18-Jan-2024 | H.W.

Physics :-

1) **Semiconductor :-** Substance which are neither good conductor nor good insulator are called Semiconductors. They can be made good conductors of insulator by adding some impurity in it by doping method.
For eg: Germanium and Silicon.

Doping :- The process of adding very small amount of impurity to insulator germanium and Silicom to make them n-type or p-type conductors called doping.
There are two types of semi-conductors:-
i) n-type semiconductor.
ii) p-type Semiconductor.

i) **n-type Semiconductors :-** A pure Semiconductor material doped with a pentavalent

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element is called n-type semiconductors.

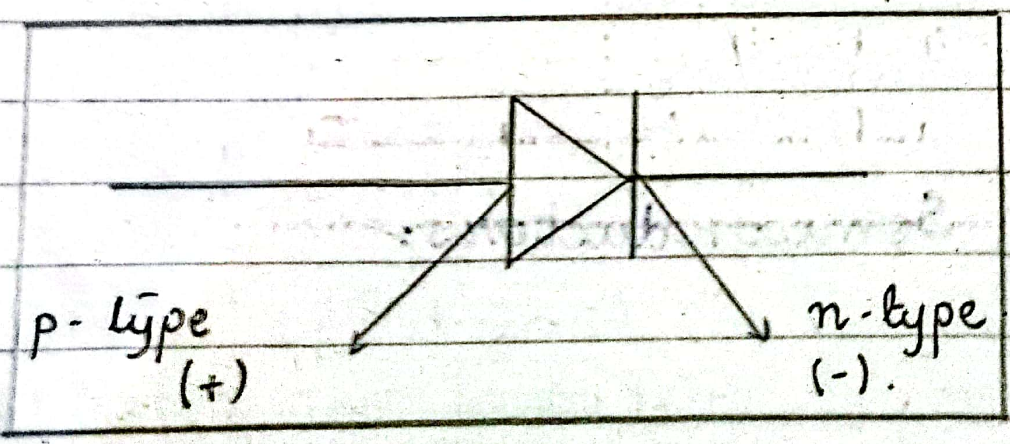
ii) **p-type Semiconductor :**

A pure semiconductor material doped with a trivalent element is called p-type semiconductors.

- Pure semiconductors are called Intrinsic semiconductor. For eg: (Germanium & Silicon)
- Impure and doped semiconductor are called Extrinsic semiconductor.

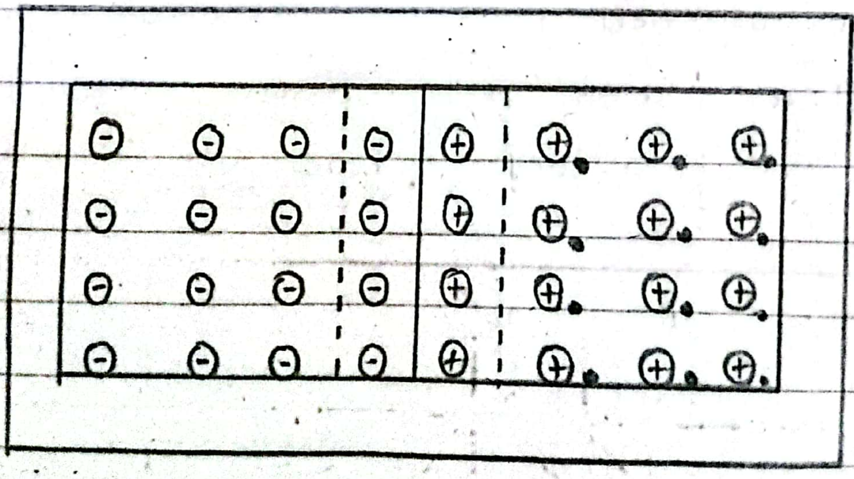
2) **p-n Junction Diode:-**

It is a two terminal device which let the current pass through one direction. It is formed from p-type and n-type semiconductors.



Working:-

P-type substance has excess of positive charge (holes) and n-type substance has excess of nagetive charge (electron). Hence, holes from p-type substance and electrons from n-type, semiconductors flow towards the junction and combine. In this way positive charge layer is formed at n-type material and nagetive charge layer is formed at p-type material. Due to migration of n-type and p-type material near junction, a potential barrier is devolope across the junction which prevents further flow of charge from one side to other.



