Board – CBSE | Class – 10th | Topic – Light Reflection and Refraction

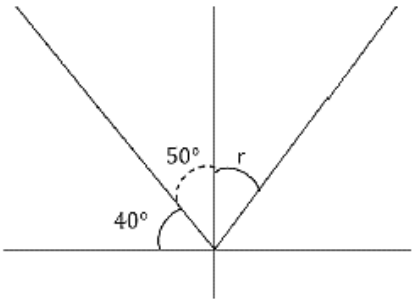
Q.1 What happens when a ray of light falls normally (or perpendicularly) on the surface of a plane mirror?

Ans. As a ray of light falls normally on the mirror, this means that the angle of incidence is 0°. From the second law of reflection, we know that angle of incidence is equal to the angle of reflection. So, the angle of reflection will also be zero. Therefore, the light ray will be reflected along the same path.

Q.2 A ray of light strikes a plane mirror at an angle of 40° to the mirror surface. What will be the angle of reflection?

Ans. Angle to the mirror surface $= 40^{\circ}$

Therefore, angle of incidence $= 90^{\circ} - 40^{\circ} = 50^{\circ}$



According to the second law of reflection, the angle of incidence is equal to the angle of reflection.

Therefore, angle of reflection $= 50^{\circ}$

Q.3 What is the difference between a real image and a virtual image? Give one example of each type of image.

Ans. A real image can be obtained on a screen because light rays pass through the point of the real image. Still, a virtual image cannot be formed on screen because light rays do not pass through the point of the virtual image.

Example:-

The image formed on a cinema screen is an example of a real image.

The image formed by a plane mirror is virtual.

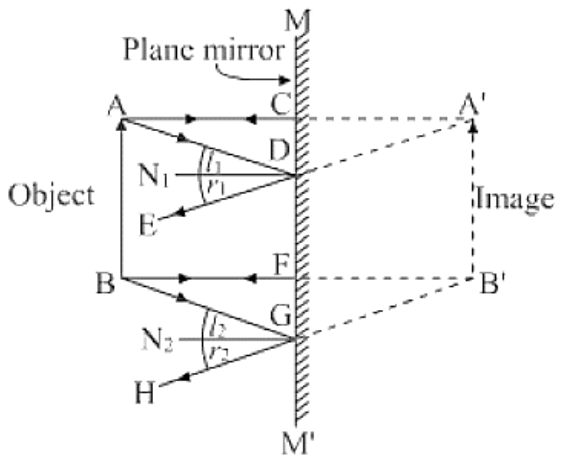
Q.4 What are the important differences between looking at a photograph of your face and looking at yourself in a plane mirror?

Ans. An image of our face in a plane mirror is laterally inverted, so left is right and right is left. However, in a photograph of our face, this is not the case.

Q.5 (a) An extended object in the form of an arrow pointing upward has been placed in front of a plane mirror. Draw a labelled ray diagram to show the formation of its image.

(b) State the uses of plane mirrors.

Ans.



The formation of image of an extended object

(b) Uses of Plane mirrors:

(i) Plane mirrors are used to see ourselves. The mirrors on our dressing table and in bathrooms are plane mirrors.

(ii) Plane mirrors are fitted at blind turns of some busy roads so that drivers can see the vehicles coming from the other side and prevent accidents.

(iii) Plane mirrors are used to make periscopes.

(iv) Plane mirrors are fixed on the inside walls of certain shops to make them look bigger.

Q.6 What is meant by 'reflection of light'? Define the following terms used in the study of reflection of light by drawing a labelled ray diagram:

(a) Incident ray

(b) Point of incidence

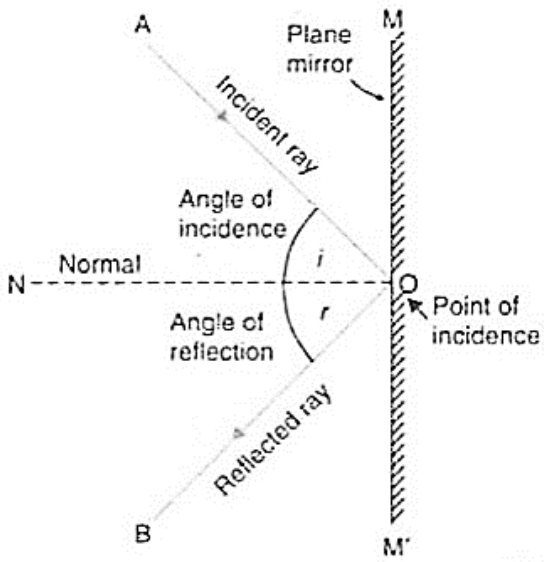
(c) Normal

(d) Reflected ray

(e) Angle of incidence

(f) Angle of reflection

Ans. The process of sending back the light rays that fall on an object's surface is called the reflection of light.



