J = H

$$\boxed{J = \frac{W}{H}}$$

Value of J is
$J = 4.2 \times 10^7 \text{ erg cal}^{-1} = 4.2 \text{ J cal}^{-1}$

35th Class (9th week 3rd Class)

First law of thermodynamics (statement)

"If the quantity of heat supplied to a system is capable of doing work, then the quantity of heat absorbed by the system is equal to the sum of the increase in the internal energy of the system, and external workdone by it."

Mathematically, $\boxed{dQ = dU + dW}$

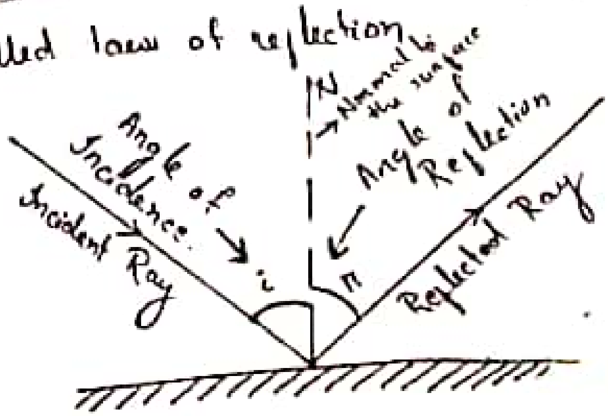
$dQ \rightarrow$ ~~change in~~ amount of heat supplied to the system
$dU \rightarrow$ " " internal energy
$dW \rightarrow$ external workdone.

36th Class (9th week 4th class) Reflection & Refraction.

Reflection:- It is the change in direction of a wavefront at an interface between two different media so that the wavefront returns into the medium from which it originated.

OR
It is the property of light by virtue of which, light is sent back into the same medium from which it is coming after being obstructed by a surface.

~~Refraction:-~~
Laws of Reflection:- Phenomenon of reflection is governed by two laws called law of reflection.



(i) The incident ray, the reflected ray and the normal to the reflecting surface at the point of incidence, all lie in one plane. and that plane is perpendicular to the reflecting surface.

(ii) The angle of incidence is equal to the angle of reflection, i.e

$\angle i = \angle r$

~~:7th Class (10th week 2nd Class)~~

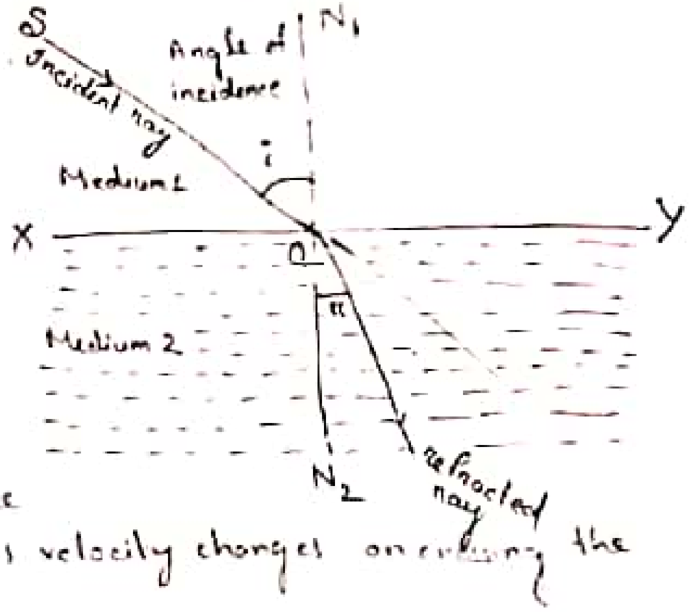
~~Critical angle and total internal reflection - Concept defn & explanation:-~~

~~:11th class~~ (Laws of reflection & refraction (statement only) Refractive index defn, formula & simple numerical

~~Refraction:-~~

"Refraction is the phenomena by virtue of which a ray of light going from one medium to the other undergoes a change in its velocity."

