23 OCT 2017

CH #13

* Electromagnetism *

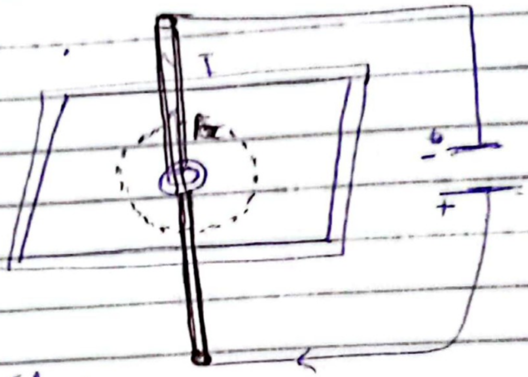
charges

That branch of physics in which we study magnetism due to current.

↳ Orsted discovered magnetic field.

MCQ:- Electricity and magnetism are both due to current (charges).

Compass neddle:



* He said that magnetic field is circular. ~~shape~~

* When we reverse the direction of current the magnetic field also reverse.

* Magnetic field is represented by B → Magnetic Induction.

1. B depend on I.

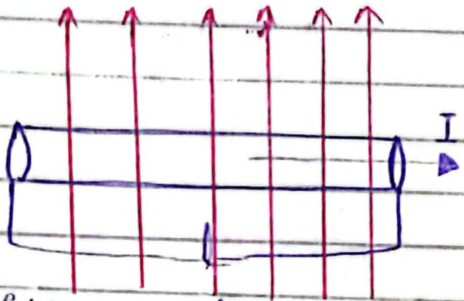
2. Magnetic field is circular in shape.

3. If we reverse the direction of I, B also reverse.

* The direction of megnetic field can be determined by Right hand rule presented by Maxwell → A very good Methmitician.

Exam Ques

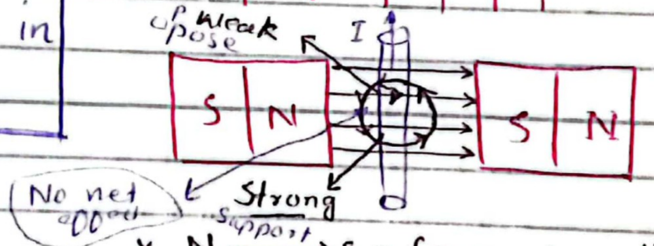
Magnetic force on a Current Carrying Conductor:-



$F_m \propto I$ —— (i)

$F_m \propto L$ —— (ii)

Length enclosed in Magnetic field



* N ⟶ S = Conventionall

$F_m \propto B$ (iii) (Permenent Magnetic field)

$F_m \propto \sin\theta$ (iv) (B/w L and B).

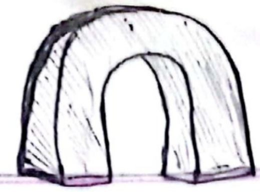
Combining these relations:

$F_m \propto ILB\sin\theta$

$F_m = KILB\sin\theta$

$$\boxed{F_m = ILB\sin\theta} \text{ —— (v)}$$

Magnitude of force acting on Conductior.



$\vec{F}_m = I L B \sin\theta \, \hat{n}$

$\vec{F}_m = I(l B \sin\theta \, \hat{n})$ —— (VI)

$\therefore \vec{A} \times \vec{B} = AB\sin\theta$

$LB\sin\theta \, \hat{n} = \vec{l} \times \vec{B}$ —— (VII)

$$\boxed{\vec{F}_m = I(\vec{l} \times \vec{B})}$$

(*) Length is Scalar quantity.

(*) The above $\vec{l}$ = is length vector.

Length vector:-
The direction of length vector is along the direction of current and magnitude is equall to the magnitude of current.

Unit of B:-

Tesla → T is the unit of $\vec{B}$.

$F_m = ILB\sin\theta$

$B = \frac{F_m}{ILB\sin\theta}$

$1T = \frac{1N}{(1A)(1m)\sin 90^\circ}$

$$\boxed{1T = \frac{1N}{1Am}}$$

MCQ:- Gaussian is the unit of B in ~~FPS~~ CGS System.

$$1T = 10^4 G$$

$$1G = 10^{-4} T$$

24 OCT, 2017

Magnetic flux :- and Flux Density:-

The no. of magnetic lines of force passes through an area placed in the magnetic field is Called Magnetic flux.

$$\phi_m = \vec{B} \cdot \vec{A}$$

$$\phi_m = BA\cos\theta \quad \text{—— (1)}$$

(i) When $\theta = 0°$

$$\phi_m = BA\cos(0°)$$

$$\phi_m = BA \qquad \cos(0°) = 1$$

(ii) When $\theta = 90°$

$$\phi_m = BA\cos(90°)$$

$$\phi_m = BA\cos(0)$$

Unit:-

$$\phi_m = BA$$

$$1Wb = 1T \cdot 1m^2$$

Flux Density:-

As, $\phi_m = BA$

$$B = \frac{\phi_m}{A}$$

↙

Flux Density:

"Flux per unit area is Called flux Density". $B = \frac{\phi_m}{A}$

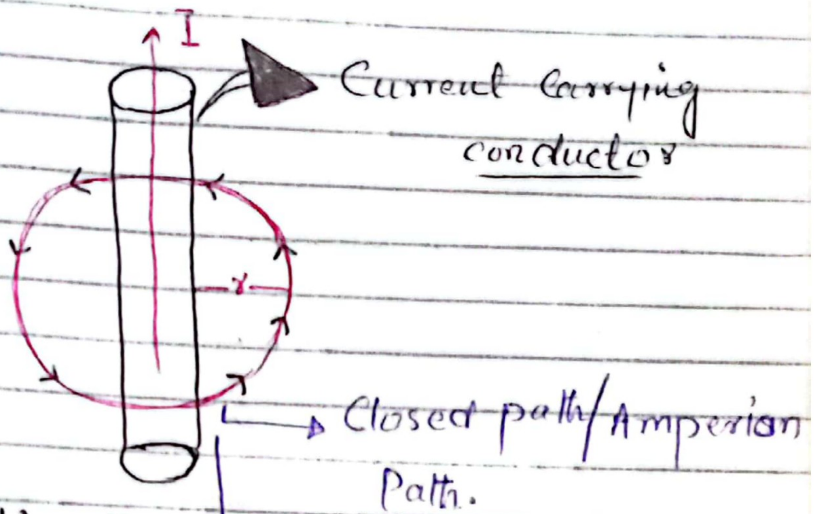
Exam Ques

Amper's Circuital law:-

This Law States that

"The magnitude of magnetic Induction (B) around a ~~Circuit~~ Current Carrying Conductor is directly proportional to the magnitude of Current (I) passing Through the

Conductor and Inversely proportional to distance (r) from the conductor.



Mathemitically :-

$$B \propto I \quad \text{—— (i)}$$

$$B \propto \frac{1}{r} \quad \text{—— (ii)}$$

$$B \propto \frac{I}{r}$$

$$\boxed{B = \frac{KI}{r}} \quad \text{—— (iii)}$$

where, K is Constant:

$$K = \frac{\mu_0}{2\pi}$$

μ_0 = permeability of free Space

$$\mu_0 = 4\pi \times 10^{-7} \frac{Wb}{A \cdot m}$$

$$B = \frac{\mu_0}{2\pi} \frac{I}{r} \quad \text{—— (iv)}$$

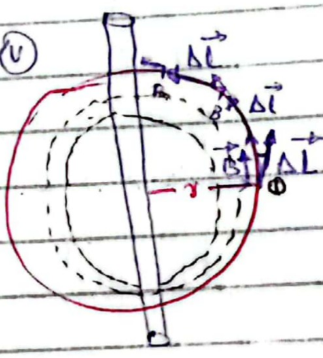
permeability: (μ_o):

"The ability of a material medium to permit the magnetic field lines through itself is called permeability..."

* permeability of free Space is

$$4\pi \times 10^{-7} \frac{Wb}{A \cdot m}$$

$$\vec{B} \cdot \vec{\Delta L} = B \Delta L \cos\theta \quad \text{—} (v)$$



$$\vec{B} \cdot \vec{\Delta L} = B \Delta L \cos(0^\circ)$$

$$\cos(0^\circ) = 1$$

$$\vec{B} \cdot \vec{\Delta L} = B \Delta L$$

$$\sum \vec{B} \cdot \vec{\Delta L} = \sum B \Delta L$$

(B constant Throughout circles)

$$\sum \vec{B} \cdot \vec{\Delta L} = B \sum \Delta L$$

As $\sum \Delta L$ = Circumference of circle $= 2\pi r$

$$\sum \Delta L = 2\pi r \quad \text{—} (vi)$$

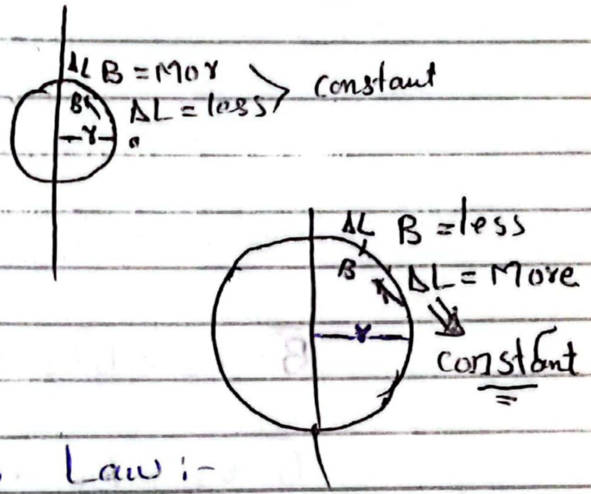
put eq (4) and 6 in (5):

$$\sum \vec{B} \cdot \vec{\Delta L} = \frac{\mu_o I}{2\pi r} (2\pi r)$$

$$\boxed{\sum \vec{B} \cdot \vec{\Delta L} = \mu_o I}$$

The sum of Dot product of B and ΔL around a current carrying conductor is equal to (mew not) μ_0 times of the total current enclosed.