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3) # Biasing:-

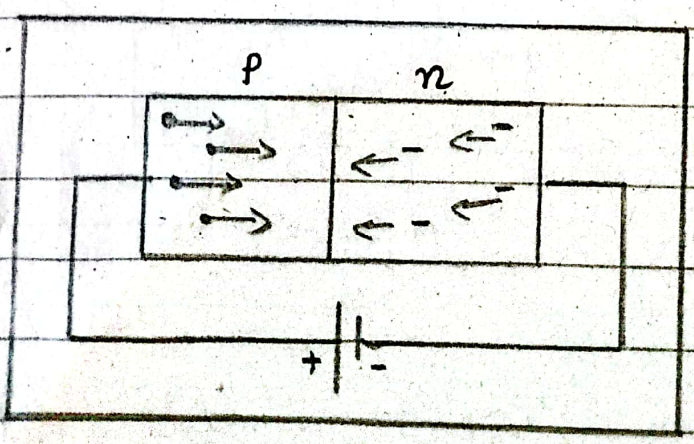
Biasing is the method of changing hiegnt of potential barrier or the thickness of depletion layer of pn-diode.

There are two types of Biasing

i) Forward Biasing
ii) Reverse Biasing

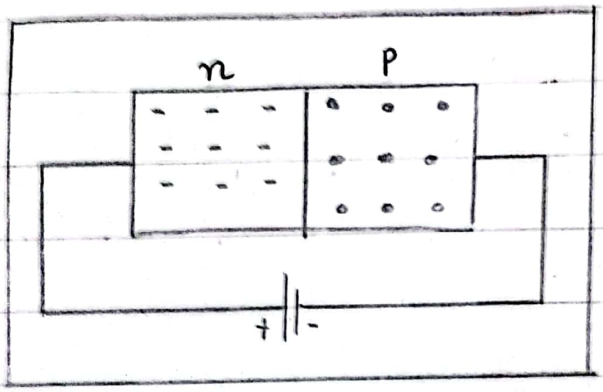
i) ## Forward Biasing:-

When voltage is applied to p-n junction in such a way that p-type material will be connected from positive terminal and n-type material will be connected from nagetive terminal of battery, then p-n junction diod be will be forward biased.



ii) **Reverse Biasing:-**

When Voltage is applied to p-n junction in such a way that, p-type material is connected with nagetive terminal and n-type material is connected with positive terminal of battery, the p-n junction diode will be reversed biased.



4) **Rectification:-**

The process of converting Alternating Current into direct current is called Rectification.

i) **Half-Wave Rectification:-**

The process of rectifying half-wave of Alternating current is called Half-wave Rectification.

