Date: / /20 SHEET # 01 Day:

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Assignment Physics

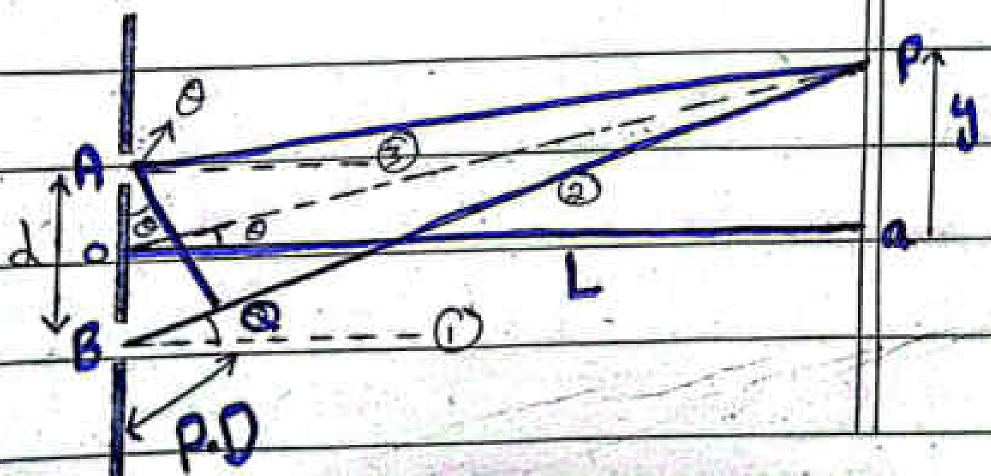
Topic 01:-

Young's Double Slit Experiment

Young's Double Slit Experiment is depend upon three Steps:-

(i) Condition for dark and bright Fringes.
(ii) Position for dark and bright Fringes.
(iii) Spacing of dark and bright Fringes.

Diagram:-



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1. Condition for Bright & Dark Fringes:-

Bright Fringe:-

Two understand the double slit interference pattern, Each slit is a different distance from a point. Waves start out from the slits in phase (crest to crest) but they may end up out of phase (crest to trough).

To obtain constructive interference for a double slit, the path difference must be an integral multiple of wavelength.

$$d\sin\theta = m\lambda$$

The line $\overline{BC}$

$$\overline{BC} = d\sin\theta$$

$$d\sin\theta = m\lambda \quad \text{—— (i)}$$

(Constructive Interference)

For $m = 0, 1, 2, 3, 4, \ldots$

$= 1\lambda, 2\lambda, 3\lambda, 4\lambda, \ldots$

Dark Fringe :-

Similarly, To obtain destructive interference of double slit, the path length difference must be a half-integral multiple of the wavelength.

$$\overline{BC} = d\sin\theta = \left[m + \frac{1}{2}\right]\lambda$$

$$d\sin\theta = \left[m + \frac{1}{2}\right]\lambda \quad \text{—— (ii)}$$

(destructive Interference)

For $m = 0, 1, 3, 5, 7, \ldots$

$$= \frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}, \frac{7\lambda}{2}, \ldots$$

2:- Position for Dark and Bright Fringes

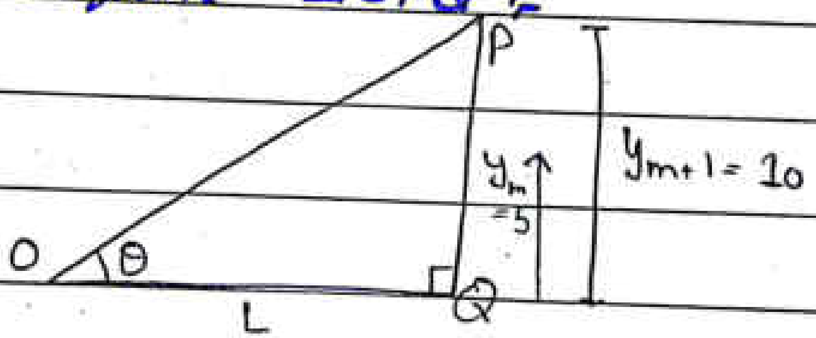
The main cause of the formation of dark fringes is destructive interference and the main cause for Bright Fringes is Constructive

Interference. Its position is denoted by calculating the distance between two adjacent Fringes Known as "Fringes Width".