$$B\sum\Delta L = \mu_0 I$$

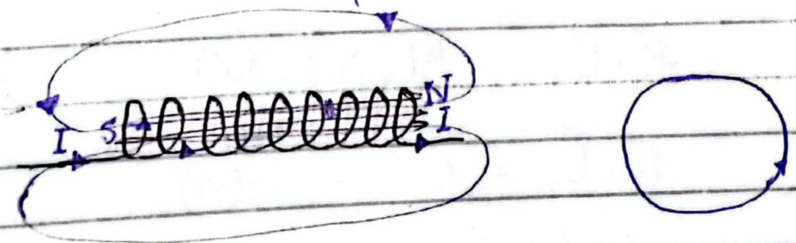


25 OCT, 2017

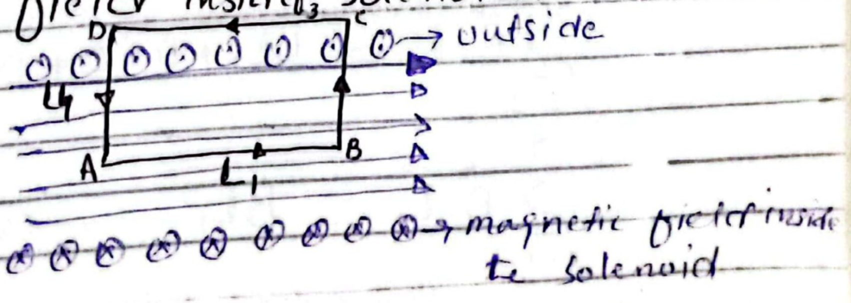
Apps of Ampere's Law:-

Magnetic field due to Current in a Solenoid:

"When a wire is so systemitically wounded that it acquires a cylindrical shape is called Solenoid."



Magnetic field inside a Solenoid:



Now, Applying Ampere's Circuital law:

$$\sum \vec{B} \cdot \vec{\Delta L} = \mu_0 I$$

$$\sum_{i=1}^{4} \vec{B} \cdot \vec{l_i} = \mu_0 I \quad \text{--- (1)}$$

$$\sum \vec{B} \cdot \vec{l_i} = \vec{B} \cdot \vec{l_1} + \vec{B} \cdot \vec{l_2} + \vec{B} \cdot \vec{l_3} + \vec{B} \cdot \vec{l_4} \quad \text{--- (2)}$$

$$\vec{B} \cdot \vec{l_1} = BL_1 \cos(0^\circ)$$

$$\vec{B} \cdot \vec{l_1} = BL_1 \quad \text{--- (III)}$$

$$\vec{B} \cdot l_2 = BL_2 \cos\theta$$

$$\vec{B} \cdot \vec{l_2} = BL_2 \cos(90^\circ)$$

$$\vec{B} \cdot l_2 = 0 \quad \text{--- (IV)}$$

$$\vec{B} \cdot \vec{l_3} = 0 \quad \text{--- (V)}$$

$\because$ $\vec{B} = 0$ outside the Solenoid......

$$\vec{B} \cdot \vec{L_4} = BL_4 \cos(90^\circ)$$

$$\vec{B} \cdot \vec{L_4} = 0 \quad \text{--- (VI)}$$

put eq (III), (IV), V, and (VI) in eq (II):

$$\sum_{i=1}^{4} \vec{B} \cdot \vec{l_i} = BL_1 + 0 + 0 + 0$$

$$\sum_{i=1}^{4} \vec{B} \cdot \vec{L_i} = BL_1 \quad \text{--- (VII)}$$

put eq (VII) in (I):

$$BL_1 = \mu_0 I$$

$$L_1 = l$$

$$Bl = \mu_0 I$$ → Current Passing through one loop of Solenoid.

$$Bl = \mu_0 N I$$ (Current Passes through "N" number of turns.

$$Bl = \mu_0 \left(\frac{N}{l}\right) I$$

$$\frac{N}{l} = n$$

No. of loops (turns) per unit length $= n$

$$\boxed{B = \mu_0 n I}$$

μ_0 = permeability of free Space

$n = \frac{N}{l}$

I = Total current.

It shows that Ampere's Law is applicable to any Shape closed path.

Num #2.

Data:

$N = 1000$ turns

$L = 0.5 m$

$B = 2.5 \times 10^{-3} T$

Req:

$\mu_0 = 4\pi \times 10^{-7} \frac{wb}{A \cdot m}$

$I = ?$

$B = \mu_0 n I$

$\because \quad n = \frac{N}{L}$

$$\boxed{I = \frac{BL}{\mu_0 N}}$$

Ans

Num #1: Data:

$I = 10A$

$B = 5 \times 10^{-5} T$

$\mu_0 = 4\pi \times 10^{-7} \frac{wb}{A \cdot m}$

Req:

$r = ?$

Applying Ampere's Law:

$$B = \frac{\mu_0 I}{2\pi r}$$

$$\boxed{r = \frac{\mu_0 I}{2\pi B}}$$

D.Y.S

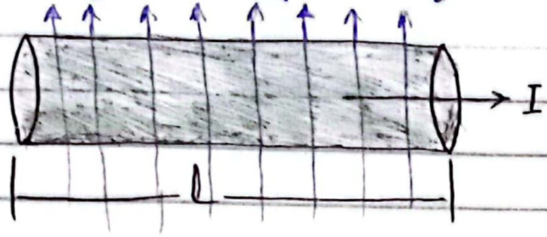
$CH_2 - CH_2$

$OH \quad Cl$

Force ↑ 26 OCT, 2017

Motion of a charge particle in a UMF (uniform magnetic field):

