REFRACTION OF LIGHT

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The bending of a ray of light due to change in its speed as it passes from one medium to another is called refraction of light.

LAWS OF REFRACTION OF LIGHT

1. 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.
2. Snell's Law of Refraction
   The ratio of sine of angle of incidence to the sine of angle of refraction is constant for the light of a given colour and for the given pair of media.

$$\frac{\sin \angle i}{\sin \angle r} = n \text{ where is a constant called refractive index}$$

REFRACTIVE INDEX

The ratio of the speed of light in first medium to that in the second medium is termed as refractive index of second medium with respect to the first medium.

Mathematically $n_{21} = \frac{v_1}{v_2}$

where

v_1 is the speed of light in the first medium ,

v_2 is the speed of light in the second medium.

Absolute Refractive Index

The ratio of the speed of light in vacuum to that in the medium is termed as the absolute refractive index of the medium.

$$n=c/v$$

Where,

v is the speed of light in the medium

c is the speed of light in vacuum.

Factors of Refractive Index

1. Material of the medium.
2. Wavelength of light.

The refractive index of water, n_w = 1.33

OPTICALLY DENSER MEDIUM

A medium in which the speed of light is comparatively less is called optically denser medium.

Denser medium has higher refractive index

OPTICALLY RARER MEDIUM

A medium in which the speed of light is comparatively more is called optically rarer medium.

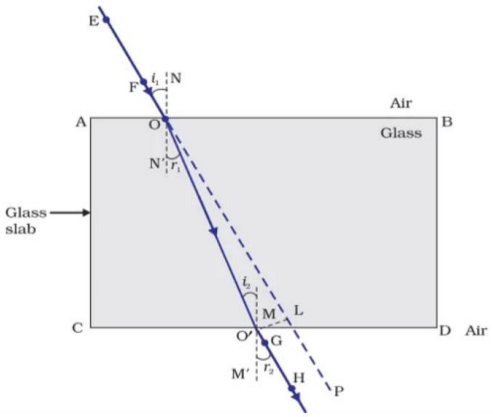
Rarer medium has lower refractive index

LATERAL DISPLACEMENT

The perpendicular distance of separation between the emergent ray and the original path of the incident ray is called lateral displacement.

Factors Affecting Lateral Displacement:

1. Thickness of the medium.
2. Angle of incidence.
3. Refractive index of the medium.



Refraction through a Rectangular Glass Slab

1. The light ray at point O has entered from a rarer medium (air) to a denser medium (glass). The light ray has bent towards the normal.

2. At O', the light ray has entered from glass to air, that is, from a denser medium to a rarer medium. The light here has bent away from the normal.

The emergent ray is parallel to the direction of the incident ray because:

3. The extent of bending of the ray of light at the opposite parallel faces AB (air-glass interface) and CD (glass-air interface) of the rectangular glass slab is equal and opposite. This is why the ray emerges parallel to the incident ray.

Refraction by Spherical Lenses

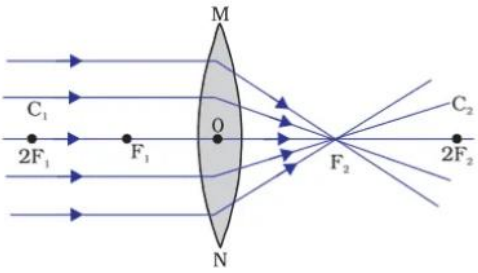
Lens: A transparent material bound by two surfaces, of which one or both surfaces are spherical, forms a lens.

There are two types of lens

1. Convex lens (Converging lens)
2. Concave lens (Diverging lens)

Convex Lens

1. It is thicker in the middle as compared to the edges.
2. Convex lens converges light rays, convex lenses are also called converging lenses.



Concave Lens

1. It is thicker at the edges than at the middle.
2. Concave lenses diverge light rays, concave lenses are also called diverging lenses.