Bright ~~Dark~~ Fringe Position:-

The distance between 2 dark or bright fringes is mainly denoted as "Fringes Width", calculated as:

From Diagram ΔOPQ :-



$$\tan\theta = \frac{y}{L}$$

$$\{\because \tan\theta \approx \sin\theta\}$$

$$\sin\theta = \frac{y}{L}$$

$$y = L\sin\theta \quad \text{——} \quad (a)$$

From equation (i)

$$\sin\theta = \frac{m\lambda}{d} \quad \text{(Put in 'a')}$$

$$y = L\frac{m\lambda}{d} \quad \text{——— (iii)}$$

B) Dark Fring Position :-

For the position of dark fringes, use equation (a)

$$y = L\sin\theta \quad \text{——— (b)}$$

from eq. (ii)

$$d\sin\theta = \left[m + \frac{1}{2}\right]\lambda$$

$$\sin\theta = \left[m + \frac{1}{2}\right]\frac{\lambda}{d} \quad \text{(Put in 'b')}$$

$$y = L\left[m + \frac{1}{2}\right]\frac{\lambda}{d}$$

$$y = \left[m + \frac{1}{2}\right]\frac{\lambda L}{d} \quad \text{——— (iv)}$$

3:- ## Spacing of Bright & Dark Fringes

Basically, The "Fringes Width" is also known as "Spacing ~~to~~ of Fringes".

Spacing of Bright Fringe:-

From equation (iii)

$$y_m = \frac{m\lambda L}{d} \quad \text{—— (c)}$$

$$y_{m+1} = (m+1)\frac{\lambda L}{d}$$

$$y_{m+1} = \frac{\lambda L m}{d} + \frac{\lambda L}{d} \quad \text{—— (d)}$$

Eq (d) - Eq (c) :-

$$y_{m+1} - y_m = \cancel{\frac{m\lambda L}{d}} + \frac{\lambda L}{d} - \cancel{\frac{m\lambda L}{d}}$$

$$\boxed{y_{m+1} - y_m = \frac{\lambda L}{d}}$$

Spacing of Dark Fringes:-

To calculate the spacing of Dark Fringes use equation (iv)

By Eq. (iv)

$$y_m = \left[m + \frac{1}{2}\right]\frac{\lambda L}{d} \quad \text{—— (e)}$$

$$y_{m+1} = \left[m+1 + \frac{1}{2}\right]\frac{\lambda L}{d}$$

$$y_{m+1} = \frac{m\lambda L}{d} + \frac{\lambda L}{d} + \frac{\lambda L}{2d}$$

Day:

$$y_{m+1} = \frac{m\lambda L}{d} + \frac{2\lambda L + \lambda L}{2d}$$

$$y_{m+1} = \frac{m\lambda L}{d} + \frac{3\lambda L}{2d} \quad (f)$$

Eq (f) - Eq (e)

$$y_{m+1} - y_m = \left[m + \frac{1}{2}\right]\frac{\lambda L}{d}$$

$$y_{m+1} - y_m = \cancel{\frac{m\lambda L}{d}} + \frac{3\lambda L}{2d} - \cancel{\frac{m\lambda L}{d}} - \frac{\lambda L}{2d}$$

~~y_{m+1}~~ =

$$y_{m+1} - y_m = \frac{3\lambda L}{2d} - \frac{\lambda L}{2d}$$

$$y_{m+1} - y_m = \frac{3\lambda L - \lambda L}{2d} = \frac{\cancel{2}\lambda L}{\cancel{2}d}$$

