**Introduction to Light – Reflection & Refraction**

**Light: Definition**
Light is a form of energy that enables us to see things. Light starts from a source and bounces off objects which are perceived by our eyes and our brain processes this signal, which eventually enables us to see.

**Nature of Light**
Light behaves as a:
- ray, e.g. reflection
- wave, e.g. interference and diffraction
- particle, e.g. photoelectric effect

**Laws of Reflection**
Light incident on another medium
When light travels from one medium to another medium it either:
- gets absorbed (absorption)
- bounces back (reflection)
- passes through or bends (refraction)
When light is incident on a plane mirror, most of it gets reflected, and some of it gets absorbed in the medium.

**Characteristics of light**
- Speed of light $c=\lambda \mu$, where $\lambda$ is its wavelength and $\mu$ is its frequency.
- Speed of light is a constant which is $2.998\times10^8$ m/s or approximately $3.0\times10^8$ m/s.

**Reflection of light by other media**
A medium that is polished well without any irregularities on its surface will cause regular reflection of light. For example, a plane mirror. But even then some light gets absorbed by the surface.

**Laws of Reflection**
The incident ray, reflected ray and the normal all lie in the same plane. Angle of incidence = Angle of reflection $[\angle i = \angle r]$
Propagation of light
Rectilinear propagation of light: Light travels in a straight line between any two points.

Fermat’s Theorem
- The principle of least time: Light always takes the quickest path between any two points (which may not be the shortest path).
- Rectilinear propagation of light and the law of reflection \( \angle i = \angle r \) can be validated by Fermat’s principle of least time.

Plane mirror
Any flat and polished surface that has almost no irregularities on its surface that reflect light is called as a plane mirror.

Characteristics of images
- Images can be real or virtual, erect or inverted, magnified or diminished. A real image is formed by the actual convergence of light rays. A virtual image is the apparent convergence of diverging light rays.
- If an image formed is upside down then it is called inverted or else it is an erect image. If the image formed is bigger than the object, then it is called magnified. If the image formed is smaller than the object, then it is diminished.

Image formation by a plane mirror
- The image formed by a plane mirror is always virtual and erect.
- Object and image are equidistant from the mirror.
Principle of Reversibility of light
If the direction of a ray of light is reversed due to reflection off a surface, then it will retrace its path.

Spherical Mirrors
Spherical mirror
Consider a hollow sphere with a very smooth and polished inside surface and an outer surface with a coating of mercury so that no light can come out. Then if we cut a thin slice out of the shell, we get a curved mirror, which is called a spherical mirror.

Relationship between focus and radius of curvature
Focal length is half the distance between pole and radius of curvature.
\[ F = \frac{R}{2} \]
Curved Mirror
A mirror (or any polished, reflective surface) with a curvature is known as a curved mirror.

**Important terms related to spherical mirror**
- Pole (P): The midpoint of a spherical mirror.
- Centre of curvature (C): The centre of the sphere that the spherical mirror was a part of.
- The radius of curvature (r): The distance between the centre of curvature and the spherical mirror. This radius will intersect the mirror at the pole (P).
- Principal Axis: The line passing through the pole and the centre of curvature is the main or principal axis.
- Concave Mirror: A spherical mirror with the reflecting surface that bulges inwards.
- Convex Mirror: A spherical mirror with the reflecting surface that bulges outwards.
- Focus (F): Take a concave mirror. All rays parallel to the principal axis converge at a point between the pole and the centre of curvature. This point is called as the focal point or focus.
- Focal length: Distance between pole and focus.

**Rules of ray diagram for representation of images formed**
- A ray passing through the centre of curvature hits the concave spherical mirror and retraces its path.
- Rays parallel to the principal axis passes through the focal point or focus.

**Image formation by spherical mirrors**
For objects at various positions, the image formed can be found using the ray diagrams for the special two rays. The following table is for a concave mirror.

