1. WAVE THEORY OF LIGHT

☞ **Wave theory of light :**

➢ **Postulates :**

i) Every source of light contineously emits tiny, and large number of perfectly elastic particles called as corpuscles, in all direction .

ii) These corpuscles are weightless, and rigid.

iii) These corpuscles emitted by sources, travels in straight line through a medium which is rectilinear propogation.

iv) When corpuscles falls on ratina of eye, they produce the sensation of light.

v) Different colours of light are due to different sizes of the corpuscles.

vi) Reflection of light is due to the repulsion of corpuscles from reflecting surface.

vii) Refraction of light is due to the attraction between corpuscles and surface of medium.

☞ **Huygen's wave theory**

In 1678 Christian Huygen a Duch physicist proposed the theory of light.

According to Huygen.

i) Each point in a source of light emits waves which propogates in all directions.

ii) These waves travels with uniform velocity in homogeneous medium called Luminiferous ether.

iii) Different colours are due to different wavelengths of light waves.

iv) When light waves enter to our eye, we get sensation of light.

v) Velocity of light in rarer medium is greater than the velocity of light in denser medium.

vi) Huygen assumed that these waves are mechanical in nature.

vii) Ether is present in vaccuum as well as in all material bodies through which light passes.

➢ **The concept of hypothetical medium in Wave theroy of light**

Huygen assumed light propagated through hypothetical medium called "Luminiferous ether" in the form of light waves.

It posses following *properties*.

i) It is contineous medium which spreads in all space.

ii) It has very high elasticity and very small size particles and has storng internal restoring force.

iii) It has zero density.

iv) It is complectly transperent.

v) It is also present in substances through which light travels in the form of wave.

➢ **Dual character of light**

Two theories have been advanced to account the nature of light called corpuscular theory and wave theory of light.

- According to corpuscular theroy light consists of tiny weightless particles called corpuscules while wave theory formulated by Huygen, explains light is form of wave motion
- Physicists today consider the light have dual nature (wave as well as particle) since some phenomenons can satisfactoraly explained by both the theories.

➢ **Wavefront :**

Wavefront at anytime is defined as locus of all the points of the medium to which the waves reaches simultaneously so that all the points are vibrating in same phase.i.e. which are in same state of vibration

different types of wavefront

Wavefornt are of three types, whose. gemotrical shape depends on the source of disturbance(light).

(i) Spherical Wavefront
(ii) Cylindrical Wavefront
(iii) Plane wavfront.

Spherical Wavefront :

A wavefront originating from a point source of light is called as spherical wavefront.

Cylindrical wavefront :

When the source of light is linear or an extended like fine rectangular slit in isotropic medium, the wavefront takes the cylindrical shape.

Plane Wavefront :

If point or linear source is placed at infinity, the portion of spherical or cylindrical wavefront in the limited or small region is simply a plane and is called plane Wavefront.

Wavenormal :

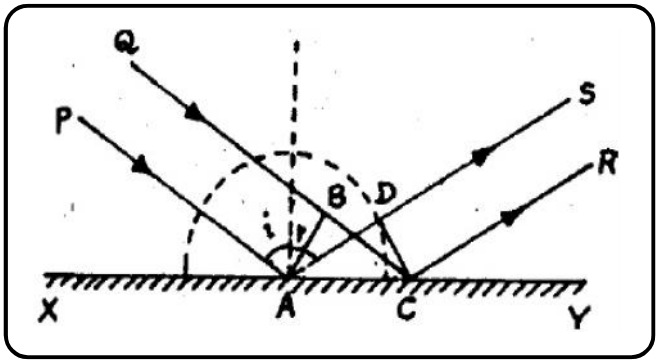
A perpendicular drawn to the surface of wavefornt at anypoint, in direction of proporgation of light, is called wavenormal

☞ **HYGEN'S PRINCIPLE.**

Huygen's Principle :

1. Every point on primary wavefront becomes a source of secondary wavelet of light.
2. These wavelets travels with the same velocity as the primary wavefront in the same medium.
3. The envelope or tangential surface joining these wavelet gives the new wavefront.

☞ **REFLECTION AT A PLANE SURFACE.**



i) It is contineous medium which

Where

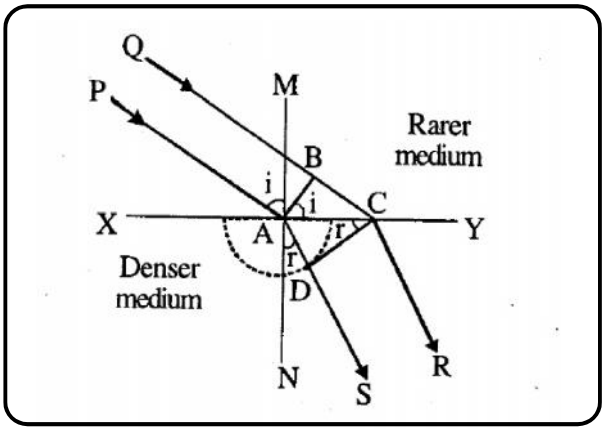
XY = Plane reflecting surface,
NA = Normal drawn to XY,
PA and QC = incident rays,
∠PAN = i
= angle of incidence,