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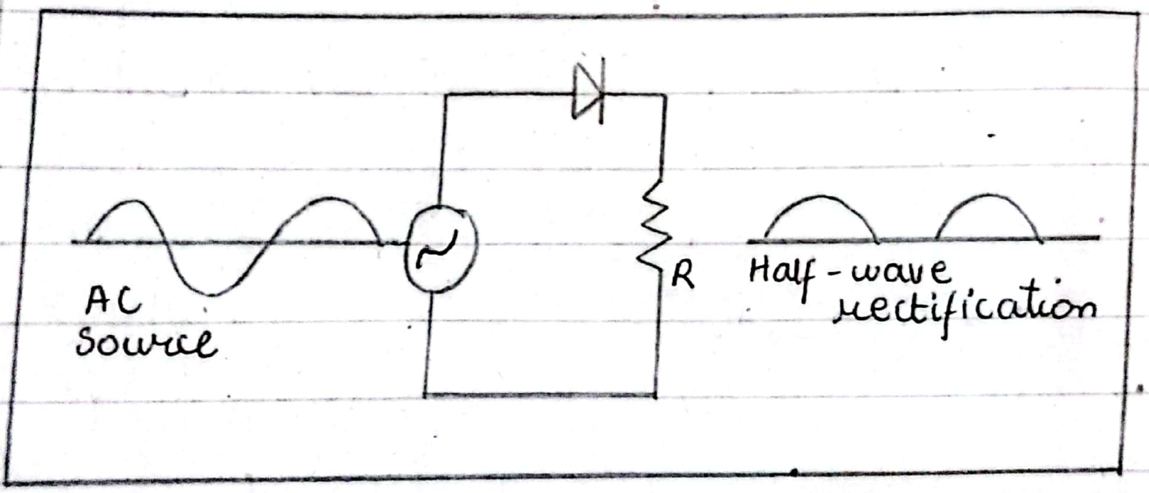
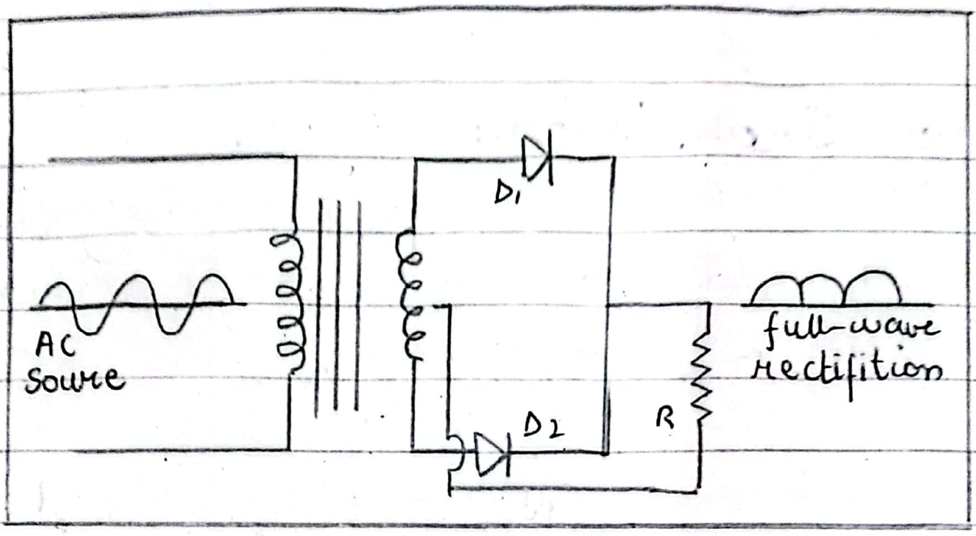
During first half cycle there will be a forward biase of p-n diode due to which diode pass on input wave of AC at output.
During Second half cycle there will be a reverse biase of p-n diode due to which diode does'nt pass on input wave of AC at output. Thus, output of only half wave is AC is rectified.



ii) Full Wave Rectification:-

The process of rectifying full wave of A.C is called full-wave Rectification.
During first half cycle there are two diodes, diode D_1 is forward biased and

diode D_2 is reversed biased. Hence D_2 will pass on second half wave of AC at output. In this way, full wave of AC is rectified.



5) # Transistors :-

Transistor is a three terminal semiconductor device which is formed by sandwiching n-type semiconductor between two p-type semiconductor or sandwiching p-type semiconductor between two n-type semi-conductor.

There are two types of Transistor.

i) npn transistor.

ii) pnp transistor.

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i) **npn Transistor:**

If p-type Semiconductor is Sandwhich between two n-type semiconductor then transistor is called npn transistor

ii) **pnp Transistor:**

If n-type semiconductor is sandwiched between two p-type semiconductor is called pnp Transistor.