<table>
<thead>
<tr>
<th>Position of the object</th>
<th>Position of the image</th>
<th>Size of the image</th>
<th>Nature of the image</th>
</tr>
</thead>
<tbody>
<tr>
<td>At Infinity</td>
<td>At focus F</td>
<td>Highly diminished, point sized</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>Beyond C</td>
<td>Between F and C</td>
<td>Diminished</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>At C</td>
<td>At C</td>
<td>Same size</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>Between C and F</td>
<td>Beyond C</td>
<td>Enlarged</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>At F</td>
<td>At Infinity</td>
<td>Highly enlarged</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>Between P and F</td>
<td>Behind the mirror</td>
<td>Enlarged</td>
<td>Virtual and erect</td>
</tr>
</tbody>
</table>

**Uses of spherical mirror based on the image formed**
Concave and Convex mirrors are used in many daily purposes.
Example: Rear view mirrors in vehicles, lamps, solar cookers.

**Mirror Formula and Magnification**
**Sign convention for ray diagram**
Distances measured towards positive x and y axes (coordinate system) are positive and towards negative x and y-axes are negative. Keep in mind the origin is the pole(P). Usually, the height of the object is taken as positive as it is above the principal axis and height of the image is taken as negative as it is below the principal axis.

**Mirror formula and Magnification**
- \( \frac{1}{v} + \frac{1}{u} = \frac{1}{f} \) where ‘u’ is object distance, ‘v’ is the image distance and ‘f’ is the focal length of spherical mirror, which is found by similarity of triangles.
- The magnification produced by a spherical mirror is the ratio of the height of the image to the height of the object. It is usually represented as ‘m’.
Position and Size of image formed
Size of image can be found using the magnification formula \( m = h'/h = -(v/u) \) If \( m \) is -ve it is a real image and if it is +ve it is a virtual image.

Refraction Through a Glass Slab and Refractive Index

Refraction
The shortest path need not be the quickest path. Since light is always in a hurry, it bends when it enters a different medium as it is still following the quickest path. This phenomenon of light bending in a different medium is called refraction.

Laws of Refraction
- The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.
- The ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant, for the light of a given colour and for the given pair of media. This law is also known as Snell’s law of refraction.

Absolute and Relative Refractive Index
Refractive index of one medium with respect to another medium is called relative refractive index. When taken with respect to vacuum, it’s known as an absolute refractive index.

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Refractive through a rectangular glass slab
When the light is incident on a rectangular glass slab, it emerges out parallel to the incident ray and is laterally displaced. It moves from rarer to denser medium and then again to the rarer medium.

Refraction at a planar surface
Following Snell’s Law:
- Light bends towards the normal when moving from rarer to denser medium at the surface of the two media.
- Light bends away from the normal when moving from denser to rarer medium at the surface of contact of the two media.
Refractive Index
The extent to which light bends when moving from one medium to another is called refractive index. This depends on the ratio of the speeds in the two media. The greater the ratio, more the bending. It is also the ratio of the sine of the angle of incidence and the sine of the angle of refraction, which is a constant for any given pair of media. It is denoted by:
\[ n = \frac{\sin \theta_i}{\sin \theta_r} = \frac{\text{speed of light in medium 1}}{\text{speed of light in medium 2}}. \]

Total internal reflection
- When the light goes from a denser to a rarer medium it bends away from the normal. The angle at which the incident ray causes the refracted ray to go along the surface of the two media parallelly is called critical angle.
- When the incident angle is greater than the critical angle, it reflects inside the denser medium instead of refracting. This phenomenon is known as Total Internal Reflection. E.g mirages, optical fibres.

Spherical Lens
Refraction at curved surfaces
When light is incident on a curved surface and passes through, the laws of refraction still hold true. For example lenses.

Spherical lenses
Spherical lenses are the lenses formed by binding two spherical transparent surfaces together. Spherical lenses formed by binding two spherical surfaces bulging outward are known as convex lenses while the spherical lenses formed by binding two spherical surfaces such that they are curved inward are known as concave lenses.