→ Velocity of light differ for different media



→ As ray of light goes from one medium to another medium, its velocity changes on crossing the interface.

→ If the ray is incident, obliquely as shown in fig, the change in velocity of light results in a change in its path, but there is no change in its path if ray is incident normally.

⇒ If light travels from an optically rarer medium to a denser medium, it bends towards the normal i.e r is less than i. If it travels from denser to rarer medium, it bends away from the normal, i.e r is greater than i.

(101)

<u>Laws of Refraction</u> :- The phenomena of refraction is governed by the following two laws, called laws of refraction:

(i) The sine of the angle of incidence bears a constant ratio with the sine of the angle of refraction.

ie $$\frac{\sin i}{\sin r} = \text{constant}$$

The law is called ~~Snel~~ "<u>Snell's Law</u>".

(ii) The incident ray, the refracted ray and the normal to the interface at the point of incidence all lie in one plane and that plane is perpendicular to the interface separating the two media

<u>Refractive Index</u>

- Refractive index of a medium is a characteristic of medium which determines its behaviour to propagation of light.
- A medium having greater value of refractive index is said to be optically denser than having a lower value.
- Refractive index of vacuum is the smallest value and is equal to one.
- When other medium is compared to the refractive index of the vacuum, it is always found to be more then it. At this case the refractive index is called "<u>absolute refractive index</u>"

which can be defined in number of ways.

(i) <u>Defination interms of angles of incidence and refraction</u>.

$$\frac{\sin i}{\sin r} = \text{constant} = {}^1\mu_2 \quad \text{——— (1)}$$

where $i \rightarrow$ incident angle

$r \rightarrow$ refractive angle.

${}^1\mu_2 \rightarrow$ refractive index of second medium w.r.t first.

→ it always refers to a the refractive index of that medium [illegible]

"Refractive index of a medium w.r.t another is defined as the ratio between sine of the angle of incidence to the sine of angle of refraction."

(ii) Defination in terms of velocity of light:-

Refractive index of medium 2 w.r.t 1 is also defined as the ratio between velocity of light in medium 1 to the velocity of light in medium 2.

i.e $${}^{1}\mu_{2} = \frac{v_1}{v_2} \qquad \text{--- (2)}$$

where $v_1 \rightarrow$ velocity of light in 1st medium
$v_2 \rightarrow$ " " " 2nd "

If the first medium is air or vacuum, the refractive index is written as ${}^{0}\mu_{2}$ or simply as μ and is known as "absolute refractive index."

$$\mu = \frac{c}{v} \qquad \text{--- (3)}$$

where, $c \rightarrow$ velocity of light in vacuum
$v \rightarrow$ velocity of light in that medium

(iii) Defination in terms of wavelength of light -

If light goes from one medium to another, there is no change in it's frequency. Since $v = n\lambda$, a change of medium shall results in the change in wavelength of light.

$$v_1 = n\lambda_1 \; , \; v_2 = n\lambda_2$$

Substituting for v_1 and v_2 in eqn (2).

$${}^{1}\mu_{2} = \frac{n\lambda_1}{n\lambda_2} = \frac{\lambda_1}{\lambda_2} \qquad \text{--- (4)}$$

"Refractive index of second medium with respect to first is defined as the ratio between wave-length of light in medium 1 to the wavelength of light in medium 2.

(iv) Definition in terms of absolute refractive indices of the a medium :-

Dividing the numerator and denominator of eqn (3) by c, we get

$$\left[\begin{array}{l} \mu_1 = \frac{c}{v_1} \quad \therefore \frac{1}{\mu_1} = \frac{v_1}{c} \\ \mu_2 = \frac{c}{v_2} \quad \therefore \frac{1}{\mu_2} = \frac{v_2}{c} \end{array}\right]$$