$$\boxed{y_{m+1} - y_m = \frac{\lambda L}{d}}$$

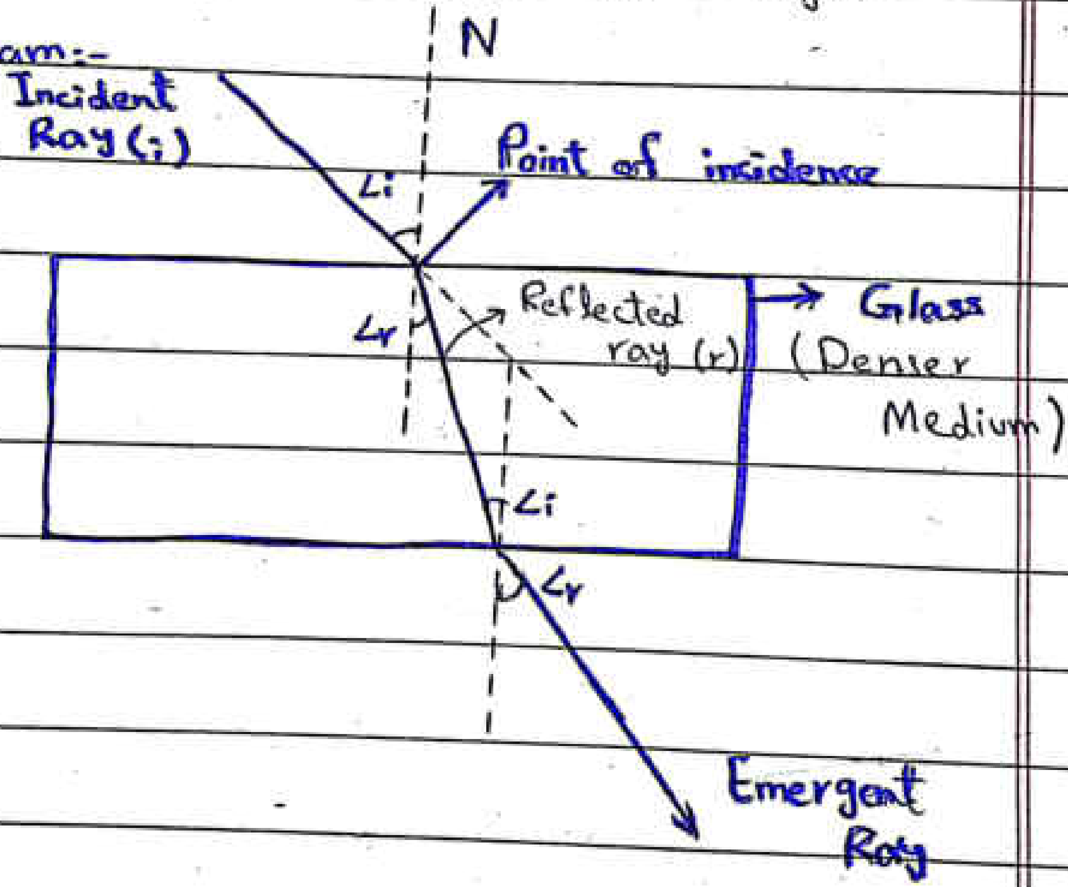
The Bright and dark fringes have same space.

Topic # 02:-
Refraction of Light waves:-

Definition:-

The process of bending of light as it passes from one medium to another and vice versa is called Refraction of light.

Diagram:-



Laws of Refraction:-

(i) The incident ray, refracted ray and the normal at the point of incidence all lie in the same plane.

(ii) The ratio of the sine of the angle of incidence 'i' to the sine of the angle of refraction 'r' is always equal to the constant.

$$\boxed{\frac{\sin(i)}{\sin(r)} = \text{constant } (n)}$$

This ratio is also known as the refrective index of the second medium with respect to the first medium.

$$\boxed{\frac{\sin i}{\sin r} = n}$$

It is called Snell's law.

Speed of light in a Medium:-

Speed of linght in air = $3.0 \times 10^8 ms^{-1}$

Speed of light in water = $2.3 \times 10^8 ms^{-1}$

Speed of light in glass = $2.0 \times 10^8 ms^{-1}$

Refractive Index:-

The refractive index 'n' of a medium is the ratio of the speed of light 'c' in air to the speed 'v' of light in the medium.