AR and CS = reflected rays,
$\angle RAN = r$ = angle of refraction,
AB = incident plane wavefront,
CD = reflected plane wavefront.
$i = r$
i.e. angle of incidence = angle of reflection

☞ **Laws :**

- **1st Law :**
  The angle of incidence is equal to the angle of reflection.
- **2nd Law :**
  From the figure, we observe that the incident ray, reflected ray and the normal are in the same plane.
- **3rd Law :**
  From the figure, we observe, that the incident ray and the reflected ray lie on opposite sides of the normal.

☞ **REFRACTION AT A PLANE SURFACE.**



i.e $\frac{C_1}{C_2} = {}^{r}\mu_d$

Which is Snell's law of refraction.

☞ **Laws of refraction :**

1st law :
The ratio of velocity of light in rarer medium to velocity of light in denser medium is equal to some constant, known as refractive index of denser medium w.r.t. rarer, medium.

2nd Law :
From the figure, we observe that incident ray, normal and refracted ray are in the same plane.

3rd Law :
From the figre, we observe that, incident ray and refracted ray lie on opposite sides of normal.

The change in waelength of light wave when refraction takes place

$$\therefore {}_1\mu_2 = \frac{C_1}{C_2} = \frac{\lambda_1}{\lambda_2}$$

☞ **POLARISATION :**

Wavenumber :
Reciprocal of the wavelength of light is called wave number

- It represents number of waves per unit distance.
- **unit** is metre $^{-1}$ (m^{-1})

a) Unpolarised light :-
Light in which a vector vibrates in any possible planes or vibration of a vector in any possible plane & a light is know as unpolarised light.

b) Place polarided light :-
Light in which vibration of vector is confined in a plane. passing through direction of propogation .

c) Plane & vibration :-
Plane & vibration is a plane containing a vector & dirction & propagation.

d) Plane & polarisation :-
Plane & polarisation is a plane perpendicular to the plane & vibraion.

ERGH - Plane & vibration

ABCD - Plane & porisation

☞ **Brewsser's law :-**

According to Malus light get polarised ofter reflection called reflection polarisation or reflected polarisation of light.

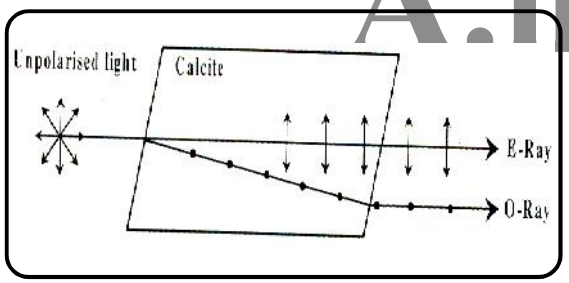
The polarisation is shown as in fig.

$$= \frac{\sin p}{\cos \theta p} = \tan \theta p$$

Thus from this relation we can say that, the tangent of polarising angle is equal to the refrctive index of the reflecting medium, known as Brewster's law.

From this we can saythat polaising angle is wavelenght dependent.

Nicol Prism :-



Important Notes

(1) Velocity of light in Vacuum:

Velocity = frequency x wavelength

$c = \upsilon\lambda$

(2) Refractive index of the given medium with respect to vacuum:

$_{Vac}\mu_{med}$ or

$$\mu = \frac{\text{Velocity of light in vacuum}}{\text{Velocity of light in medium}} = \frac{c}{V}$$

It is a pure number. It has no units.

(3) When a light wave travels from one medium to another, its frequency (υ) does not change but its wavelength (A) changes. Hence its velocity (C) also changes.

(4) Velocity of light in vacuum :

$c = 2.99792458 \times 10^8$ m/s

$\approx 3.0 \times 10^8$ m/s

(5) Refractive index of vacuum is taken as 1.

(6) If in an example, velocity of light in air or free space or vacuum is not given, take it as $c = 3.0 \times 10^8$m/s.

Note: Refractive index of air is 1.0003. It is taken 1.0 solving the problem on light.

(7) For a medium of refractive index, μ :

i) Velocity of light in medium

$$= \frac{c}{\mu} = \frac{3.0 \times 10^8}{\mu} \text{ m/s}$$

(ii) Wavelength of light in medium

$$= \lambda = \lambda_0 / \mu$$

where λ_o is wavelength of light in vacuum.

Thus both velocity and wavelength decrease μ times.

(8) If light passes from medium "a" into medium "b"; refraciive :' index of medium

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