Refraction of Light

The bending of a light wave when it passes from one medium to another due to the change in the speed of the light traveling the two different media is called the **refraction of light.** This bending of light from one medium to another takes place due to the different speeds of light in different media.

Here are the definitions of important terms used to study Refraction:

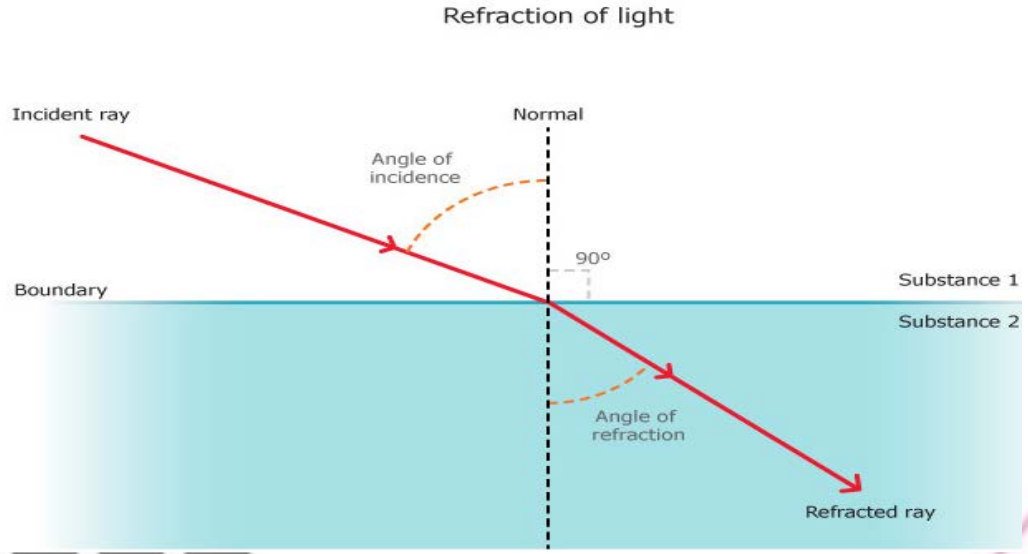
Normal: The point of the surface at which an optical phenomenon occurs is called the normal. In simple words, it is termed the point of incidence. It is shown by a dotted line drawn perpendicular to the surface of the refracting material, in a ray diagram.

Incident Ray: The light rays that strike the refracting surface, at the separation of two media are called the Incident Ray.

Refracted Ray: The light rays that bend after passing into another medium are called the Refracted Ray.

Angle of Incidence: This is the angle between the incident ray and the normal. It is represented by ∠i and it is also called an Incident angle.

Angle of Refraction: This is the angle between refracted ray and the normal. It is represented by ∠r and it is also called a Refracted angle.



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Laws of Refraction of Light

The incident ray, the refracted ray and the normal to the interface of the two transparent media at the point of incidence all lie in the same plane.

For the light of given colour, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant in the given pair of media. This is known as Snell's law of Refraction. It is true for the angle of incidence (i) $0^\circ < I < 90^\circ$

According to this law,

$\sin i / \sin r = \text{constant}$ — (1)

Where r is the angle of refraction.

The constant in equation (1) is the refractive index of medium 2 w.r.t medium 1 denoted by n_{21}.

Refractive Index

The refractive index of medium 2 with respect to medium 1 is equal to the ratio of the speed of light in medium 1 to the speed of light in medium 2. If v_1 and v_2 be the speed of light in medium 1 and 2 respectively.

$$n_{21} = \frac{\text{speed of light in medium 1} = v_1}{\text{speed of light in medium 2} = v_2}$$

If medium 1 is vacuum or air, the refractive index of medium 2 with respect to vacuum is called the absolute refractive index of medium 2. It can be given as:

$$n_2 = \frac{\text{speed of light in air} = c}{\text{speed of light in medium 2} = v_2}$$

This is the formula for the refractive index of the medium 2.

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Types of Refraction

The refraction of light occurs in different ways depending on the medium through which the light travels.

Refraction from denser to rarer medium: When light rays pass through rarer to a denser medium, the light rays bend towards the normal. Due to this the angle of refraction is smaller than the angle of incidence. e.g. In the case when light rays pass from air to water or from air to glass, it bends towards normal. It is because of the reason that the speed of light rays reduces **while passing from air to glass or water.**

Refraction from rarer to denser medium: When light rays pass from denser to rarer medium, the light rays bend away from the normal. Due to this the angle of refraction becomes more than the angle of incidence. e.g. In case when light rays pass from water to air or glass to air, light rays bend away from the normal. The speed of light rays becomes greater while passing from glass or water to air.

Examples of Refraction of Light

- The stars twinkle in the night sky due to the refraction of their light.
- Looming and Mirage formation, both occur due to the optical illusions caused by the refraction of light.
- The formation of rainbows in the sky and VIBGYOR, when white light passes through the prism are also major examples of refraction.
- A swimming pool always seems or looks much shallower than it really is because of the light that comes from the bottom of the pool bends at the surfaces due to the refraction of light.

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Applications of Refraction of Light

Refraction has many applications in optics and technology. A few of the prominent applications are listed below:

- A lens uses refraction to form an image of an object for various purposes, such as magnification.
- Spectacles worn by people with defective vision use the principle of refraction.
- Refraction is used in peepholes of house doors, cameras, movie projectors and telescopes