Refractive Index = $\frac{\text{Speed of light in air}}{\text{Speed of light in glass}}$

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

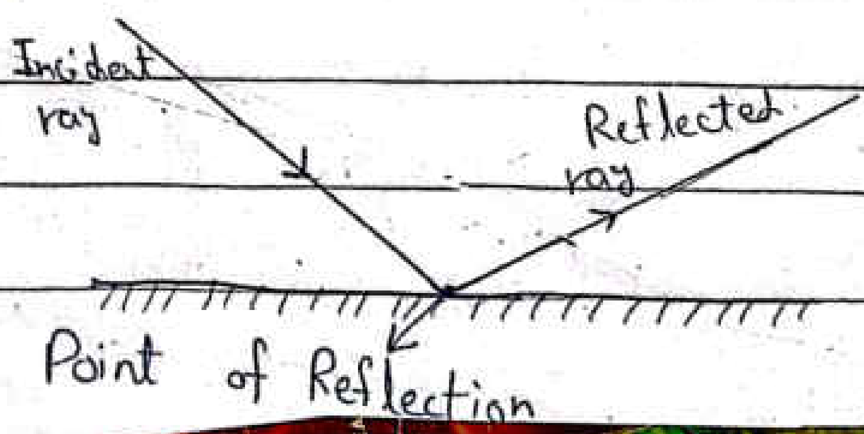
Topic 03:-

Reflection of Light

Definition:-

When light travelling in a certain medium falls on the surface of another medium, a part of it turns back in the same medium is called Reflection of light.

Diagram:-

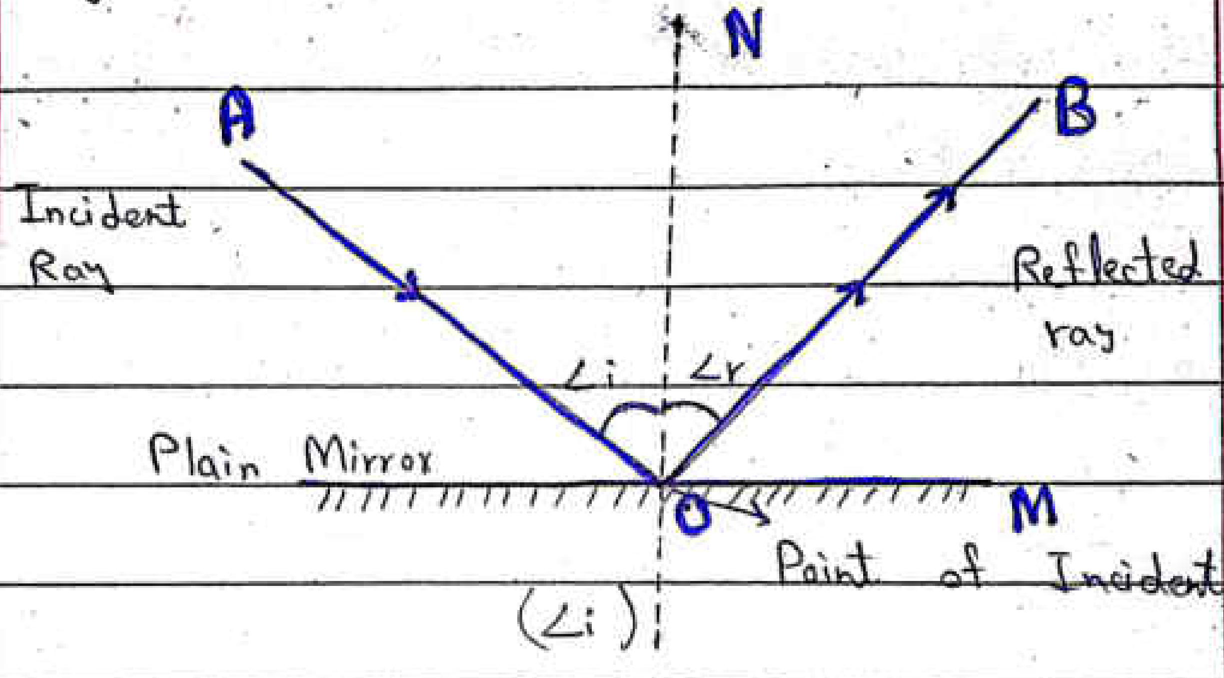


Incident Ray:-

The ray AO is called incident ray.

Reflected Ray:-

The ray OB is called reflected ray.



Angle of Incidence:- (∠i)

The angle between incident ray AO and normal N (i.e ∠AON) is called angle of incidence.

Angle of Reflection (∠r):-

The angle between normal N and reflected ray OB (i.e ∠BON) is called angle of reflection.

Normal (N) = Normal is the line which is perpendicular on the surface of another medium.