There are three major parts of Transistor

i) Base
ii) Collector
iii) emitter

i) **Base:**

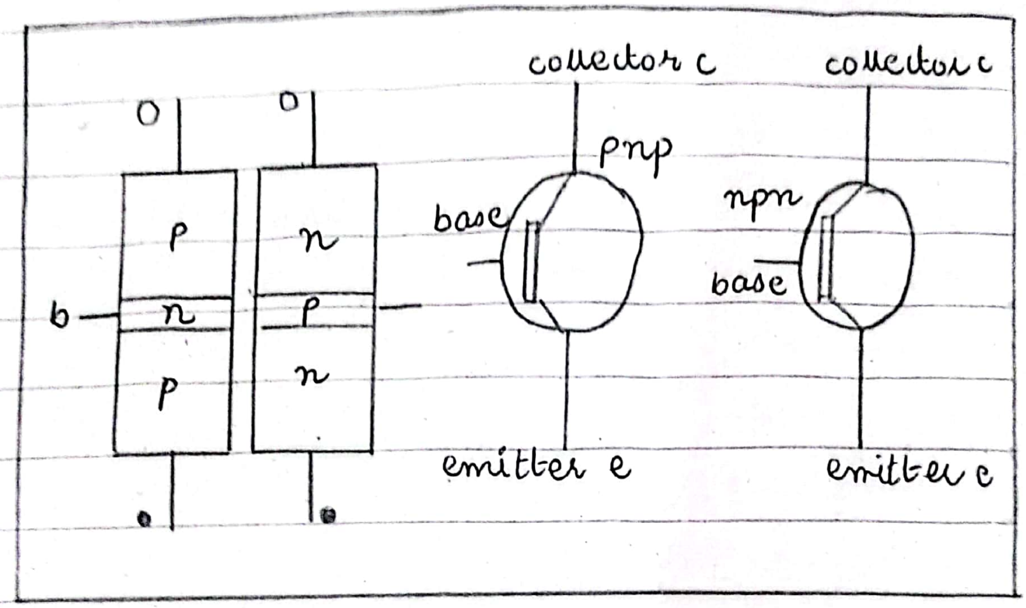
Base is a Central layer of Transistor which which is very thin about 3um to 5um

ii) **Collector :-**

It is The thickest layer placed on side of the base.

iii) **Emitter:-**

It is also a thick layer placed on another side of base.



6) ## Characteristicks Of Diode:-

i) Diode Allow current to flow in one direction on
ii) Used in Rectifier circuits to convert Alternatin current (AC) into direct current (DC).
iii) Diode are Typically made up of germanium & Sili
iv) Diodes can Switch between conducting and non-conducting states rapidly.
v) Diodes are compact electronic components.

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Numericals :-

1) Fermi-energy level of silver is 5.5 ev at temp 0°C.

a) What are possibilities following occupie

i) 4.4 ev ii) 5.5 ev

b) At what temp will probablity that state at 5.6 ev at 0.16.

Solution :

a)
$E_f = 5.5$ ev.

i)
$E_i = 4.4$ ev.

$K = 8.62 \times 10^{-5}$

$T = 0°C = 273$ K

$$P(E) = \frac{1}{1 + e^{\frac{e_f - e_i}{KT}}}$$

$$= \frac{1}{1 + (1.6 \times 10^{-19})^{\frac{5.5 - 4.4}{(8.6 \times 10^{-5})(273)}}}$$

$P(E) = 1$.

ii)
$$P(E) = \frac{1}{1 + e^{\frac{e_f - e_i}{KT}}}$$

$$P(E) = \frac{1}{1 + (1.6\times10^{-19})^{\frac{5.5-5.5}{(8.6\times10^{-5})(273)}}}$$

$$P(E) = 0.5 .$$

b) $$P(E) = \frac{1}{1 + e^{\frac{ef - ei}{KT}}}$$

$$1 + e^{\frac{ef-ei}{KT}} = \frac{1}{P(E)}$$

$$e^{ef-ei/KT} = \frac{1}{0.16} - 1$$

$$\ln(e^{Ef-Ei/KT}) = \ln\left(\frac{1}{0.16} - 1\right)$$

$$\frac{Ef - Ei}{KT} = 1.65$$

$$T = \frac{Ef - Ei}{K(1.65)}$$

$$= \frac{5.6 - 5.5}{(8.6\times10^{-5})(1.65)}$$

$$T = 704.72 \quad K$$

Ans!

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Simple Harmonic Motion:-

Such a motion of body in which direction of Acceleration is always towards its mean position is called simple Harmonic motion.

Conditions:-

- Body must be performing too and fro motion
- Direction of Acceleration is always towards mean position.
- Magnitude of Acceleration is directly proportional to distance.

Mass Spring System:-

Consider a body of mass 'm' is attached to one end of a spring and another end of spring is attached with rejid support. The body is placed at mean position (O). Now if we displaced the body to some value 'x' and place at point A. By releasing it will start too and fro motion about mean position.