$$^1\mu_2 = \frac{v_1/c}{v_2/c}$$

$$= \frac{1/\mu_1}{1/\mu_2}$$

$$\Rightarrow \boxed{^1\mu_2 = \frac{\mu_2}{\mu_1}} \quad \text{———— (5)}$$

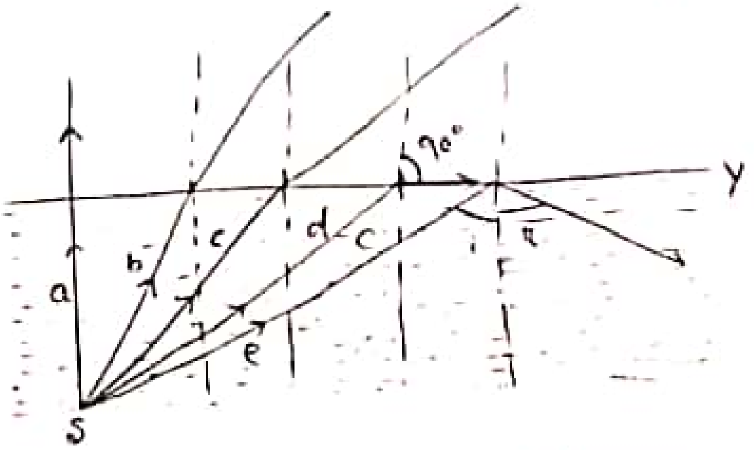
So, Refractive index of second medium with respect to first is defined as the ratio between absolute refractive index of second medium to the absolute refractive index of first medium.

38th Class (10th week 2nd Class)

Critical angle and total internal reflection - Concept, defn & explanation :-

As here we can see in fig,

→ Let here S is the source of light in a denser medium, from which rays, a, b, c, d, e are generated & going to a less denser i.e rarer medium



→ ~~The ray a is projected~~

→ We can observe that a projected ⊥ar to the interface surface it goes undeviated.

→ With b, d we can say the angle of incidence is increased and the refracted angle also increased, i.e they are more deviated from the normal.

(104) A ray 'd' is incident at a particular angle of incidence 'C' such that refracted ray is parallel to the surface, i.e $r = 90°$. The angle of incidence 'C' is called the critical angle

def^n: Critical angle is the angle of incidence of a ray of light in denser medium such that its angle of refraction in the rarer medium is 90°.

→ If the angle of incidence (i) of the ray is increased further, it is reflected back into the same medium. This phenomena is known as total internal reflection.

"Total internal reflection is the phenomenon by virtue of which, a ray of light travelling from a denser to rarer medium is sent back in the same medium provided, it is incident on the interface at an angle greater than critical angle."

The rays while suffering total internal reflection obey the laws of reflection.

Consider refraction of ray 'd'. Since, the ray goes from medium 2 to medium 1

$$ {}^{2}\mu_{1} = \frac{\sin C}{\sin 90°} = \frac{\sin C}{1} = \sin C $$

$$ \therefore {}^{1}\mu_{2} = \frac{1}{{}^{2}\mu_{1}} = \frac{1}{\sin C} $$

In case the first medium is air to or vacuum

$$ {}^{1}\mu_{2} = \mu $$

$$ \therefore \mu = \frac{1}{\sin C} $$

Therefore, the absolute refractive index of medium is equal to the reciprocal of the sine of the critical angle for that medium.

(105) 39th class

Refraction through Prism :- (Ray diagram, formula to calc. the deviation)

When a ray of light is incident on one of the refracting faces of a prism & proceeds through the prism, it undergoes following two changes:

(i) deviation (ii) dispersion.