Laws of Reflection:-

The incident ray, the normal and the reflected ray at the point of incidence all lie in the same plane.

The angle of incidence is equal to the angle of reflection.

$$\boxed{\angle i = \angle r}$$

-: Types of Reflection :-

Reflection depends upon smoothness of the surface. There are two types of reflection

(i) **Regular Reflection:-** The reflection by the smooth surface is called Regular reflection.

(ii) **Irragular Reflection:** The reflection by the rough surface is called Irragular ~~[illegible]~~ reflection.

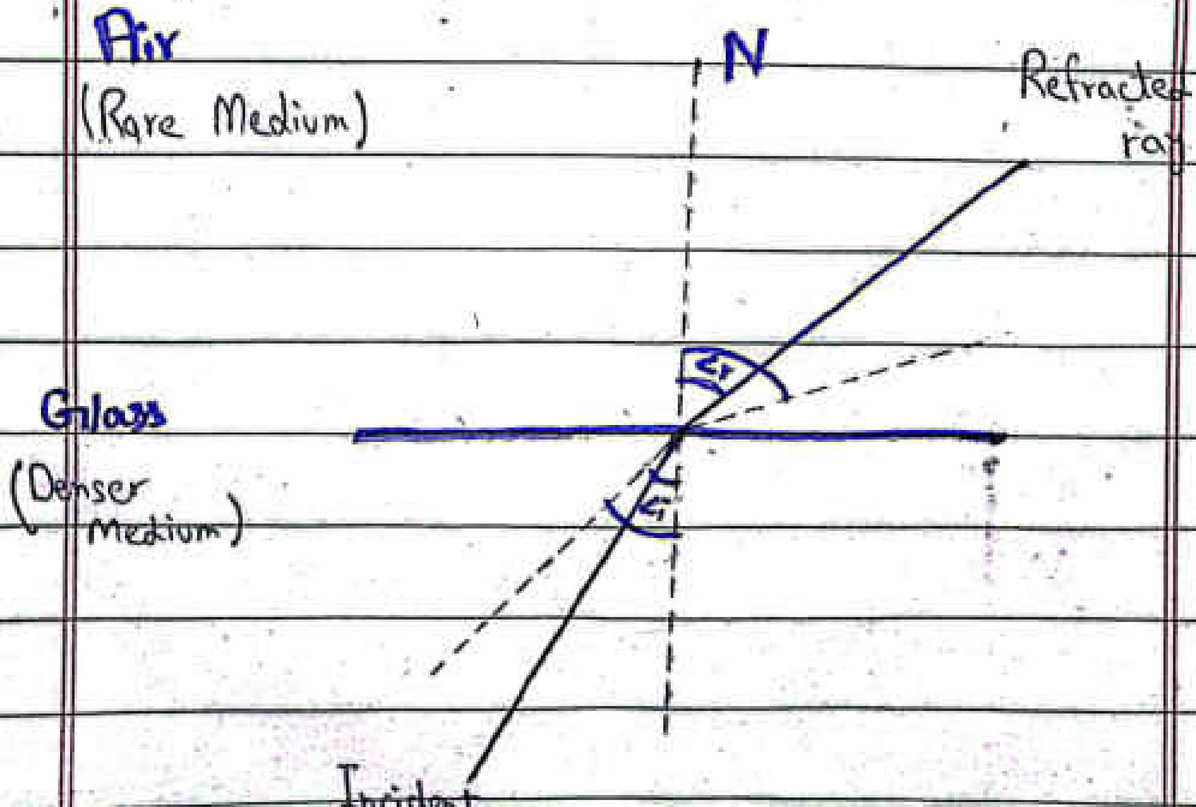
Topic # 04:-

Total Internal Reflection

Definition:-

When the angle of incidence becomes larger than the critical angle, then the entire light is reflected back into the same medium. This is called Total Internal Reflection.