[Exam Ques]



$F_m = I(\vec{l} \times \vec{B})$

$\vec{F}_m = ILB \sin\theta \, \hat{n}$

$F_m = ILB\sin\theta$

When $\theta = 90°$ $F_m = (F_m)_{max}$

$(F_m)_{max} = ILB \sin(90°)$

$(F_m)_{max} = ILB$ —— (1)

Magnetic force on all the charge particle... We Calculate force On a Sngel charge. ~~So~~.
Then we replace $I = \frac{Q}{t}$ and then divide by No: of charge.

$I = \frac{Q}{t}$ —— (2)

Total charge ↖ $Q = Nq$ —— (3)

$n = \frac{N}{l}$

$N = nl$ —— (4)

$$Q = nlq \quad \text{—— (5)}$$

put eq (5) in (2):

$$I = \frac{nlq}{t}$$

$$I = n\left(\frac{l}{t}\right)q$$

As $\frac{l}{t} = v$

So, $I = nvq$ —— (6)

put eq (6) in (1):

$$\boxed{(F_m)_{max} = nvqlB \quad \text{—— (7)}}$$

Magnetic force on all the charges.

(ii) Magnetic force on Singel charge:

$$F_m = \frac{(F_m)_{max}}{N} \quad (8) \quad \left(\frac{\text{Total force}}{\text{total no. of charge}}\right)$$

$$F_m = \frac{nvqlB}{nl}$$

$$\boxed{F_m = qvB \quad \text{—— (9)}}$$

Generalizing the equation:

$$F_m = qvB\sin\theta$$

$$\vec{F}_m = q(vB\sin\theta)\hat{n}$$

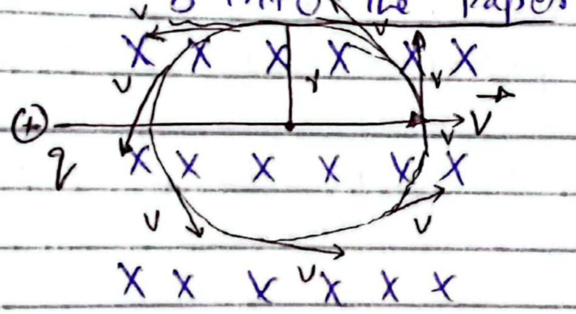
$$VB\sin\theta\,\hat{n} = \vec{v} \times \vec{B} \quad \text{--- (10)}$$

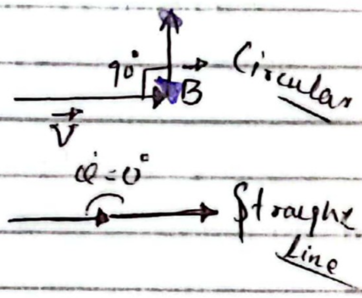
$$\boxed{\vec{F}_m = q(\vec{v} \times \vec{B})}$$

Genral formula for magnetic force....

(I) When charge is displaced perpendicular in a magnetic field, the charge will circulate.

(II) When charge is displace parallal → charge will move in Straight Line.





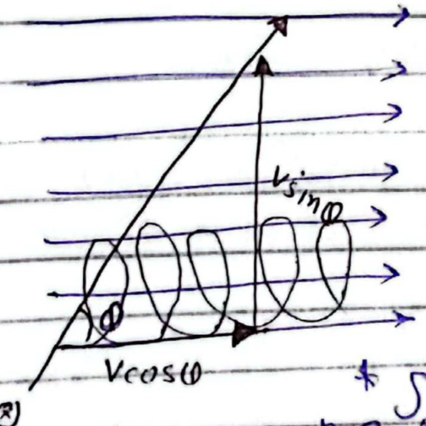
When θ ≠ 90° and > 0°

$v\sin\theta$ = Want to circulate the charge particle.

$v\cos\theta$ = Want to move in st Straight Line.

* So there will be two types of motion and will cover helical path.

* Semi-Circular
* Semi-Straight

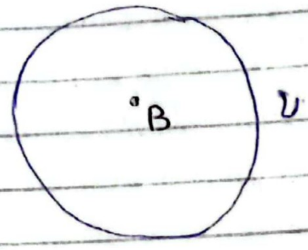


Helical path

When θ = 45° the particle will move in same velocity along circle and straight line

"MCQ"

* The magnetic field (B) is behaving like the axis of rotation for the particle....



* If $\theta > 45^\circ$, Particle will move faster in Circle, Slow in Straight line

* If $\theta < 45^\circ$ Particle will move faster in Straight line.