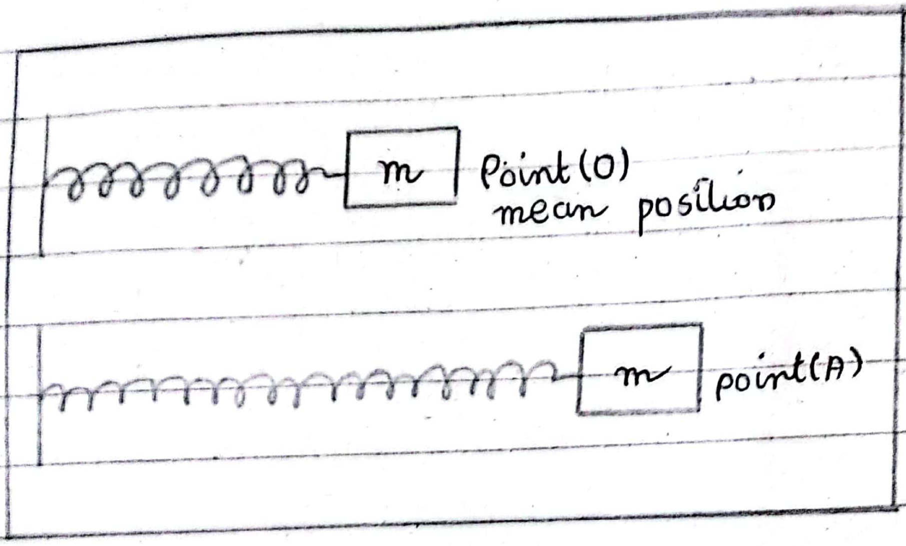
A/c to Hooke's law,

$F = -kx$

$\therefore F = ma$

$ma = -kx$

$a = \frac{-k}{m} x.$



Hooks Law :-

$$F \propto -x$$

$$F = -kx$$

$$\therefore F = ma$$

$$\therefore v = \frac{dx}{dt}, \quad \therefore a = \frac{d^2x}{dt}$$

$$m\frac{d^2x}{dt^2} = -kx \quad = \frac{d^2x}{dt^2} = \frac{-k}{m} x$$

$$\frac{d^2x}{dt^2} + \frac{k}{m} x = 0$$

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Numericals :-

1). A star strings vibrates at 400 Hz what is the time period of vibration.

Solution:

$f = 400\ Hz$

$T = ?$

$$f = \frac{1}{T}$$

$$\therefore T = \frac{1}{f}$$

$$= \frac{1}{400}$$

$T = 2.5 \times 10^{-3}$ sec   Ans !

2) Sound wave of frequency 400 Hz and wavelenght 3 m passes through medium calculate velocity of wave in medium.

Solution:

$f = 400\ Hz$

$\lambda = 3m$

$V = ?$

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$V = f\lambda$

$= (400)(3)$

$= 1200$ m/s Ans!

3) Wavelenght of wave is 0.1 nm. Its speed is 3×10^8 m/s. What is the frequency of wave.

Solution:

$\lambda = 0.1$ nm

$\lambda = 0.1 \times 10^{-9}$ m

$V = 3 \times 10^8$ m/s

$f = ?$

$V = f\lambda$

$\therefore f = \dfrac{V}{\lambda}$

$= \dfrac{3 \times 10^8}{0.1 \times 10^{-9}}$

$f = 3 \times 10^{-18}$ Hz Ans!

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4) Find the time period of a simple pendulum whose lenght is 144 cm.

Solution:

$l = 144\ cm$

$l = 1.44\ m$

$g = 9.8\ m/s^2$

$\pi = 3.14$

$T = ?$

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$= 2(3.14)\sqrt{\frac{1.44}{9.8}}$$

$T = 2.40\ sec$ Ans!

5) A body of mass 0.3 kg attach to Horizontal spring. It value of spring constant is 5 N/m. Find time period:

Solution:

$m = 0.3\ kg$

$k = 5\ N/m$

$\pi = 3.14$

$T = ?$

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$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$= 2(3.14)\sqrt{\frac{0.3}{5}}$$

$T = 1.53$ sec Ans!