Diagram:-

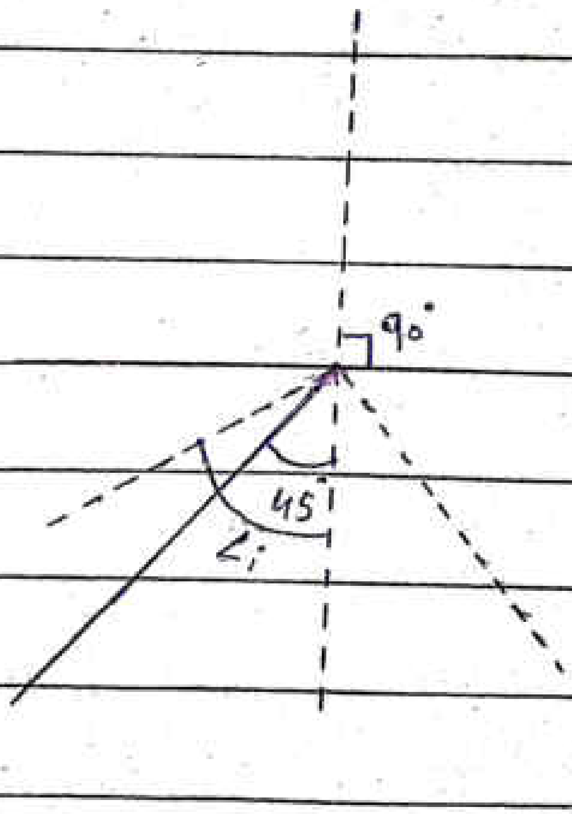


$\angle i > \angle c$

Critical Angle:-

The angle of incidence, that cause the refrected ray in the rare medium to bend through 90° is called Critical angle.

