

• Light



1. State the two laws of reflection of light.
(CBSE 2011, 2013 2014)
2. The absolute refractive indices of glass and water are 1.5 and 1.33 respectively. In which medium does light travel faster? Calculate the ratio of speeds of light in the two media.
(CBSE 2013, 2019, 2020)
3. The image of a candle flame placed at a distance of 30 cm from a mirror is formed on a screen placed in front of the mirror at a distance of 60 cm from its pole. What is the nature of the mirror? Find its focal length. If the height of the flame is 2.4 cm, find the height of its image. State whether the image formed is erect or inverted.
(CBSE 2014, 2015, 2017)
4. Draw ray diagram to show the path of the refracted ray in each of the following cases. A ray of light incident on a concave lens (i) is parallel to its principal axis, (ii) is passing through its optical centre and (iii) is directed towards its principal focus.
(Delhi 2013, CBSE 2015, 2016)
5. An object is placed at a distance of 50 cm from a concave lens of focal length 30 cm.
 - (i) Use lens formula to find the distance of the image from the lens.
 - (ii) List four characteristics of the image (nature, position, size, erect/inverted) formed by the lens in this case.
 - (iii) Draw a ray diagram to justify your answer of pair (ii).
(CBSE 2016, 2019)

Solutions

1. Laws of reflection of light states that:

- (i) The angle of incidence is equal to the angle of reflection.
- (ii) The incident ray, the reflected ray and the normal to the mirror at the point of incidence all lie in the same plane.

2. Refractive index (RI) of glass is 1.5

Refractive index (RI) of water is 1.33

Now, RI of glass with respect to water = $\text{RI of glass} / \text{RI of water}$
 $= 1.5 / 1.33 = 1.127$

RI of water with respect to glass = $\text{RI of water} / \text{RI of glass}$
 $= 1.33 / 1.5 = 0.89$

Since velocity of light in medium is inversely proportional to its refractive index, the light will travel faster in optically rarer medium i.e. water.

3. Here, $u = 30$, $v = -60$

As $1/f = 1/u + 1/v = 1/(-60) + 1/(-30) = -1/20$

$f = 20$, The mirror is concave.

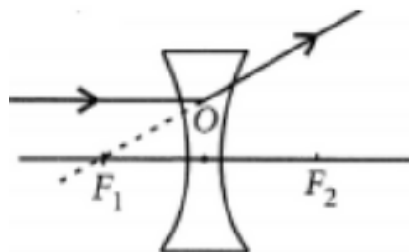
As the image is formed on the screen, it is real and inverted.

From $h_2/h_1 = -v/u = +60/-30 = -2$

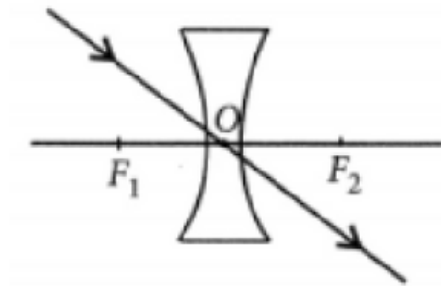
$h_2 = -2 \times h_1 = -2 \times 2.4 = -4.8 \text{ cm}$

This is the size of inverted image.

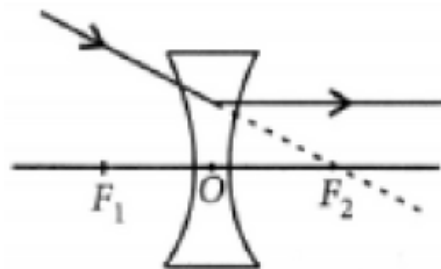
4. (i) A ray of light incident on a concave lens is parallel to its principal axis, the diagram can be drawn as follows:



4. The refracted ray appears to pass through focus on the same side of the lens.
(ii) If a ray of light incident on a concave lens is passing through its optical centre then the refracted ray will go without deviation.



- (iii) If a ray of light incident on a concave lens is directed towards its principal axis then it will go parallel to principal axis.



5. Object distance, $u = -60$ cm
Focal length of the lens, $f = -30$ cm
Step 2: Finding the image distance using the lens formula:
Using the lens formula, we get
$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$
$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$
$$\frac{1}{v} = \frac{1}{(-30)} + \frac{1}{(-60)}$$
$$\frac{1}{v} = \frac{1}{-20}$$
$$v = -20\text{cm}$$

Thus, the distance of the image from the lens is 20 cm.

- (ii) The four characteristics of the image formed by the lens in this case are:

1. The image formed is virtual as the given lens is a concave lens.
2. The image is erect as it formed above the principal axis.

3. Image is diminished (smaller than the object).
4. Image is formed at a distance of 20 cm from the optical centre of the concave lens on the same side of the object.