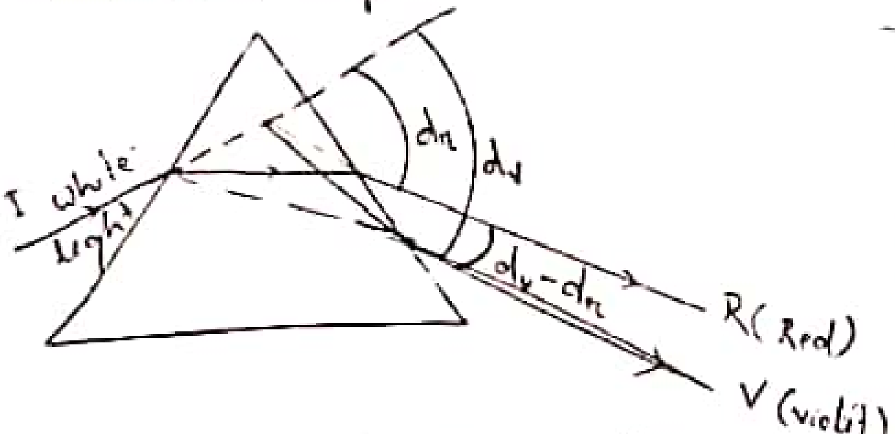
(i) <u>Deviation:</u> A ray of monochromatic light (light possessing one wavelength only), while passing through a prism suffers a change in its path, the phenomenon is known as deviation.

deviation, $d = (\mu - 1)A$

where, $A \rightarrow$ the refracting angle of the prism

$\mu \rightarrow$ refractive index of the material of the prism.

(ii) <u>Dispersion:</u> A ray of light (containing more than one wavelengths), while passing through the prism splits up into a number of rays. This phenomenon is called dispersion.



Color	Wavelength
violet	380 – 450 nm
blue	450 – 495 nm
green	495 – 570 nm
yellow	570 – 590 nm
orange	590 – 620 nm
red	620 – 750 nm

$\left[\mu = \frac{c}{v}\right]$

Let μ_v & μ_r be the refractive indices of the material of prism for violet and red colours; the corresponding deviations are given by

$$d_v = (\mu_v - 1)A$$

$$d_r = (\mu_r - 1)A$$

$$\mu_v > \mu_r \qquad [\because \lambda_v < \lambda_r]$$

Therefore 'dv' is greater than 'dr'

Other colours, in the dispersed beam, will be spread with the cone angle '$d_v - d_r$' and is called angular dispersion.

can be written as
$$d_v - d_r = (\mu_v - \mu_r) A$$

we can also write,
$$\frac{d_v - d_r}{d} = \frac{\mu_v - \mu_r}{\mu - 1} = \omega$$

where 'ω' is called the "dispersive power" of the prism.

Dispersive power of a prism is defined as the ratio between angular dispersion to mean deviation produced by the prism.

If $d\mu$ denotes the difference between the refractive indices of material of prism for violet & red light.

$$\omega = \frac{d\mu}{\mu - 1}$$

where ; $\mu \rightarrow$ refractive index of prism for mean colour.

A mean colour is that colour whose wavelength lies in between that of violet & red.

For white light, yellow colour is generally taken to be the mean colour.

* Since μ_v is always greater than μ_r, the dispersive power of a prism is always positive. It always depends upon the type of glass used.

* It is different for crown glass and for flint glass.

→ [illegible] made without lead or iron [illegible] and [illegible] of optical glass, [illegible].

[illegible]

→ [illegible] glass [illegible] optical glass that has [illegible] index.

(107) <u>Optical Fibre:-</u> Defn. properties & applications

"Optical fibers are the thin transparent fibers of glass or plastic that are enclosed by material of a lower refractive index and that transmit light throughout their length by internal reflections."

Light propagates through an optical fibre in two modes.

(i) <u>Monochrome propagation:-</u> In this case light has only one propagation path along the length of the core. As light propagates, cladding causes total internal reflection.

(ii) <u>Multimode propagation:-</u> There are many propagation paths while the reflection takes place from the edges of the core. The core, in this case, is of greater diameter. Due to pulse dispersion in this case, the data is transmitted at a lesser rate than that in monomode propagation.

<u>Applications of Optical Fibre</u>

(i) These are used to study the interior of lungs and other parts of body which cannot be viewed directly otherwise.

(ii) These are used for the study of tissues and blood vessels far below the skin.

(iii) It can be used to transmit high intensity laser light ~~insight~~ inside the body for medical purposes.

(iv) They are used in the field of communication in sending video signals from one place to other.