1 = \frac{c}{v_1} \quad \text{and} \quad n_2 = \frac{c}{v_2}$$

$$\therefore \quad n_{21} = \frac{n_2}{n_1} = \frac{\frac{c}{v_2}}{\frac{c}{v_1}}$$

$$\therefore \quad n_{21} = \frac{n_2}{n_1} = \frac{v_1}{v_2} \ldots\ldots\ldots\ldots\ldots\ldots\text{(i)}$$

Now, according to Snell's law

$$n_{21} = \frac{\sin\theta_1}{\sin\theta_2} \ldots\ldots\ldots\ldots\ldots\ldots\text{(ii)}$$

From (i) and (ii),

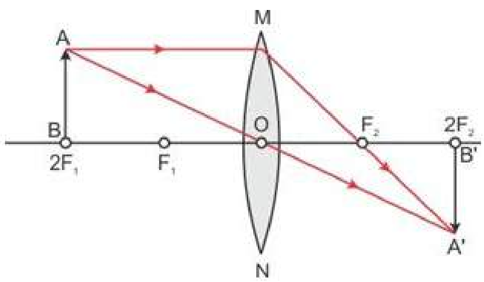
$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

This is the general form of Snell's law.

Question 2.10:

Draw a ray-diagram showing the position, nature and size of an image formed by convex lens when the object is placed at centre of curvature of lens.

Solution :

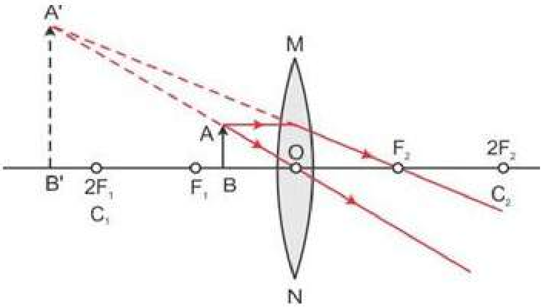


A real inverted image of the same size as the object is formed on the other side of the lens at the centre of curvature when the object is placed at the centre of curvature in front of a convex lens.

Question 2.11:

Draw a ray-diagram showing the position, nature and size of an image formed by a convex lens when object is placed between its optical centre and focus

Solution :

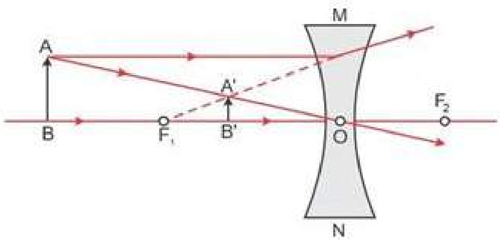


A virtual, erect and magnified image is formed on the same side of the lens as the object beyond the centre of curvature, when the object is placed between the optical centre and focus of the convex lens.

Question 2.12:

Draw a ray-diagram showing the position, nature and size of an image formed by a concave lens when the object is placed between an optical centre and infinite point.

Solution :



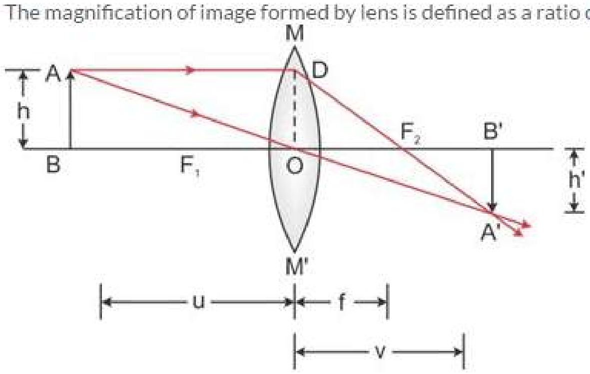
A virtual, erect and diminished image is formed on the same side of the lens as the object between the focus and optical centre, when the object is placed between infinite point and optical centre of a concave lens.

Question 2.13:

What is called the magnification of an image ? Derive the formula of magnification for spherical lens.

Solution :

The magnification of image formed by lens is defined as a ratio of height of image to the height of an object.