Centripetal force is provided by magnetic force.

$$F_c = \frac{mv^2}{r} \quad \text{—— (11)}$$

$$F_m = qVB \quad \text{—— (12)}$$

Compairing (11) and (12).

$$\frac{mv^2}{r} = qVB$$

$$\boxed{r = \frac{mv}{qB}} \quad \text{—— (13)}$$

$$mv = qBr$$

$$v = \frac{qBr}{m} \quad \text{--- (13)}$$

$$v = r\omega$$

$$\cancel{r}\omega = \frac{qB\cancel{r}}{m}$$

$$\omega = \frac{qB}{m} \quad \text{--- (14)}$$

$$\omega = \frac{2\pi}{T}$$

$$\omega = 2\pi\left(\frac{1}{T}\right)$$

$$\omega = 2\pi f \text{ --- (15)} \quad \left(\because \frac{1}{T} = f\right)$$

put eq (15) in (14)

$$2\pi f = \frac{qB}{m}$$

$$f = \frac{qB}{2\pi m}$$

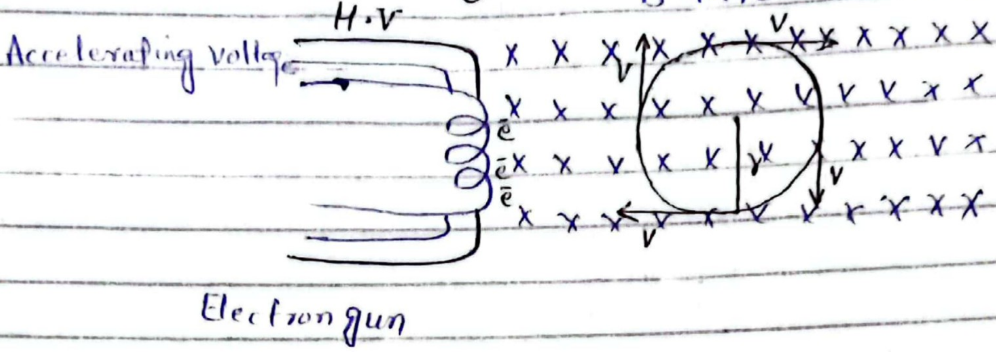
↳ Cyclotran frequancy.

Cyclotran: A machine by which we accelerate ~~+ive~~ charged particles.

Betatrane: A machine by which we accelerate -ive charge particle

Dated:- 27/10/2017

$\left(\frac{e}{m}\right)$ Ratio of an Electron:-



Thermal Emission:- Emission due to heat.

photoelectric Emission: Emission of $\bar{e}$s due to Light

* For +ive charge:

$$F = q(V \times B)$$

* For -ive charge,

$$(B \times V)$$

$$F_m = q(\vec{V} \times \vec{B})$$

$$q = -e$$

$$\vec{F}_m = -e(\vec{V} \times \vec{B})$$

$$\vec{F}_m = e(\cancel{B} - \vec{V} \times \vec{B}) \quad \text{——} (1)$$

$$\because \vec{A} \times \vec{B} \neq \vec{B} \times \vec{A}$$

$$\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$$

So,

$$\vec{V} \times \vec{B} \neq \vec{B} \times \vec{V}$$

But → $\vec{V} \times \vec{B} = -\vec{B} \times \vec{V}$

$$-\vec{V}\times\vec{B} = \vec{B}\times\vec{V} \quad \text{—— (II)}$$

$$\vec{F}_m = e(\vec{B}\times\vec{v})$$

* $F_m = eBv\sin\theta$

$$F_m = eVB\sin(90^\circ) \quad (\because B \perp V)$$

$$\boxed{F_m = eVB} \quad \text{—— (III)}$$

The (F_m) Supply Centripetal force which is:

$$F_c = \frac{mv^2}{r} \quad \text{—— (IV)}$$

Compare (III) and (IV):

$$e\cancel{v}B = \frac{mv^{\cancel{2}}}{r}$$

$$eB = \frac{mv}{r}$$

$$\boxed{\left(\frac{e}{m}\right) = \frac{V}{Br}} \quad \text{—— (V)}$$

$\left(\frac{e}{m}\right)B = \frac{m}{m}\frac{v}{r}$, $\frac{e}{m} = \frac{v}{Br}$ ... $\frac{mv}{m} = \frac{eBr}{m}$

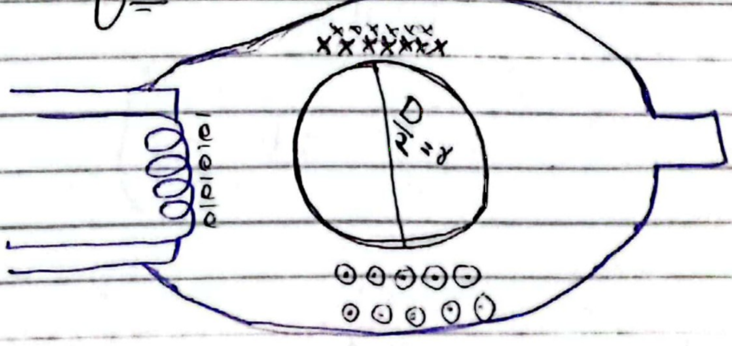
B = Constant.

problem is V and r...

So we Calculate it..