5) Calculate lenght of second pendulum taking g equal to 9.8 m/s^2. Time period is 2sec

Solution:-

$g = 9.8\ m/s^2$

$T = 2$ sec

$l = ?$

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Taking square both sides.

$$T^2 = 4\pi^2\frac{l}{g}$$

$$l = \frac{T^2 g}{4\pi^2}$$

$$= \frac{(2)^2(9.8)}{4(3.14)^2}$$

$l = 0.99$ m Ans!

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6) An Oscillatory System consist of a block of mass 512 gm connected to spring when act into oscillation with Amplitude 34.7 cm. It is observed it repeat its motion every 0.484 sec. Find,

i) frequency
ii) Time period.
iii) Angular frequency
iv) force constant
v) max. speed
vi) max. force.

Solution:-

$m = 512\ gm$

$m = 0.512\ kg$

$Amp = 34.7\ cm$

$Amp = 0.347\ m$

$T = 0.484\ sec$.

i) frequency = ?

$$f = \frac{1}{T}$$

$$= \frac{1}{0.484}$$

$$f = 2.06\ Hz$$

ii) Time period = ?

$$T = \frac{1}{f}$$

$$T = \frac{1}{2.06}$$

$$T = 4.854 \text{ sec}$$

iii) Angular frequency:

$$\omega = 2\pi f$$

$$= 2(3.14)(2.06)$$

$$\omega = 12.93 \text{ rad/sec}$$

iv) force constant = ?

$$\omega = \sqrt{\frac{K}{m}} \qquad \therefore S.B.S$$

$$K = \omega^2 m$$

$$= (12.93)^2(0.512)$$

$$K = 85.59 .$$

v) max. force = ?

$$f = kx$$

$$= (85.59)(0.347)$$

$$f = 29.70 \text{ N.}$$

vi) max. speed = ?

$$V = x\omega$$

$$= (0.347)(12.93)$$

$$V = 4.48 \text{ m/s}$$

Ans!

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Youngs Double Slit Experiment:

Youngs perform an experiment to show wave nature of light by doing interference of light rays.

Explainatlon:-

In his experiment he take two slits S_1 and S_2 at a distance d from each other. Two rays r_1 and r_2 passes through slit S_1 and S_2 at meet at a point which is at distance Y from its mean position.

for path difference:-

Consider $\Delta S_1 S_2 A$.

$$\sin\theta = \frac{P}{H}$$

$$\sin\theta = \frac{S_2 A}{S_1 S_2}$$

$\therefore S_2 A = \delta$

$S_1 S_2 = d$

$$\sin\theta = \frac{\delta}{d}$$

$\delta = d\sin\theta$ — (i)

for Constructive,

$\delta = m\lambda$

put δ in (i)

$m\lambda = d\sin\theta$

for Destructive,

$\delta = \left(m + \frac{1}{2}\right)\lambda$ ∴ Put δ in eq (i)

$\left(m + \frac{1}{2}\right)\lambda = d\sin\theta$.

Position of fringe:-

Consider $\Delta OO'P$

$\tan\theta = \frac{P}{B}$

$\tan\theta = \frac{O'P}{OO'}$

∴ $O'P = y$

∴ $OO' = l$

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

For smaller angles,

$\tan\theta \cong \sin\theta$

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$$\sin\theta = \frac{Y}{l}$$

Multiply by d on both sides

$$d\sin\theta = \frac{dY}{l} \quad -\ (ii)$$

For Bright fringe,

$d\sin\theta = m\lambda$ ∴ put in eq (ii)

$$m\lambda = \frac{dY}{l}$$

$$Y = \frac{m\lambda l}{d}$$

For Dark fringe,

$d\sin\theta = \left(m + \frac{1}{2}\right)\lambda$ ∴ put in eq (ii)