It is clear from the geometry of the above figure, that right angle ΔABO and ΔA'B'O are similar.

$$\therefore \frac{A'B'}{AB} = \frac{OB'}{OB} = -\frac{v}{u} \ldots\ldots\ldots\ldots\ldots\ldots(i)$$

From definition,

Magnification (m) = Image height / object height = A'B'/AB = - h'/h ....(ii)

From (i) and (ii), in terms of object distance (u) and image distance (v)

Magnification = v /u

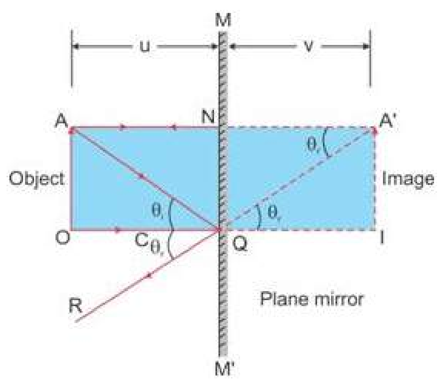
Question 3:

Write answers of the following questions :

Question 3.1:

Explain the reflection by a plane mirror by drawing suitable figure.

Solution :



In the above figure, an extended object AO of height h is kept in front of the plane mirror MM' at a distance u.

Each small portion of the extended object facing the mirror acts like a point source.

The incident rays ANand AQ are drawn from points A of the object.

The corresponding reflected rays NA and QR are drawn applying the laws of reflection. As the reflected rays NA and QR are divergent rays, they cannot meet in front of the mirror, but they intersect at A', when extended behind the mirror as shown in figure. Thus, A' is the virtual image of the real object A. Similarly, all point sources between A and O will form corresponding images between A' and I.

Thus, we see that a plane mirror forms a virtual, erect and inverted image at the same distance behind the mirror as that of an object kept in front of the mirror.

Question 3.2:

Give the cartesian sign convention for the reflection by spherical mirror.

Solution :

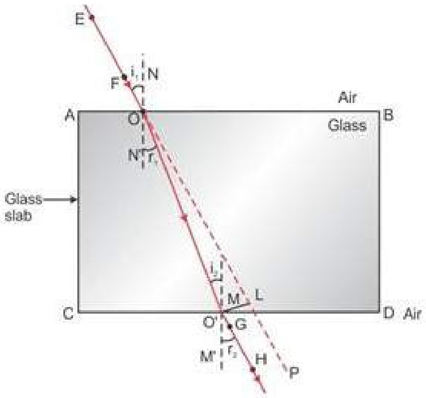
Cartesian sign convention for the reflection by spherical mirrors:

1. Pole is taken as the origin of the Cartesian co-ordinate system. All distances are measured from the pole parallel to the principal axis.
2. The object is on the left side of the mirror means the light rays are incident from the left side of the mirror.
3. The distances measured in the direction of incident ray (towards right) are taken positive.
4. The distances measured in the direction opposite to incident ray (towards left) are taken negative.
5. The height measured upward and perpendicular to principal axis is taken positive.
6. The height measured downward and perpendicular to principal axis is taken negative.

Question 3.3:

With the necessary figure, explain the refraction of light through a rectangular glass slab.

Solution :



Consider a rectangular glass slab ABCD having parallel faces AB and CD as shown in above figure. A ray of light EF in air is incident on the glass surface AB at point O. As the ray EO enters from air (rarer medium) to glass (denser medium), the ray bends towards normal and follows the path OO' inside the glass slab. At point O', refraction takes place again. As the ray OO' enters from glass (denser medium) to air (rarer medium), the ray bends away from normal and follow the path O'H outside glass slab.
Here, the ray EF is called incident ray, OO', the refracted ray and O'H, the emergent ray.
As per the laws of refraction, and $\angle i_1 = \angle r_1$ and $\angle i_2 = \angle r_2$.
The emergent ray O'H is parallel to the incident ray EF. The perpendicular distance O'L between the original path of incident ray and the emergent ray is called the lateral displacement.

Question 3.4:

Obtain the lens formula for spherical lens.

Solution :

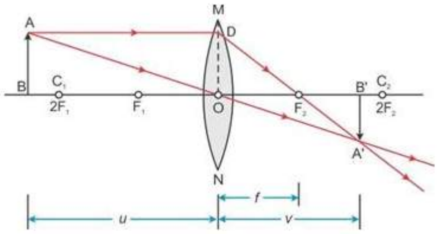


Figure above shows that formation of a real, inverted and diminished image A'B' of the object AB placed beyond the centre of curvature at a distance u from the convex lens. Let v be the image distance.

