REFRACTION OF LIGHT

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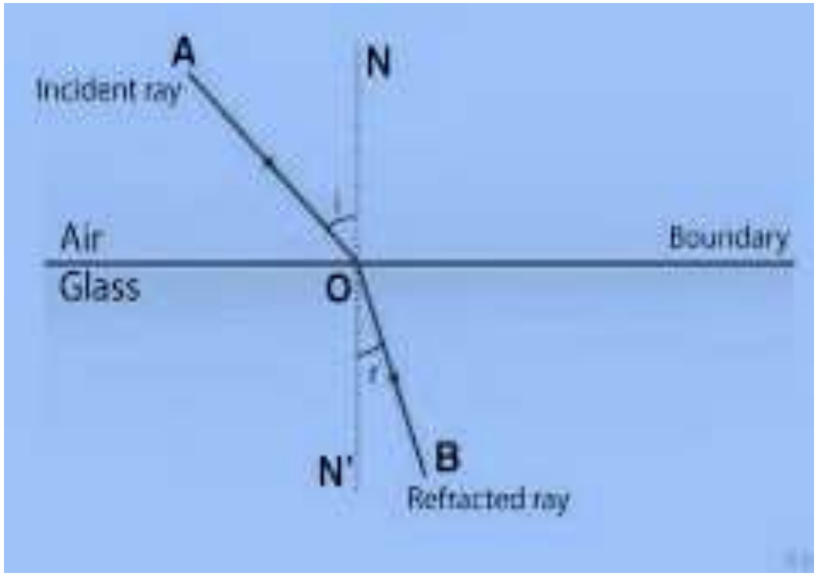
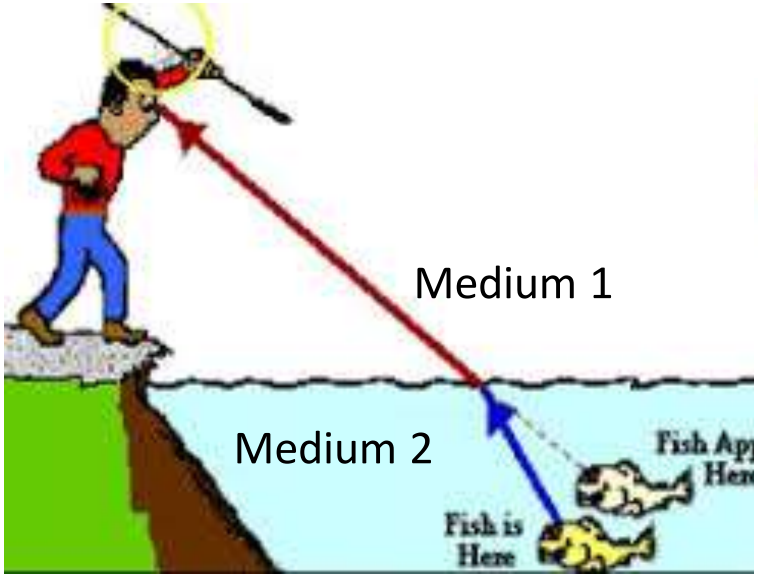
What is refraction of light:

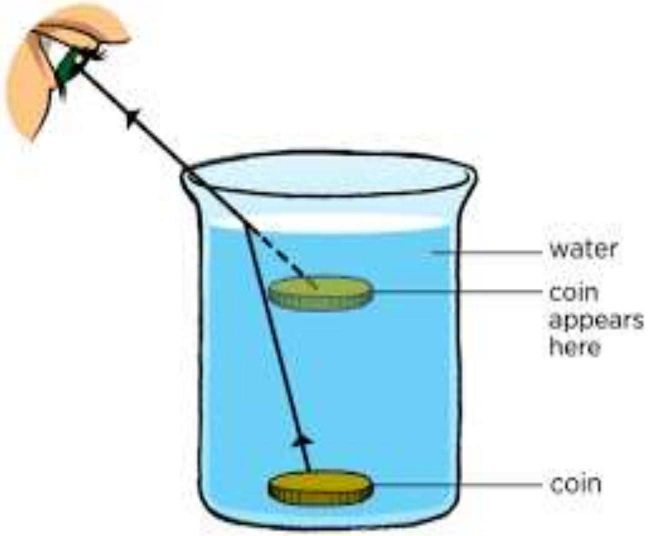
Bending of a light ray or changing of velocity of light at the interface of the media ,when it passes from one transparent medium to another is called as refraction of light. When light travels from a rarer to a denser medium the refracted ray bends towards the normal and vice versa.



angle of incidence--i
angle of refraction-- r

Practical applications of refraction.





In terms of depth refractive index

$$^{1}n_{2} = \frac{Real\ depth}{apparent\ depth}$$

Laws of refraction:

There are two laws of refraction

i. The incident ray, the refracted ray and the normal at the point of incidence lie on same plane.

ii. When light passes from one transparent medium to another medium then for a particular colour and for two particular media the ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant. This constant is called as refractive index of the medium 2 with respect to medium 1. This 2nd law of refraction is also called as Snell's law. So refractive index of the medium can be represented by

$$^{1}n_{2} = \frac{\sin i}{\sin r}$$

Again refractive index can be expressed as the ratio of the velocity of the light in two medium . The refractive index of a medium with respect to vacuum for a light ray can be expressed as

$$^{1}n_{2} = \frac{velocity\ of\ light\ in\ vacuum}{velocity\ of\ light\ \ in\ the\ medium}$$

$^{1}n_{2} = \frac{c}{v}$ c is the velocity if light in vacuum

v is the velocity of light in the medium.

Refractive index in terms of wave length of light:

When light travels from one medium to other its frequency remains same but wavelength and velocity changes.