$$\left(m + \frac{1}{2}\right)\lambda = \frac{dY}{l}$$

$$Y = \left(m + \frac{1}{2}\right)\frac{\lambda l}{d}$$

Fringe Spacing:-

As we know that,

$$Y = \frac{m\lambda l}{d}$$

For 1^{st},

$$m = 0$$

$\therefore$ $y_1 = 0$

For 2^{nd},

$$y_2 = \frac{m\lambda L}{d}$$

$\therefore$ $m = 1$

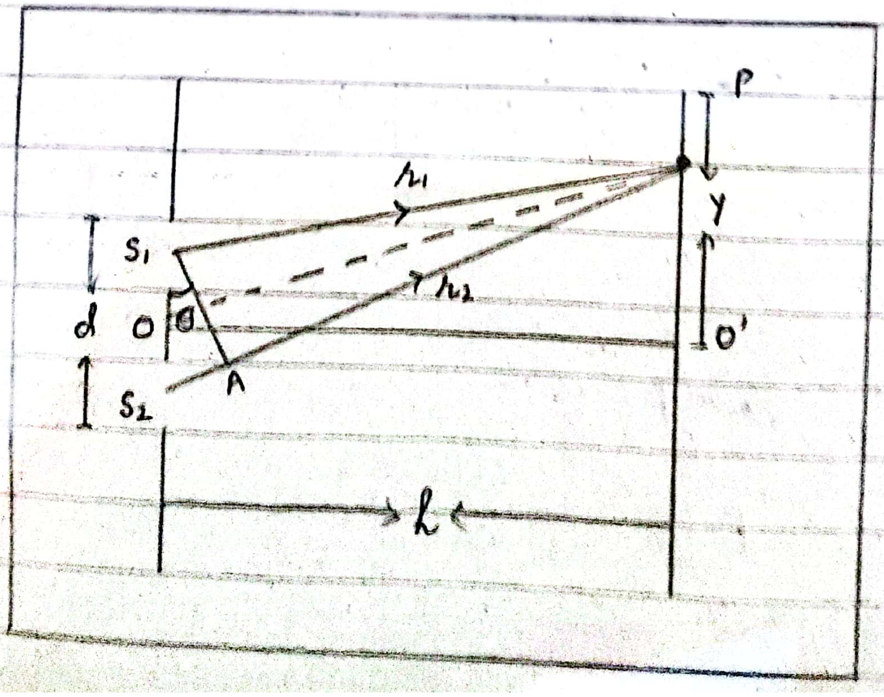
$$y_2 = \frac{\lambda L}{d}$$

Now,

$$\Delta y = y_2 - y_1$$

$$= \frac{\lambda L}{d} - 0$$

$$\Delta y = \frac{\lambda L}{d}$$



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Define The Following:

1) **Magnetic Induction:-**

The magnitude of internal feild strenght with a substance that is subjected to H feild

2) **Magnetic Permeability:**

The ratio between magnetic induction and magnetic feild.

3) **Magnetization:**

The total magnetic moment per unit volume.

4) **Magnetic Susceptibility:-**

The ratio betwe magnetization and the applied feild.

5) **Magnetic Dipole:-**

magnetic feild lines of force around a current loop and a bar magnet.

Classification Of Magnetic Materials :-

They are classified into five classifications

i) Ferromagnetism.
ii) Ferrimagnetism.
iii) Paramagnetism.
iv) Dimagnetism
v) Antiferromagnetism.

i) Ferromagnetism :-

The ferromagnetic material produces magnetic feild even in the absence of external magnetic feild.

- Exist upto T_c, the Curie Temperature.
- Only certain materials are ferromagnetic (Iron, Cobal, Nickel) etc

) Ferrimagnetism :-

They are generally oxides of iron combined with one or more translition metals such as magnese, nickel, eg: $MnFe_2O_3$

- Permenant ferrimagnets often include barium ($BaO \cdot 6Fe_2O_3$).

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iii) **Dimagnetism :-**

A dimagnetic material place in non-uniform magnetic feild experiences force towards smaller feild This repel the dimagnetic material away from permenant magnetic.

- Dimagnetim results from changes in electron orbital motion that are induced by external feild.

iv) **Paramagnetism :-**

In paramagnetic materia each individual atom posses a permenar magnetic moment but due to thermal agitation there is no average moment per atom and $M = 0$.

v) **Antiferromagnetism :-**

Antiferromagnetism is a type of magnetic ordering in materials where neighbouring magnetic moments, associated with individual atom or ions tends to align in opposite direction

Application Of Magnetic Material :-

- magnetic material are used for data storage
- magnetic material are used to make strong permenant magnets.
- strenght of permenant magnetic as expressed by maximum product of inductance and magnetic feild.