① Determination of r :-

Performed in Dark room



$r = \frac{D}{2}$

2. Determination of Velocity (v):-

When we apply A.V → the $\bar{e}s$ are accelerating and produce K.E.

$K.E = \frac{1}{2}mv^2$ — (4)

$K.E = eV$ — (5)

Compare (4) and (5):

$\frac{1}{2}mv^2 = eV$

$V = \frac{W}{q}$

$W = qV$

$W \Rightarrow$

$K.E = eV$

$\frac{mv^2}{2} = eV$

$v = \sqrt{\frac{2eV}{m}}$ — (6)

put eq (6) in eq (3):

$F = evB$

$\left(\frac{e}{m}\right) = \frac{1}{Br}\sqrt{\frac{2eV}{m}}$

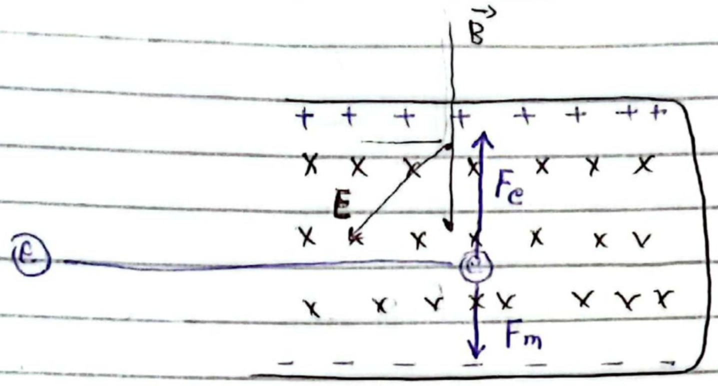
Taking Squre On b.s.

$\left(\frac{e}{m}\right)^2 = \left(\frac{1}{B^2r^2}\right)\frac{2eV}{m}$

$\left(\frac{e}{m}\right)^2 = \left(\frac{e}{m}\right) 2V\left(\frac{1}{B^2r^2}\right)$

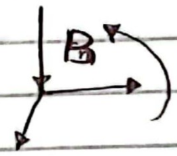
$$\left(\frac{e}{m}\right) = \frac{2V}{B^2r^2} \quad \text{— } 7$$

Method # 2: For Determination of $\left(\frac{e}{m}\right)$ of $\bar{e}s$. particle Velocity Slector Method:



$$F_m = q\left(\vec{B} \times \vec{V}\right) \text{ For } \bar{e}s.$$

As,



$$F_m = eVB \quad \text{—— (8)}$$

$$F_e = eE \quad \text{—— (9)}$$

Compare (8) and (9):

$$\cancel{e}VB = \cancel{e}E$$

$$VB = E$$

$$V = \frac{E}{B} \quad \text{—— (10)}$$

→ Some $\bar{e}s$ are selected to move in straight line...

Therefor it is called velocity slector method.

i.e $V = \frac{E}{B}$.

$v = \frac{E}{B}$

maximum $\left(\frac{E}{B}\right)$ ratio...

put (10) in (3):

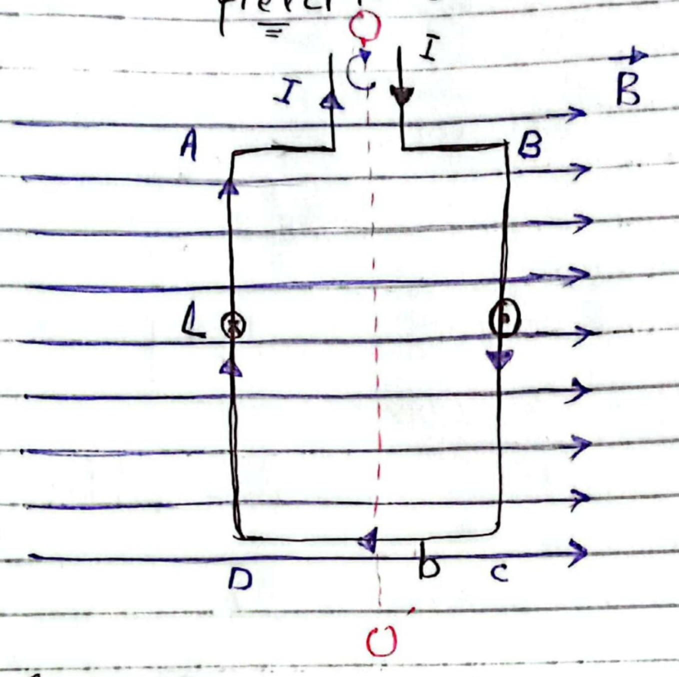
$$\boxed{\left(\frac{e}{m}\right) = \frac{E}{B^2 r}}$$

P.T.O

28 OCT, 2017

Torque on a Current carrying coil placed in a Uniform magnetic field:-

* A couple is Acting on the Coil. Torque is resultant of Couple Degrees.