(a) Incident ray: The ray of light that falls on the mirror surface is called the incident ray.

(b) Point of incidence: The point at which the incident ray falls on the mirror is called the point of incidence.

(c) Normal: The normal is a line at a right angle to the mirror surface at the point of incidence.

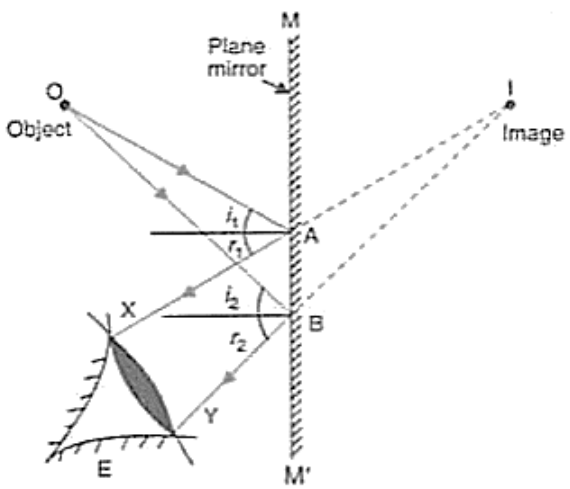
(d) Reflected Ray: The ray of light sent back by the mirror is called the reflected rays.

(e) Angle of incidence: The angle of incidence is the angle made by the incident ray with the normal at the point of incidence.

(f) Angle of reflection: The angle of reflection is the angle made by the reflected ray with the normal at the point of incidence.

Q.7 With the help of a labelled ray diagram, describe how a plane mirror forms an image of a point source of light placed in front of it. State the characteristics of the image formed in a plane mirror.

Ans.



Consider a point source of light O placed in front of a plane mirror MM'. a ray of light OA coming from 0 in an incident at point A on the mirror and gets reflected in the direction AX according to the laws of reflection of light. Another ray of light OB from 0 strikes the mirror is point B and gets reflected in the direction BY. Rays AX and BY, on producing backwards, meet at point I behind the mirror, which is the image of point source 0.

Characteristics of the image formed in a plane mirror:

(i) The image formed in a plane mirror is virtual. It cannot be received on a screen.

(ii) The image formed in a plane mirror is erect. It is the same side up as the object.

(iii) The image in a plane mirror is of the same size as the object.

(iv) The image formed by a plane mirror is at the same Distance behind the mirror as the object is in front of the mirror.

(v) The image formed by a plane mirror is laterally inverted.

Q.8 A man sits in an optician's chair, looking into a plane mirror 2 m away from him and viewing the image of a chart that faces the mirror and is 50 cm behind his head. How far away from his eyes does the chart appear to be?

Ans. Distance between the man and the mirror $= 2\ m$

Distance between man and chart $= 50\ cm = 0.5\ m$

Distance between chart and mirror $= 0.5\ m + 2\ m = 2.5\ m$

Distance between the mirror and the image of the chart $= 2.5\ m$

Distance between man and the image of chart = Distance between man and the mirror +

Distance between the mirror and the image of the chart $= 2\ m + 2.5\ m = 4.5\ m$

Q.9 Explain how to read the following message, which was found on some blotting paper:

Ans. The impression on blotting paper is the mirror image of the written massage. Therefore, to read this message, we need to hold the written message in front of a mirror to produce a laterally inverted image of this message.

Q.10 A man holds a spherical shaving mirror of radius of curvature 60 cm, and focal length 30 cm, from his nose at a distance of 15 cm. Find the position of the image, and calculate the magnification.

Ans. The radius of curvature, $R = -\ 60\ cm$ (concave mirror)

$f = -\ 30\ cm, u = -\ 15\ cm$

We have,

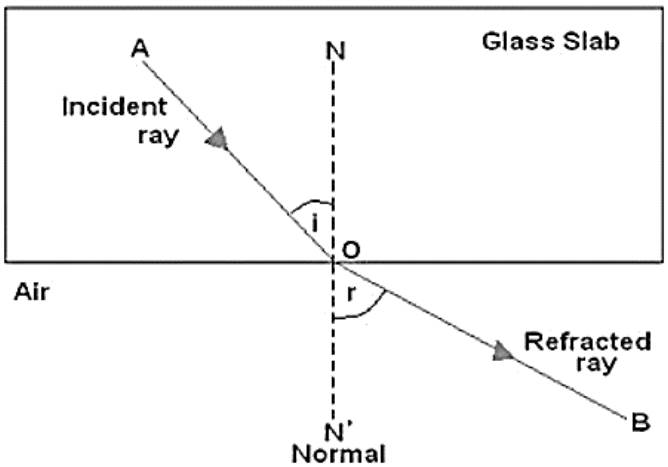
$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \quad \frac{1}{v} + \frac{1}{-15} = \frac{1}{-30} \quad \frac{1}{v} = \frac{1}{30} \quad v = 30\ cm$$

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

So, the image is formed 30 cm behind the mirror, and the magnification is $+\ 2$.