Important terms related to spherical lenses
- Pole (P): The midpoint or the symmetric centre of a spherical lens is known as its Optical Centre. It is also called as the pole.
- Principal Axis: The line passing through the optical centre and the centre of curvature.
- Paraxial Ray: A ray close to principal axis and also parallel to it.
- Centre of curvature (C): The centres of the spheres that the spherical lens was a part of. A spherical lens has two centres of curvatures.
- Focus (F): It is the point on the axis of a lens to which parallel rays of light converge or from which they appear to diverge after refraction.
Focal length: Distance between optical centre and focus.
Concave lens: Diverging lens
Convex lens: Converging lens

Rules of ray diagram for representation of images formed
- A ray of light parallel to principal axis passes/appears to pass through the focus.
- A ray passing through the optical centre undergoes zero deviation.

Image formation by spherical lenses
The following table shows image formation by a convex lens.

<table>
<thead>
<tr>
<th>Position of the object</th>
<th>Position of the image</th>
<th>Relative size of the image</th>
<th>Nature of the image</th>
</tr>
</thead>
<tbody>
<tr>
<td>At infinity</td>
<td>At focus F_2</td>
<td>Highly diminished, point-sized</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>Beyond 2F_1</td>
<td>Between F_2 and 2F_2</td>
<td>Diminished</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>At 2F_1</td>
<td>At 2F_2</td>
<td>Same size</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>Between F_1 and 2F_1</td>
<td>Beyond 2F_2</td>
<td>Enlarged</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>At focus F_1</td>
<td>At infinity</td>
<td>Infinitely large or highly enlarged</td>
<td>Real and inverted</td>
</tr>
<tr>
<td>Between focus F_1 and optical centre O</td>
<td>On the same side of the lens as the object</td>
<td>Enlarged</td>
<td>Virtual and erect</td>
</tr>
</tbody>
</table>

Lens Formula, Magnification and Power of Lens

Lens formula and magnification
Lens formula: \( \frac{1}{v} = \frac{1}{u} = \frac{1}{f} \), gives the relationship between the object-distance (u), image-distance (v), and the focal length (f) of a spherical lens.

Uses of spherical lens
Applications such as visual aids: spectacles, binoculars, magnifying lens, telescopes.

Power of a Lens
Power of a lens is the reciprocal of its focal length i.e \( \frac{1}{f} \) (in metre). The SI unit of power of a lens is dioptre (D).

Access Chapter wise NCERT Solutions for Class 10 Science – Light Reflection and Refraction (All In-text and Exercise Questions Solved)

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1. Define the principal focus of a concave mirror.
   **Answer**
   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 called the principal focus of the concave mirror.

2. The radius of curvature of a spherical mirror is 20 cm. What is its focal length?
   **Answer**
   Radius of curvature (R) = 20 cm
Radius of curvature of the spherical mirror = 2 × Focal length (f)
R = 2f
f = R/2 = 20 / 2 = 10
Therefore, the focal length of the spherical mirror is 10 cm.

3. Name the mirror that can give an erect and enlarged image of an object.
Answer-
The mirror that can give an erect and enlarged image of an object is Concave Mirror.

4. Why do we prefer a convex mirror as a rear-view mirror in vehicles?
Answer-
Convex mirror is preferred as a rear-view mirror in cars and vehicles as it gives a wider field of view, which helps the driver to see most of the traffic behind him. Convex mirrors always form an erect, virtual, and diminished image of the objects placed in front of it.

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1. Find the focal length of a convex mirror whose radius of curvature is 32 cm.
Answer-
Radius of curvature (R) = 32 cm
Radius of curvature = 2 × Focal length (f)
R = 2f
f = R/2 = 32/2 = 16
Therefore, the focal length of the given convex mirror is 16 cm.