Force on Side AB:

$F_m = ILB\sin(0°)$ $(\because \theta = 0)$

$F_m = ILB(0)$

$F_m = 0$

Force on Side CD:-

$F_m = ILB\sin(180°)$

$F_m = 0$ $(\because \sin(180°) = 0)$

Magnetic force on BC:-

$F_m = ILB\sin\theta$

$F_m = ILB\sin(90°)$

$F_m = ILB$ —— (I)

Magnetic Force on DA:-

$F_m = ILB\sin(90°)$

$F_m = ILB$ —— (II)

*

Couple = product of the magnitude of either force × perpendicular distance.

$\tau = F_m b$ —— (3)

put eq (1) or (2) in (3):

$T = ILbB$

$T = NILbB$ ($\because N = $ if there are N numbes of turns in coil).

$\because Lb = A$

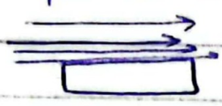
$$\boxed{T = BINA \text{ —— (4)}}$$

BINA is the torque Acting on the coil.

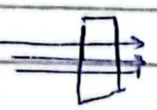
Generalizing:-

$T = BINA \cos\theta$

θ = Angel b/w B and plane of the coil.



$T = BINA \sin\theta$ $\cos(0°) = 1$



$T = BINA \sin\alpha$ $\cos(90°) = 0$

$\alpha = 90°$

$\theta = 0°$

or

$\alpha = 0°$

$\theta = 90°$

α = Angel b/w B and Plane of

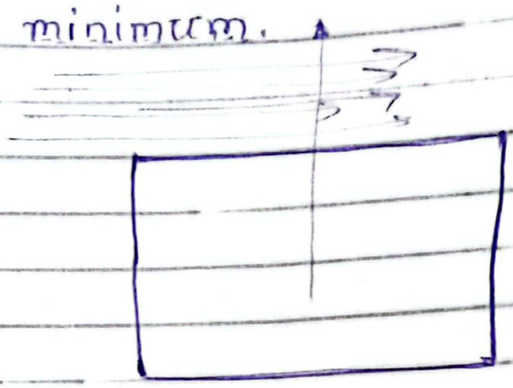
$\sin\theta =$

$\sin(0°) = 0$ $\theta = 90° = \sin(90°) = 1$

α = Angel b/w normal of area(coil) and B.
$\alpha = 90°$
$\sin 90° = 1$ ($\cos\theta = 0$)
$\sin(0°) = 0$ ($\cos\theta = 1$)

* When flux is zero = Torque will be maximum

* When flux is maximum — torque will be minimum.



$\alpha = 0^\circ$

$\theta = 90^\circ$

Nm #3: Data:

$B = 1T$

$F_m = 2\times10^{-12} N$

$q = 1.6\times10^{-19} C$

$m = 1.67\times10^{-27} kg$

Required:

$V = ?$

$$\vec{F}_m = q(\vec{V}\times\vec{B})$$

$$F_m = qVB\sin\theta$$

$$F_m = qVB \qquad \theta = 90^\circ$$

$$\boxed{B = \frac{F_m}{qB}}$$

(4) Data:-

$K.E = 8 MeV$

$K.E = 8 \times 10^{6} eV$

~~K.E = 1.~~ $1 eV = 1.6 \times 10^{-19} J$

$K.E = 12.8 \times 10^{-13} J$

$q = 1.6 \times 10^{-19} C$

$m = 1.67 \times 10^{-27} kg$

Req:- (a) $F_m = ?$

(b) $r = ?$

(a) $F_m = qVB$ —— (1)

$K.E = \frac{1}{2} mv^2$

$v = \sqrt{\frac{2(K.E)}{m}}$ —— (2)

$F_c = \frac{mv^2}{r}$

$F_m = qVB$

$\frac{mv^2}{r} = qVB$

$\frac{mv}{r} = qB$

$$\boxed{r = \frac{mV}{qB}}$$

(5) Data:

$$(F_m)_1 = I_1 LB$$

$$\frac{2}{10\times10^{-3}} = \frac{10\times10^{-3} lB}{10\times10^{-3}}$$

$$lB = 200 \; ?$$

$$(F_m)_2 = I_2 LB$$

$$= 30\times10^{-3}\times 200$$

$$= 6\times10^{-3}\times10^{3}$$

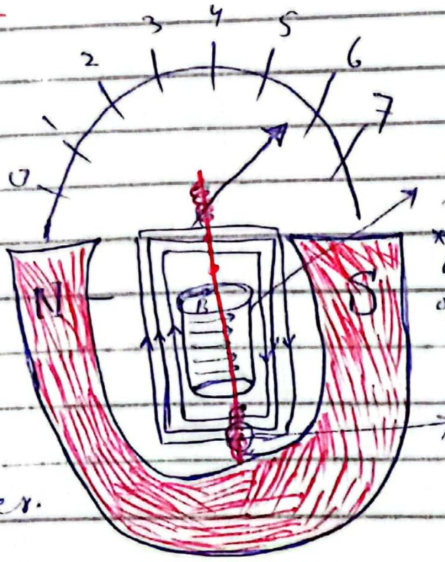
$$(F_m)_2 = 6N$$

30 OCT 2017

(I) Galvanometer:-

Def^n

A device by which we can determine (detect) the current in a circuit is called Galvanometer.



* Galvanometer is current detector not current measurer.

(II) principles:

A current carrying coil placed in a

uniform magnetic field is acted upon by a torque.