According to Cartesian sign convention,
Object distance (OB) = -u
Image distance (OB') = +v
Focal length ($OF_1 = OF_2$) = +f

From geometry of figure above, right angle ΔABO and ΔA'B'O are similar.

$$\therefore \frac{AB}{A'B'} = \frac{OB}{OB'} = -v \ldots\ldots\ldots\ldots\ldots(i)$$

From geometry of figure above, right angle ΔODF_2 and ΔBAF_2 are similar.

$$\therefore \frac{OD}{A'B'} = \frac{OF_2}{F_2B'}$$

$$\therefore \frac{AB}{A'B'} = \frac{OF_2}{F_2B'} \quad (\because OD = AB, \text{ are the opposite sides of } \square ABOD)$$

$$\therefore \frac{AB}{A'B'} = \frac{OF_2}{OB' - OF_2}$$

$$\therefore \frac{AB}{A'B'} = \frac{f}{v - f} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(ii)$$

From (i) and (ii),

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

$$\Rightarrow -u(v - f) = vf$$

$$\Rightarrow -uv + uf = vf$$

Dividing each term by uvf,

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

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

This equation is called the 'Lens formula'.

Question 3.5:

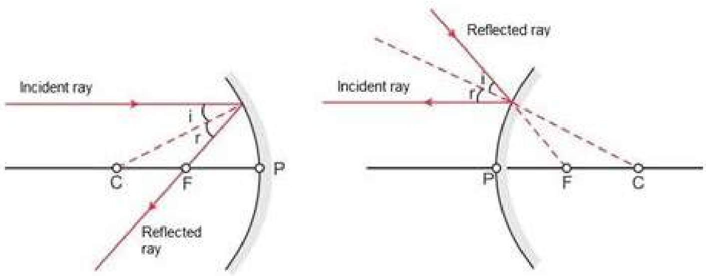
Explain how the position of an image is located for spherical mirror by considering the different rays using necessary ray-diagrams.

Solution :

The image formed by a spherical mirror can be located by constructing a ray diagram. For convenience any of the following two rays can be drawn from the object. The point of intersection of these two rays shall give the position of the image.

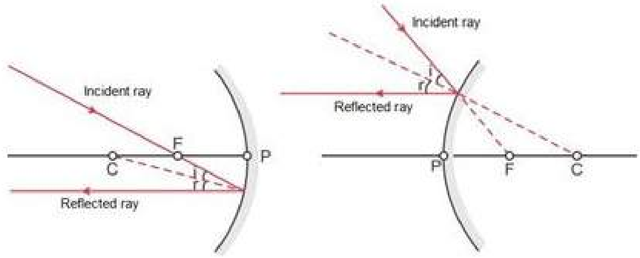
Rays which can be taken into consideration are:

1. A ray parallel to principal axis after reflection passes through the focus or appears to diverge from the focus.

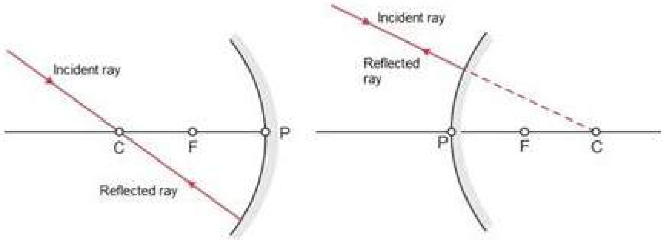


2. A ray passing through the principal focus of a concave mirror or a ray which is directed

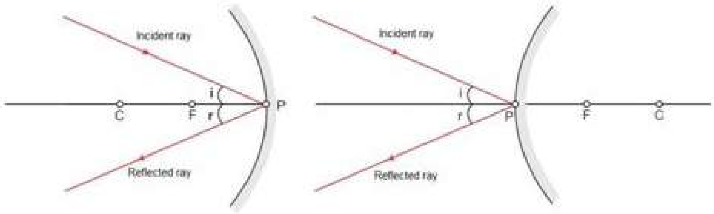
towards the principal focus of a convex mirror will emerge parallel to the principal axis.



3. A ray passing through the centre of curvature of a concave mirror or directed towards the centre of curvature of convex mirror after reflection, is reflected along the same path.



4. A light ray incident obliquely to the principal axis towards the pole of a concave or a convex mirror is reflected obliquely following the laws of reflection.



Question 3.6:

Write a note on power of lens.

Solution :

The efficiency with which a lens can converge or diverge the light rays is expressed in terms of its power.

The reciprocal of focal length of the lens is called the power of the lens (p).

$$p \text{ (in Dioptre)} = \frac{1}{f \text{ (in metre)}}$$

The S.I. unit of power of lens is dioptre (D).

Power of a convex lens is positive and that of a concave lens is negative. The instrument used for measuring the power of lens is known as dioptremeter.