We know that

Velocity of light=frequency x wavelength of light.

velocity of light in vacuum c= γ. λc

Velocity of light in medium v= γ. λv

Here γ frequency of the light. λc is the wavelength of light in vacuum and λv is the wavelength of light in medium.

So refractive index of the medium can be written as

$$^{1}n_{2} = \frac{C}{V} = \frac{\lambda c.\gamma}{\lambda v\,.\gamma} = \frac{\lambda c}{\lambda\, v}$$

$$= \frac{wavelength\ \ of\ light\ in\ vacuum}{wavelength\ of\ light\ in\ medium}$$

Absolute refractive index and the relative refractive index:

When light travels from vacuum to the medium then the refractive index is called as absolute refractive index and when light travels from medium 1 with velocity v_1 to another medium with velocity v_2 then the refractive index is called as relative refractive index.

absolute refractive index $n = \frac{C}{V}$

relative refractive index. $^{1}n_{2} = \frac{v_1}{v_2}$

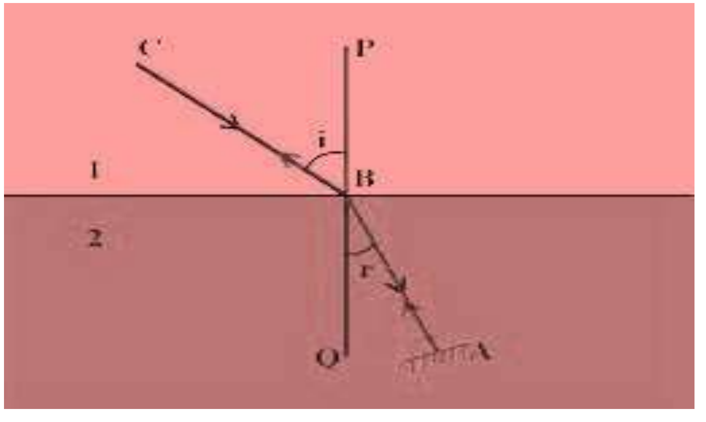
Physical significance of refractive index:

I) Refractive index of a medium gives the information about the bending of refracted ray towards the normal.

II) It gives us the information of the velocity of light in comparison to the velocity of light in vacuum.

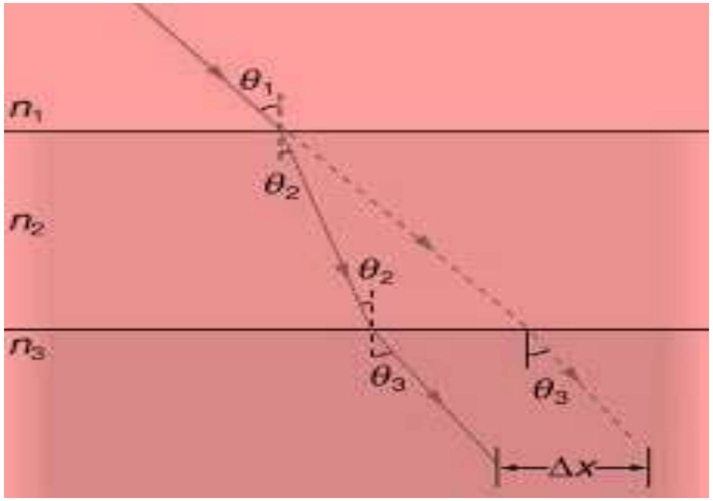
Principle of reversibility:

According to principle of reversibility of light, if the path of the light is reversed after suffering a number of reflections or refractions, then it exactly retraces its path.



This is called as principle of reversibility

Refraction through a combination of media:



Medium 1is air
Medium 2 is water
Medium 3 is air

Angle of incidence θ_1 is equal to angle of emergence θ_3 since both these media are air. Therefore

$$ {}^1n_2 = \frac{\sin\theta_1}{\sin\theta_2} $$

$$ {}^2n_3 = \frac{\sin\theta_2}{\sin\theta_3} = \frac{\sin\theta_2}{\sin\theta_1} $$

$$ {}^1n_2 \times {}^2n_1 = \frac{\sin\theta_1}{\sin\theta_2} \times \frac{\sin\theta_2}{\sin\theta_1} = 1 $$

$$ \mathbf{{}^1n_2 = 1/\,{}^2n_1} $$

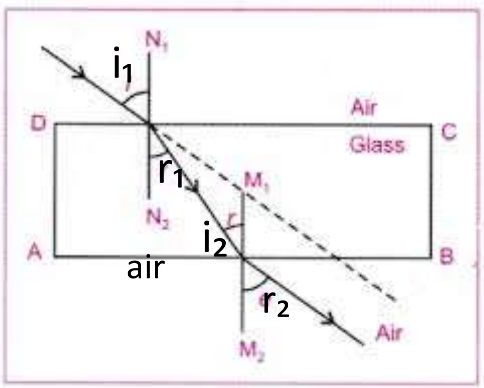
Refraction through a rectangular glass slab:

${}^{a}n_{g} = \sin i_1 / \sin r_1$

${}^{g}n_{a} = \sin i_2 / \sin r_2$

We know that ${}^{g}n_{a} = \frac{1}{{}^{a}n_{g}}$

${}^{a}n_{g} \times {}^{g}n_{a} = 1$ since $r_1 = i_2$



$$\left(\frac{\sin i_1}{\sin r_1}\right) \times \left(\frac{\sin i_2}{\sin r_2}\right) = 1$$

Since $\sin i_1 = \sin r_2$

therefore $i_1 = r_2$

So emergent ray is parallel to the incident ray.

Any queries ?

Thank You