Q.11 A beam of light travelling in a rectangular glass slab emerges into the air. Draw a ray diagram indicating the change in its path.

Ans. A ray of light travelling from the glass slabs and emerges into the air.



Q.12 State two effects caused by the refraction of light.

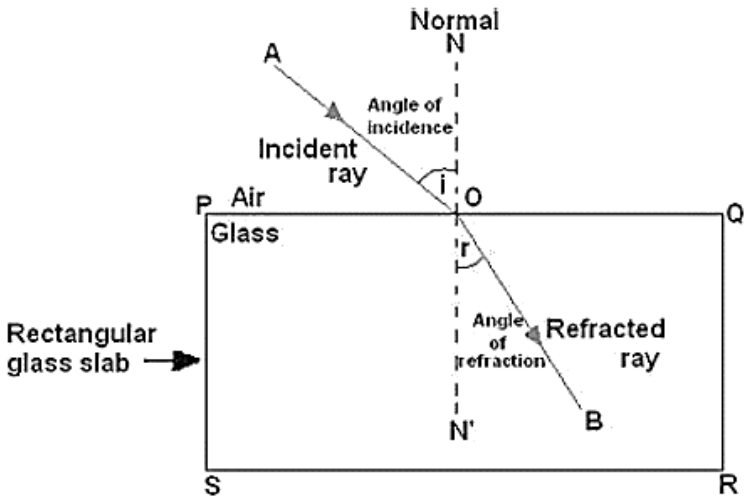
Ans. Two effects caused by the refraction of light are:

- a pool of water appears to be less deep than it is.
- An object placed underwater appears to be raised.

Q.13 What is meant by the 'angle of incidence' and the 'angle of refraction for a ray of light? Draw a labelled ray diagram to show the angle of incidence and the angle of refraction for a refracted ray of light.

Ans. The angle between the incident ray and normal at the point of incidence is called the angle of incidence.

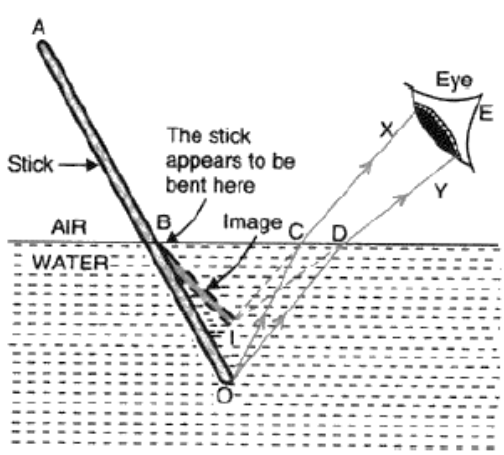
The angle between the refracted ray and normal at the point of refraction is called the angle of refraction.



Q.14 (a) Explain why a stick half immersed in water appears to be bent at the surface. Draw a labelled diagram to illustrate your answer.

(c) A coin in a glass tumbler appears to rise as the glass tumbler is slowly filled with water. Name the phenomenon responsible for this effect.

Ans. (a) The apparent bending of the stick is due to the refraction of light when it passes from water into the air. A ray of light $0C$ coming from 0 passes from water into the air and gets refracted away from normal (along CX). Another ray OD gets refracted along DY. The two refracted rays CX and DY, when produced backwards, appear to meet at the point I. Thus, I is the virtual image of the end 0 of the stick. So, the stick appears to be bent, as shown below.



(b) This phenomenon is due to the refraction of light as it comes out from water into the air.

Q.15 Why does a beam of light bend when it enters glass at an angle? Why does it not bend if it enters the glass at right angles?

Ans. A beam of light bends when it enters glass at an angle. This is due to the refraction of light. It does not bend if it enters the glass at right angles because no refraction will occur in this case. The angle of incidence, in this case, is zero, and the angle of refraction is also zero.

