

Chapter 04

Refraction of Light at Plane Surfaces

- What is refractive Index?

The extent of the change in direction that takes place when a light ray propagates through one medium to another medium is expressed in terms of refractive index.

Light travels in vacuum with a speed nearly equal to 3×10^8 m/s (denoted by letter 'c'). The speed of light is smaller than 'c' in other transparent media.

Let 'v' be the speed of light in a certain medium. Then the ratio of speed of light in vacuum to the speed of light in that medium is defined as refractive index 'n'. It is called absolute refractive index.

Absolute refractive index (n):

$$= \frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}$$

$$n = \frac{c}{v}$$

It is a dimensionless quantity because it is a ratio of the same physical quantities. Refractive index gives us an idea of how fast or how slow light travels in a medium.

Material medium	Refractive index	Material medium	Refractive index
Air	1.0003	Canada balsam	1.53
Ice	1.31	Rock salt	1.54
Water	1.33	Carbon Diasulphide	1.63
Kerosene	1.44	Dense flint glass	1.65
Fused quartz	1.46	Ruby	1.71
Turpentine oil	1.47	Sapphire	1.77
Crown glass	1.52	Diamond	2.42
Benzene	1.50		

From table-1, you know that an optically denser medium may not possess greater mass density.

- Why do different material media possess different values of refractive indices?
- On what factors does the refractive index of a medium depend?

Refractive index depends on the following factors.

- (1) Nature of material
- (2) Wavelength of light used.

The speed of light in a medium is low when refractive index of the medium is high and vice versa. The refractive index 'n' means that the speed of light in that medium is n^{th} part of speed of light in vacuum

Relative refractive index:

The refractive index of a medium with respect to another medium is defined as the ratio of speed of light in the first medium to the speed of light in the second medium. Let v_1 and v_2 be the speeds of light in the first and second media respectively.

Refractive index of second medium with respect to first medium is given by

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

$$= \frac{v_1}{v_2} = \frac{v_1}{c} \bigg/ \frac{v_2}{c} = \frac{1}{n_1} \bigg/ \frac{1}{n_2} = \frac{n_2}{n_1}$$

$$n_{21} = \frac{n_2}{n_1}$$

This is called relative refractive Index. We define relative Refractive index as,

Relative refractive index,

$$n_{21} = \frac{\text{Refractive index of second medium } (n_2)}{\text{Refractive index of first medium } (n_1)}$$