Band Energy Theory :-

According to energy band theory, a large number of atoms that interacts in solid will result in closely-spaced energy levels that form bands. The hiegnest occupied molecular orbital (HOMO), usually partially filled or fully filled that posseses highest electron energy is called valance band.

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Numericals :-

1) Magnetic feild in Interior solenoid is 6.15×10^{-4} T. When solenoid is empty. then filled with iron 1.4T. find relative permeability

Solution:

$B_0 = 6.15 \times 10^{-4}$ T

$B_r = 1.4$ T

$x = ?$

$$x = \frac{B_r}{B_0}$$

$$= \frac{1.4}{6.15 \times 10^{-4}}$$

$x = 2153.84$ T Ans

2) Magnet in shape of rod has lenght 4.8cm and diameter of 1.1 cm. It has magnetization 5.3 kA/m. Calculate dipole moment

solution:

$l = 4.8$ cm

$l = 0.048$ m

$d = 1.1$ cm $= 0.011$ m

$r = d/2 = 0.011/2 = 5.5 \times 10^{-3}$ m

$$M = \frac{\mu}{V}$$

$$\mu = MV.$$

$$\therefore V = \pi r^2 l$$

$$= (3.14)(5.5 \times 10^{-3})^2 (0.048).$$

$$V = 4.5 \times 10^{-6} \ m^3.$$

Now,

$$\mu = (5.3)(4.5 \times 10^{-6})$$

$$\mu = 2.38 \times 10^{-5} \ T$$ Ans!

3) A double slit is illuminated with light from a mercury vapour lamp filtered so only green light ($\lambda = 546$ nm). The slits are 0.12 nm and screen on which interference appears in 55 cm away. What is angular position of first min.

Solution:

$$\lambda = 546 \times 10^{-9} \ m$$

$$d = 0.12 \times 10^{-3} \ m$$

$$\theta = ?$$

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

$$\theta = \sin^{-1}\frac{\left(m + \frac{1}{2}\right)\lambda}{d}$$

$$\theta = \sin^{-1}\frac{\left(0 + \frac{1}{2}\right)(546 \times 10^{-9})}{0.12 \times 10^{-3}}$$

$$\theta = 0.12^\circ$$ Ans!

4) Monochromatic light ($\lambda = 554\ nm$) to parallel slits $7.7\ \mu m$ apart. Calculate angular division of third order ($m = 3$) bright fringe

Solution:-

$\lambda = 554 \times 10^{-9}\ m$

$d = 7.7 \times 10^{-6}\ m$

$m = 3$

$\theta = ?$

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

$$\theta = \sin^{-1}\left(\frac{m\lambda}{d}\right)$$

$\theta = 12.46^\circ$ Ans!

5) find slits seperation of double slits that will produce bright fringe 1° apart in angular seperation. ($\lambda = 592\,nm$).

Solution:-

$\lambda = 592 \times 10^{-9}\ m$

$\theta = 1^\circ$

$d = ?$

$m = 1$

$d\sin\theta = m\lambda$

$d = \dfrac{m\lambda}{\sin\theta}$

$= \dfrac{(1)(592 \times 10^{-9})}{\sin(1)}$

$d = 3.3 \times 10^{-5}\ m$ Ans!

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6) Slit of width a is illuminated by white light for what value of first minima for red light ($\lambda = 650$ nm) at $\theta = 15°$

Solution:-

$\lambda = 650 \times 10^{-9}$ m

$\theta = 15°$

$m = 1$

$a = ?$

$a \sin\theta = m\lambda$

$$a = \frac{m\lambda}{\sin\theta}$$

$$= \frac{(1)(650 \times 10^{-9})}{\sin(15)}$$

$a = 2.5 \times 10^{-6}$ m Ans

1) When monochromatic light incident on slit 0.02 mm. at angle 1.8°. find wavelenght.

Solution :-

$a = 0.02 \times 10^{-3}$ m

$\theta = 1.8°$

$m = 1$

$\lambda = ?$

$a\sin\theta = m\lambda$

$$\lambda = \frac{a\sin\theta}{m}$$

$$= \frac{(0.02 \times 10^{-3})(\sin(1.8))}{1}$$

$\lambda = 6.2 \times 10^{-7}$ m Ans!