Question 4:

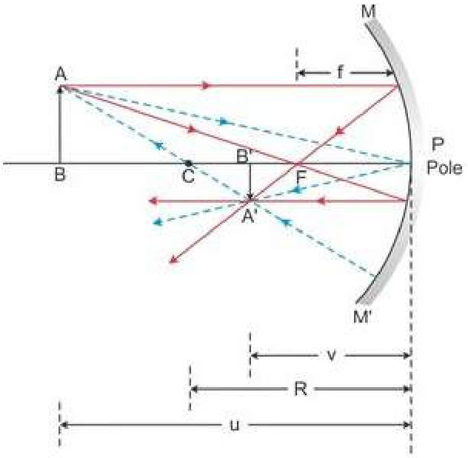
Answer the following questions in detail :

Question 4.1:

Derive the formula for spherical mirror $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

Solution :

The formula which gives relation between object distance (u), image distance (v) and focal length (f) of mirror is known as mirror formula.



In the figure shown above, an object AB is placed at a distance u from the pole of the concave mirror of small aperture, just beyond the centre of curvature. Hence, its real, inverted and diminished image A’B’ is formed at a distance v in front of the mirror.

A/C to Cartesian sign convention,

Object distance (PB) = -u

Image distance (PB’) = -v

Focal length (PF) = -f

Radius of curvature (PC) = -R

It is clear from the geometry of figure, right angle ΔABP and ΔA’B’P’ are similar.

$$\therefore \frac{A'B'}{AB} = \frac{PB'}{PB} = \frac{-v}{-u}$$

$$\therefore \frac{A'B'}{AB} = \frac{v}{u} \text{.......................(i)}$$

Similarly, ΔABC and ΔA'B'C' are similar.

$$\therefore \frac{A'B'}{AB} = \frac{CB'}{CB} \text{...(ii)}$$

From figure,

$CB' = PC - PB' = -R - (-v) = -R + v$

and, $CB = PB - PC = -u - (-R) = -u + R$

From (ii),

$$\frac{A'B'}{AB} = \frac{-R+v}{-u+R} \text{................................(iii)}$$

Comparing (i) and (iii),

$$\frac{v}{u} = \frac{-R+v}{-u+R}$$

$\therefore -uv + Rv = -Ru + vu$

or, $R(u + v) = 2uv$

or, $\frac{1}{v} + \frac{1}{u} = \frac{2}{R}$ [Dividing both sides by Ruv.]

We know that $f = \frac{R}{2}$;

substituting this value in above equation we get:

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

This equation is known as mirror formula.

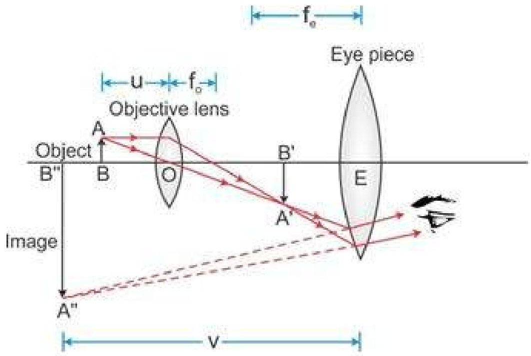
Question 4.2:

Explain the construction and working of a compound microscope with a neat ray-diagram.

Solution :

Construction: A compound microscope consists of two convex lenses. The lens towards the object is called objective lens and the lens near the eye is called eyepiece. The lenses are so chosen that the focal length of the objective lens is small compared to the eyepiece. This combination of lenses forms a magnified image of the object.

Diagram:



Working: The object AB is placed at a distance slightly more than focal length of the objective so that its real, inverted and magnified image A’B’ is obtained beyond the centre of curvature (C) of objective lens. The image A’B’ becomes an object for the eyepiece. The position of image A’B’ is adjusted such that it lies within the focal length of eyepiece. The piece forms a virtual, erect and magnified image A”B” of the object.

Thus, the final image formed by a compound microscope is virtual, inverted and magnified behind the object.

Question 4.3:

Write a note on astronomical telescope.

Solution :

Astronomical telescope is used to observe distant objects such as planets, stars etc.

It consists of two convex lenses placed co-axially such that the focal length of the objective is large compared to the focal length of the eyepiece.

When the telescope is focused on a distant object, parallel rays coming from the object form real, inverted and diminished image of the object. This image acts as an object for eyepiece and is adjusted in such a way that the object lies at a distance less than the focal lens of the eyepiece. The eyepiece then forms a virtual, magnified and erect final image of the distant object.

Question 5:

Solve the following problems :

Question 5.1:

An object of height 5 cm is placed at a distance of 10 cm from convex mirror of focal length 15 cm. Find the position, nature and size of an image.

Solution :

We know that,

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

u = - 10 cm

Focal length = 15 cm

$$\therefore \frac{1}{v}=\frac{1}{15}-\frac{1}{(-10)}$$

$$\Rightarrow \frac{1}{v}=\frac{5}{30}=\frac{1}{6}$$

$\Rightarrow v = 6cm$

$\therefore$ The image is formed at a distance 6 cm behind the mirror.