Diagram:-



Critical angle of glass 42°

Critical angle of water 48.8°

Topic 05:-

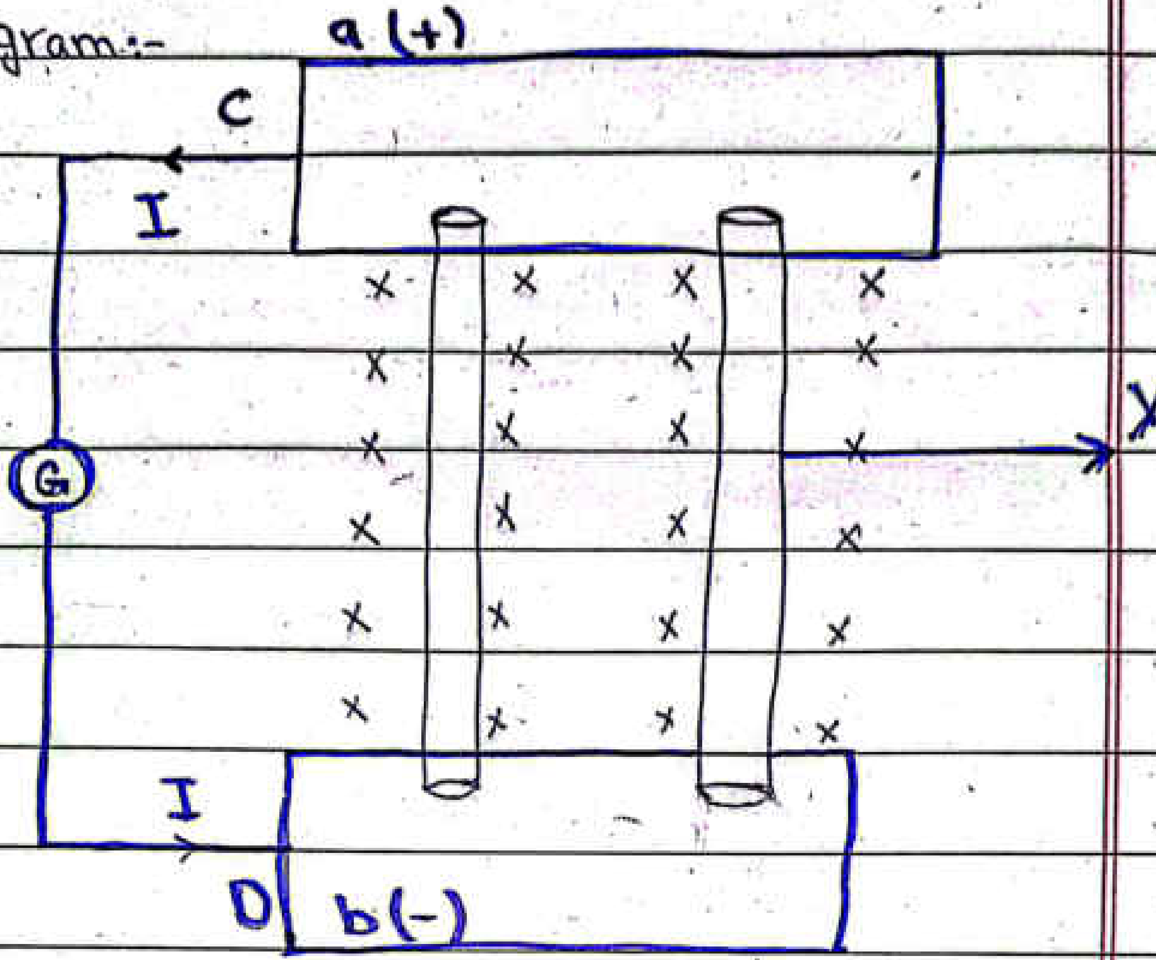
Electro-Magnetic Induction

Faraday's LAW Of Electro-Magnetic Induction

The Faraday's law of electromagnetic induction states that whenever magnetic flux changes in a coil or loop, emf is induced in it which lasts only for for the time, the flux change continuously. The magnitude of induced emf is directly proportional to the rate of change in magnetic flux.

The emf is induced in a coil or loop due to change in magnetic flux. The magnetic flux in a coil or loop can be changed by the number of ways.

Diagram:-



Explanation:-

Consider a conductor having length L is placed on a conducting rail as shown. The ends of conducting rail are connected with galvanometer. The magnetic field B is directed into plane of paper and denoted by (x).

$$\varepsilon = -VBL \quad \text{(i)}$$

Velocity V of rod which travel distance dx in time dt is:-

$$V = \frac{dx}{dt} \quad (\text{Put in eq } ①)$$

$$\mathcal{E} = -\left(\frac{dx}{dt}\right) B l$$

$$\{\because L dx = da\}$$

$$\mathcal{E} = -B\frac{da}{dt}$$

$$\left[\begin{array}{l} \because \phi = \bar{B} \cdot \bar{A} \\ d\phi = \bar{B} \cdot \bar{da} \end{array}\right]$$

$$\mathcal{E} = -\frac{d\phi}{dt}$$

For Number of turns:-

$$\boxed{\mathcal{E} = -N\frac{d\phi}{dt}} \quad \text{———} \quad (ii)$$

The magnetic flux is:

$$d\phi = \vec{B} \cdot \vec{da}$$

Integrate:

$$\phi = \int \vec{B} \cdot \vec{da} \quad (\text{Put in ii})$$

$$\boxed{\mathcal{E} = -N\frac{d}{dt}\int \vec{B} \cdot da} \quad \text{———} \quad (iii)$$

Integral form:-

we know that:

$$\boxed{\mathcal{E} = \int \vec{E} \cdot \vec{dr}} \quad \text{———} \quad (iv)$$

Compairing eq (iii) and (iv)

$$\int \vec{E} \cdot \vec{dr} = -N \frac{d}{dt} \int \vec{B} \cdot \vec{da}$$

$$\boxed{\int \vec{E} \cdot \vec{dr} = -\frac{d}{dt} \int \vec{B} \cdot \vec{da}}$$

Differential form:-

$$\int \vec{E} \cdot \vec{dr} = -\frac{d}{dt} \int \vec{B} \cdot \vec{da} \quad \text{(v)}$$

$$\boxed{\int \vec{E} \cdot \vec{dr} = \int (\vec{\nabla} \times \vec{E}) \cdot da} \quad \text{(Put in v)}$$

$$\int (\vec{\nabla} \times \vec{E}) da = -\frac{d}{dt} \int \vec{B} \cdot \vec{da}$$

$$\int (\vec{\nabla} \times \vec{E}) da + \frac{d}{dt} \int \vec{B} \cdot \vec{da} = 0$$

$$\int \left((\vec{\nabla} \times \vec{E}) + \frac{d\vec{B}}{dt} \right) da = 0$$

$$(\vec{\nabla} \times \vec{E}) + \frac{d\vec{B}}{dt} = 0$$

$$\boxed{\vec{\nabla} \times \vec{E} = -\frac{dB}{dt}}$$