2. A concave mirror produces three times magnified (enlarged) real image of an object placed at 10 cm in front of it. Where is the image located?
Answer-
Magnification produced by a spherical mirror:
\[ m = \frac{\text{Height of the image}}{\text{Height of the object}} = \frac{\text{Image Distance}}{\text{Object Distance}} \]
\[ m = \frac{h_1}{h_0} = \frac{v}{u} \]
Let the height of the object, \( h_0 = h \)

Then, height of the image \( h_1 = -3h \) (Image formed is real)
\[ -\frac{3h}{h} = \frac{v}{u} \]
\[ \frac{v}{u} = 3 \]
Object distance (u) = −10 cm
\[ v = 3 \times (-10) = -30 \text{ cm} \]
Therefore, the negative sign indicates that an inverted image is formed in front of the given concave mirror at a distance of 30 cm.
1. A ray of light travelling in air enters obliquely into water. Does the light ray bends towards the normal or away from the normal? Why?

Answer-
The light ray bends towards the normal. When a light ray enters from an optically rarer medium (which has low refractive index) to an optically denser medium (which has a high refractive index), its speed slows down and bends towards the normal. As water is optically denser than air, a ray of light entering from air into water will bend towards the normal.

2. 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 $3 \times 10^8$ ms$^{-1}$.

Answer-
Refractive index of a medium (nm) = Speed of light in vacuum/Speed of light in the medium
Speed of light in vacuum ($c$) = $3 \times 10^8$ m/s
Refractive index of glass (ng) = 1.50
Speed of light in the glass ($v$) = Speed of light in vacuum/Refractive index of glass
= $c$/ng
= $3 \times 10^8/1.50 = 2 \times 10^8$ ms$^{-1}$.

3. Find out, from Table, the medium having highest optical density. Also find the medium with lowest optical density.

<table>
<thead>
<tr>
<th>Material medium</th>
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<tr>
<td>Air</td>
<td>1.0003</td>
<td>Canada Balsam</td>
<td>1.53</td>
</tr>
<tr>
<td>Ice</td>
<td>1.31</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Water</td>
<td>1.33</td>
<td>Rock salt</td>
<td>1.54</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1.36</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Kerosene</td>
<td>1.44</td>
<td>Carbon disulphide</td>
<td>1.63</td>
</tr>
<tr>
<td>Fused quartz</td>
<td>1.46</td>
<td>Dense flint glass</td>
<td>1.65</td>
</tr>
<tr>
<td>Turpentine oil</td>
<td>1.47</td>
<td>Ruby</td>
<td>1.71</td>
</tr>
<tr>
<td>Benzene</td>
<td>1.50</td>
<td>Sapphire</td>
<td>1.77</td>
</tr>
<tr>
<td>Crown glass</td>
<td>1.52</td>
<td>Diamond</td>
<td>2.42</td>
</tr>
</tbody>
</table>

Answer-
Lowest optical density = Air
Highest optical density = Diamond

The optical density of a medium is directly related to its refractive index. A medium with the highest refractive index will have the highest optical density and vice-versa.

It can be observed from the table that air and diamond respectively have the lowest and highest refractive index. Hence, air has the lowest optical density and diamond has the highest optical density.

4. You are given kerosene, turpentine and water. In which of these does the light travel fastest? Use the information given in Table.

<table>
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<td>1.52</td>
<td>Diamond</td>
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</tr>
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</table>

Answer-
Light travel faster in water as compared to kerosene & turpentine as the refractive index of water is lower than that of kerosene and turpentine. The speed of light is inversely proportional to the refractive index.

5. The refractive index of diamond is 2.42. What is the meaning of this statement?
Answer-
Diamond has a refractive index of 2.42 which means that the speed of light in diamond will reduce by a factor of 2.42 as compared to its speed in the air.
In other words, the speed of light in diamond is 1/2.42 times the speed of light in vacuum.
1. Define 1 dioptre of power of a lens.

**Answer:**

Dioptre is the SI unit of power of lens is denoted by the letter D. 1 dioptre can be defined as the power of a lens of focal length 1 metre.

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 the object? Also, find the power of the lens.

**Answer:**

The position of the image should be at 2F since the image is the real and same size. It is given that the image of the needle is formed at a distance of 50 cm from the convex lens. Therefore, the needle is placed in front of the lens at a distance of 50 cm.