Q.16 The refractive index of glass is 1. 5. Calculate the speed of light in glass. The speed of light in air is $3.0\times10^{8}\ ms^{-1}$

Ans. Refractive index of glass $= 1.5$

Speed of light in air $= 3.0\times\frac{10^{8}\ m}{s}$

We know that,

$$Refractive\ index\ of\ glass\ = \frac{Speed\ of\ light\ in\ air}{Speed\ of\ light\ in\ the\ glass}\quad 1.5\ = \frac{3\times10^{8}}{Speed\ of\ light\ in\ the\ glass}$$

Speed of light in glass $= 2\times10^{8}\ m/s$

Q.17 What is a lens? Distinguish between a convex lens and a concave lens. Which of the two is a converging lens: convex lens or concave lens?

Ans. A lens is a piece of transparent glass bound by two spherical surfaces.

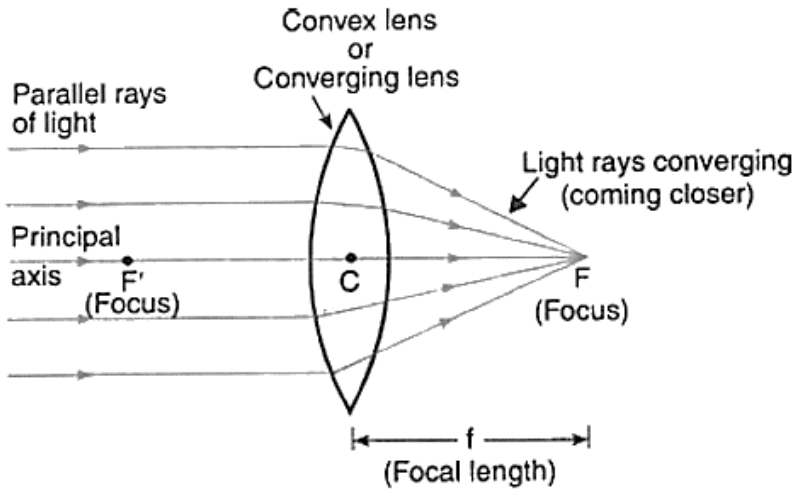
A convex lens is thicker at the middle than the edges, while a concave lens is thicker at the edges than the middle.

The convex lens is converging.

Q.18 (a) Explain with the help of a diagram why the convex lens is also called a converging lens.

(b) Define principal axis, principal focus and focal length of a convex lens.

Ans. (a) A convex lens is also known as a converging type because it converges a parallel beam of light rays passing through it.



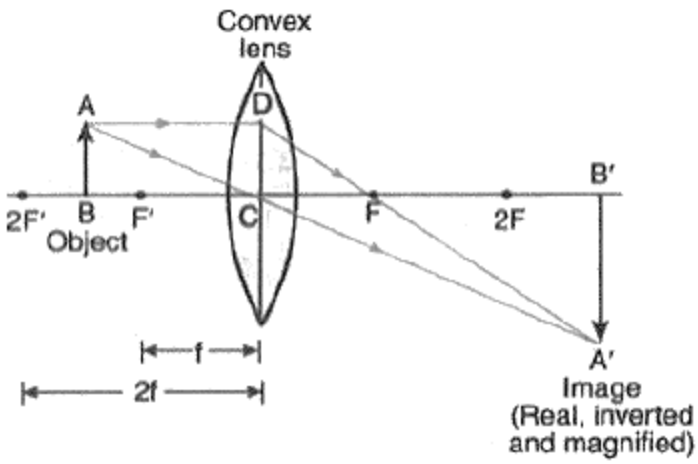
(b) Principle axis: The principal axis of a lens is a line passing through the optical centre of the lens and perpendicular to both the faces of the lens.

Principle focus: The principal focus of a convex lens is a point on its principal axis to which light rays parallel to the principal axis converge after passing through the lens.

Focal length: The Distance of the principal focus from the optical centre is called its focal length.

Q.19 Draw a ray diagram to show a real magnified image formation by a convex lens. (In your sketch, the position of object and image with respect to the principal focus of lens should be shown clearly).

Ans. Formation of the real magnified image by a convex lens.



Q.20 An object 4 cm high is placed at a distance of 10 cm from a convex lens of focal length 20 cm. Find the position, nature and size of the image.

Ans.

$u =- 10\ cm \quad h_1 = 4\ cm \quad f = 20\ cm \quad \frac{1}{v} - \frac{1}{u} = \frac{1}{f} \quad \frac{1}{v} - \frac{1}{-10} = \frac{1}{20} \quad \frac{1}{v} = \frac{1}{20} - \frac{1}{10} =- \frac{1}{20} \quad v =- 20$

The image is 8 cm in size and is real and inverted.