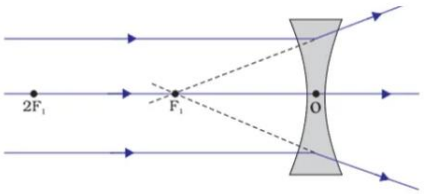
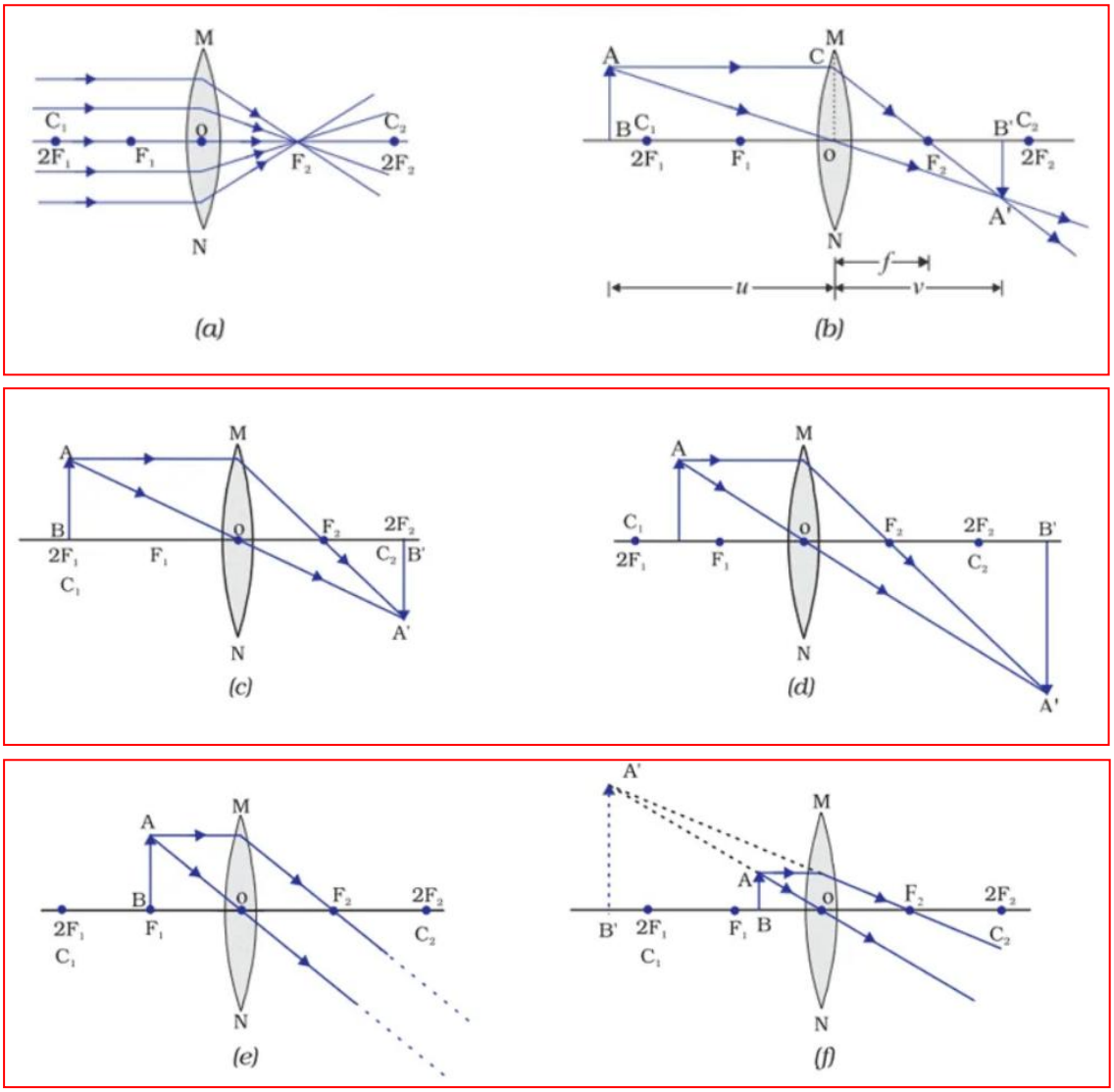


Image formation by convex lens

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



Uses of convex lens and concave lens

Concave lens	Convex lens
(i) It is called diverging lens.	(i) It is called converging lens.
(ii) This lens is thinner in the centre than at its edges.	(ii) This lens is thicker at the centre than at its edges.
(iii) The principal focus is virtual.	(iii) The principal focus is real.
(iv) The focal length is negative.	(iv) The focal length is positive.
(v) This lens is used to correct myopia.	(v) This lens can be used to correct hypermetropia.