Object distance \( (u) = -50 \text{ cm} \)

Image distance, \( (v) = 50 \text{ cm} \)

Focal length = \( f \)

According to the lens formula,

\[
\frac{1}{v} - \frac{1}{u} = \frac{1}{f}
\]

\[
\frac{1}{50} - \frac{1}{-50} = \frac{1}{f}
\]

\[
f = \frac{1}{50} + \frac{1}{50} = \frac{1}{25} = 25 \text{ cm} = 0.25 \text{ m}
\]

Power of lens, \( P = \frac{1}{f} \text{ (in metres)} = \frac{1}{0.25} = +4 \text{ D} \)

3. Find the power of a concave lens of focal length 2 m.

**Answer:**

Focal length of concave lens \( (f) = 2 \text{ m} \)

Power of lens \( (P) = \frac{1}{f} = 1/(-2) = -0.5 \text{ D} \)

**Exercise**

1. Which one of the following materials cannot be used to make a lens?
   (a) Water
   (b) Glass
   (c) Plastic
   (d) Clay

**Answer –**

(d) Clay cannot be used to make a lens because if the lens is made up of clay the light rays cannot pass through it.
2. 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.
Answer-
(d) The position of the object should be between the pole of the mirror and its principal focus.

3. Where should an object be placed in front of a convex lens to get a real image of the size of the object?
(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.
Answer –
(b) The object should be placed at twice the focal length

4. A spherical mirror and a thin spherical lens have a focal length of -15 cm. The mirror and the 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, but the lens is concave
Answer –
(a) Both are likely to be concave.

5. 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 plane or convex
Answer –
(d) The mirrors are likely to be either plane or convex

6. 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
Answer –
(c) A convex lens of focal length 5 cm can be used while reading small letters found in a dictionary
7. We wish 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 the image? Is the image larger or smaller than the object? Draw a ray diagram to show the image formation in this case.

Answer-
Range of the distance of the object = 0 to 15 cm from the pole of the mirror.
Nature of the image = virtual, erect, and larger than the object.

8. 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.
   Answer-
   (a) Concave Mirror: Because concave mirrors can produce a powerful parallel beam of light when the light source is placed at their principal focus.
   (b) Convex Mirror: Because of its largest field of view.
   (c) Concave Mirror: Because it concentrates the parallel rays of the sun at a principal focus.

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

Answer-
Yes, it will produce a complete image of the object, as shown in the figure. This can be verified experimentally by observing the image of a distant object like a tree on a screen when the lower half of the lens is covered with a black paper. However, the intensity or brightness of the image will reduce.

10. An object 5 cm in length is held 25 cm away from a converging lens of focal length 10 cm. Draw the ray diagram and find the position, size and the nature of the image formed.

Answer-
Height of the Object, \(h_0 = 5\) cm
Distance of the object from converging lens, \(u = -25\) cm
Focal length of a converging lens, \(f = 10\) cm
Using lens formula,
\[
\frac{1}{v} - \frac{1}{u} = \frac{1}{f}
\]
\[
\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{10} + \frac{1}{-25} = \frac{1}{250}
\]
\[
v = \frac{250}{15} = 16.66\text{cm}
\]
Also, for a converging lens, \(\frac{h_i}{h_0} = \frac{v}{u}\)
\[
h_i = \frac{v}{u} \times h_0 = \frac{50 \times 5}{3 \times (-25)} = \frac{10}{3} = -3.3\text{cm}
\]
Thus, the image is inverted and formed at a distance of 16.7 cm behind the lens and measures 3.3 cm. The ray diagram is shown below.
11. A concave lens of focal length 15 cm forms an image 10 cm from the lens. How far is the object placed from the lens? Draw the ray diagram.

**Answer**-
Focal length of concave lens \((OF_1)\), \(f = -15\) cm
Image distance, \(v = -10\) cm
According to the lens formula,
\[
\frac{1}{v} - \frac{1}{u} = \frac{1}{f}
\]
\[
\frac{1}{u} = \frac{1}{v} - \frac{1}{f} = \frac{1}{-10} - \frac{1}{-15} = \frac{1}{10} + \frac{1}{15}
\]
\[
v = -\frac{5}{150} = -30\) cm
The negative value of \(u\) indicates that the object is placed 30 cm in front of the lens. This is shown in the following ray diagram.