As, v is positive and $v<u$;

$\therefore$ $m < 1$

Therefore, a virtual, erect and diminished image is formed behind the convex mirror at a distance 6 cm from the mirror

$$\text{Magnification (m)} = \frac{v}{u}=\frac{\text{Image height}}{\text{Object height}}$$

$$\text{or, Image height} = \frac{6}{10}\times 5 = 3 \text{ cm}$$

Question 5.2:

An object of height 6 cm is placed at a distance of 15 cm from a concave mirror of focal length 10 cm. Find position, nature and height of an image.

Solution :

We know that,

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

u = - 15 cm

Focal length = -10 cm

$$\therefore \frac{1}{v}=\frac{1}{-10}-\frac{1}{(-15)}$$

$$\Rightarrow \frac{1}{v}=\frac{1}{-10}+\frac{1}{15}=\frac{-3+2}{30}=-\frac{1}{30}$$

$\Rightarrow v = -30$ cm

$$\text{Magnification (m)} = \frac{v}{u}=\frac{\text{Image height}}{\text{Object height}}$$

$$\therefore m = -\frac{v}{u}=+\frac{30}{-15}=-2$$

Also, Image height = -2×6 = -12 cm

Therefore, a real, inverted and enlarged image of the object is formed beyond the centre of curvature.

Question 5.3:

The rays of light are entering from glass into glycerine. If the absolute refractive indices of glass and glycerine are 1.5 and 1.47 respectively, find the refracting index of glycerine relative to glass.

Solution :

$$\text{Refractive index of glycerine w.r.t. glass} = \frac{\text{Absolute r.i. of glycerine}}{\text{Absolute r.i. of glass}}$$

$$\text{or, Refractive index of glycerine w.r.t. glass} = \frac{1.47}{1.5}=0.98$$

Question 5.4:

The refractive index of light entering glass from water is 1.12. Find absolute refractive index of water if the absoute refractive index of glass is 1.5.

Solution :

$$\text{Refractive index of glass w.r.t. water} = \frac{\text{Absolute r.i. of glass}}{\text{Absolute r.i. of water}}$$

$$\text{or, } 1.12 = \frac{1.5}{n_{water}}$$

$$\Rightarrow n_{water} = \frac{1.5}{1.12} \approx 1.34$$

Question 5.5:

When the light entering from glass to water, refractive index of water with respect to glass is 0.9. The angle of incidence at the surface seprating two media is 26°48\ Find the angle of refraction at the surface.

Solution :

$$\text{Refractive index of water w.r.t. glass} = \frac{\sin i}{\sin r}$$

$$\text{or, } 0.9 = \frac{\sin 26°48'}{\sin r}$$

$$\Rightarrow \sin r = \sin 26°48' \times \frac{1}{0.9}$$

$$\Rightarrow \sin r = 0.5$$

$$\Rightarrow r = \sin^{-1}(0.5)$$

$$\Rightarrow r = 30°$$

Question 5.6:

An object is placed perpendicular to the principal axis of a convex lens having focal length 10 cm. The distance of an object from the lens is 15 cm. Find the position of an image.

Solution :

From lens formula,

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

$u = -15$ cm

Focal length $= 10$ cm

$$\therefore \frac{1}{v} = \frac{1}{10} + \frac{1}{(-15)}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{10} - \frac{1}{15} = \frac{3-2}{30} = \frac{1}{30}$$

$$\Rightarrow v = 30 \text{ cm}$$

Question 5.7:

An object is placed perpendicular to the principal axis of concave lens of focal length 30 cm. Find the position of an image when the object is at a distance 20 cm from the lens.

Solution :

From lens formula,

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

u = - 20 cm

Focal length = -30 cm

$$\therefore \frac{1}{v} = \frac{1}{-30} + \frac{1}{(-20)}$$

$$\Rightarrow \frac{1}{v} = \frac{-20-30}{600} = \frac{-50}{600} = -\frac{1}{12}$$

$$\Rightarrow v = -12 \text{ cm}$$

Question 5.8:

A power of convex lens is + 4.0 D. At what distance should the object from the lens be placed to obtain its real and inverted image of the same size on the screen ?

Solution :

Given, power of the lens, P = +4 D

We know that, focal length (f) = $\frac{1}{P}$ = 0.25 m

Given, size of the object = size of the image

For convex lens, this condition is possible only when the object is placed at the centre of curvature.

$\therefore$ Object distance = 2f = 2 $\times$ 0.25 m = 0.5 m or 50 cm