12. 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.

**Answer**-
Focal length of convex mirror \((f)\) = +15 cm
Object distance \((u)\) = −10 cm
According to the mirror formula,
13. The magnification produced by a plane mirror is +1. What does this mean?
Answer-
The positive sign means an image formed by a plane mirror is virtual and erect. Since the magnification is 1 it means that the size of the image is equal to the size of the object.

14. 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,
\[
\frac{1}{u} + \frac{1}{v} = \frac{1}{f}
\]
\[
\frac{1}{15} + \frac{1}{20} = \frac{1}{-10} \quad \frac{4 + 3}{60} = 7
\]
v = 8.57 cm
The positive value of v indicates that the image is formed behind the mirror

Magnification, \( m = \frac{\text{Image Distance}}{\text{Object Distance}} = \frac{-8.57}{-20} = 0.428 \)

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

Magnification, \( m = \frac{\text{Height of the image}}{\text{Height of the object}} = \frac{h_1}{h} \)

\( h_1 = m \times h = 0.428 \times 5 = 2.14 \text{ cm} \)
The positive value of image height indicates that the image formed is erect. Hence, the image formed is erect, virtual, and smaller in size.
15. 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 sharply focused image can be obtained? Find the size and nature of the image.

**Answer**
Object distance (u) = –27 cm  
Object height (h) = 7 cm  
Focal length (f) = –18 cm

According to the mirror formula,

\[
\frac{1}{v} - \frac{1}{u} = \frac{1}{f}
\]

\[
\frac{1}{v} - \frac{1}{-27} = \frac{1}{-18}
\]

\[
v = \frac{-54}{18} = -3 
\]

The screen should be placed at a distance of 54 cm in front of the given mirror.

**Magnification, m =** \[
\frac{-\text{Image Distance}}{\text{Object Distance}} = \frac{-54}{27} = -2
\]

The negative value of magnification indicates that the image formed is real.

**Magnification, m =** \[
\frac{\text{Height of the image}}{\text{Height of the object}} = \frac{h_1}{h}
\]

\[
h_1 = m \times h = -2 \times 7 = -14 \text{ cm}
\]

The negative value of image height indicates that the image formed is inverted.

16. Find the focal length of a lens of power -2.0 D. What type of lens is this?

**Answer**

Power of lens (P) = \(1/f\)

\[P = 2 \text{D}\]

\[f = -1/2 = -0.5 \text{ m}\]

A concave lens has a negative focal length. Therefore, it is a concave lens.

17. A doctor has prescribed a corrective lens of power +1.5 D. Find the focal length of the lens. Is the prescribed lens diverging or converging?

**Answer**

Power of lens (P) = \(1/f\)

\[P = 1.5 \text{D}\]

\[f = 1/1.5 = 10/15 = 0.66 \text{ m}\]

A convex lens has a positive focal length. Therefore, it is a convex lens or a converging lens.

**Frequently Asked Questions on Light Reflection and Refraction**

**Define the principal focus of a concave mirror?**
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 called the principal focus of the concave mirror.
Name the mirror that can give an erect and enlarged image of an object?
The mirror that can give an erect and enlarged image of an object is Concave Mirror.

Why do we prefer a convex mirror as a rear-view mirror in vehicles?
A convex mirror is preferred as a rear-view mirror in cars and vehicles as it gives a wider field of view, which helps the driver to see most of the traffic behind him. Convex mirrors always form an erect, virtual, and diminished image of the objects placed in front of it.

Define 1 dioptre of power of a lens?
Dioptre is the SI unit of power of lens is denoted by the letter D. 1 dioptre can be defined as the power of a lens of focal length 1 metre.

The magnification produced by a plane mirror is +1. What does this mean?
The positive sign means an image formed by a plane mirror is virtual and erect. Since the magnification is 1 it means that the size of the image is equal to the size of the object.