I) Deflecting torque:

$$T_D = BINA\cos\theta$$

$$\therefore \theta = 0^\circ$$

$$T_D = BINA\cos\theta$$

$$\boxed{T_D = BINA \text{ —— (i)}}$$

(II) Elastic Restoring torque:-

$$T_R \propto \theta$$ (Angel of deflection)
→ (Always taken in Rad)

$$T_R = C\theta \text{ —— (II)}$$

Where,

$$C = \frac{T_R}{\theta} \text{ —— (III)}$$

"Elastic Restoring torque per unit deflection"

"C" Depends upon the materials of the spring.

if θ = Less (spring is Hard)
Then T_R = More (~~For~~ More torque will be Stored).

Where, C is called Torsion Constant.

Compare (I) and (II):

$$BINA = CQ$$

$$I = \left(\frac{C}{BNA}\right) Q \quad \text{—— (K)}$$

Factor

$$I = \text{constant}\,(Q)$$

$$I \propto Q$$

Sensitivity Galvanometer:-

Galvanometer which shows deflection for small current.

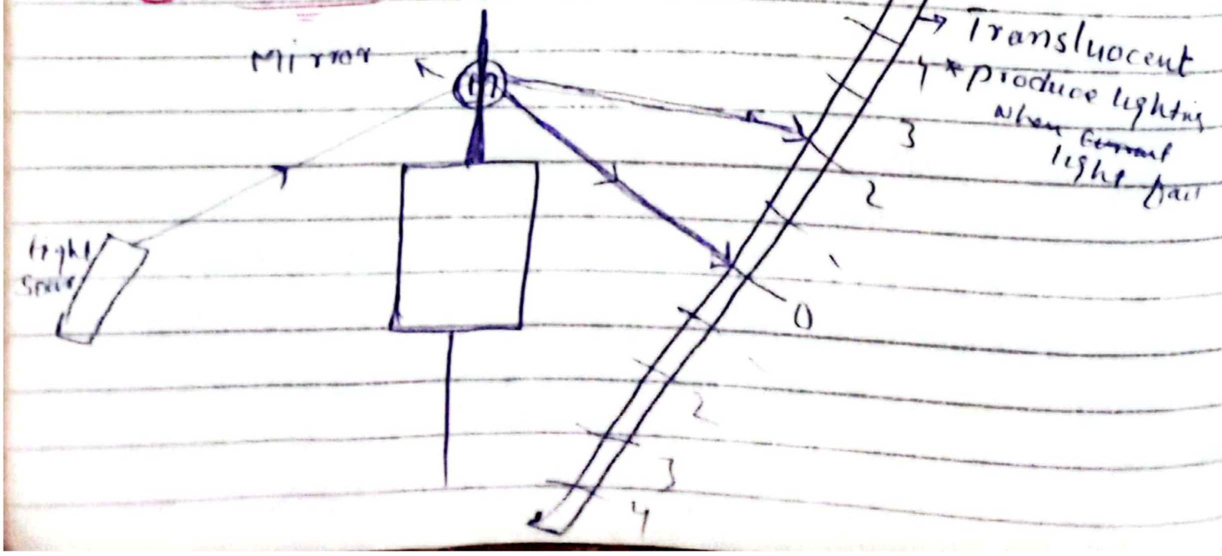
* Sensitivity of galvanometer depends on the smallness of Factor $\left(\frac{C}{BNA}\right)$.

* "C" should be taken normal to maintain sensitivity.

$10 = 10(1)$
$10 = 5(2)$
$10 = 1(10)$

$$I = \left(\frac{C}{BNA}\right) Q$$

Calibration:-



if $\theta = 20^\circ$

$20^\circ = 2div$

$2div = 20^\circ$

$1div = 10^\circ$

(I) ~~Calc~~ convert θ = Radian.

(II) calculate I for this angel

Suppose $I = 2A$

$2div = 2A$

$\boxed{1div = 1A}$

31 OCT, 2017

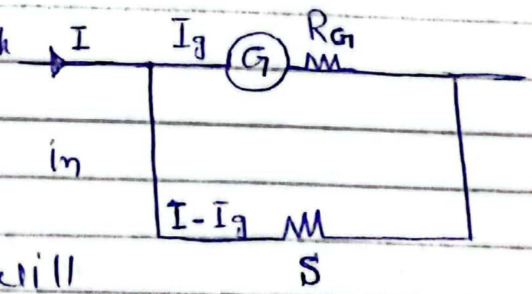
Conversion of Galvanometer Into Ammeter and voltmetere.

(1) Ammetre :-

Def : A device by which we can measure Current is Called Ammetre.

(I) Current I Passes through G and S.

(II) As G and S are in parallel, so the I will divide into two parts. I_g and $I - I_g$.



* The potential difference across G and

S is the Same.

* The Current Can be measured by an Ammetre, the desired value of Current I_g passes through galvanometre Can be achived by Changing Shunt.

Now, Potential of Shunt = potential of galv—

$$V_s = V_G$$

$$(I - I_G) S = I_g R_G$$

$$\boxed{R_S = \frac{I_g R_G}{I - I_G}}$$

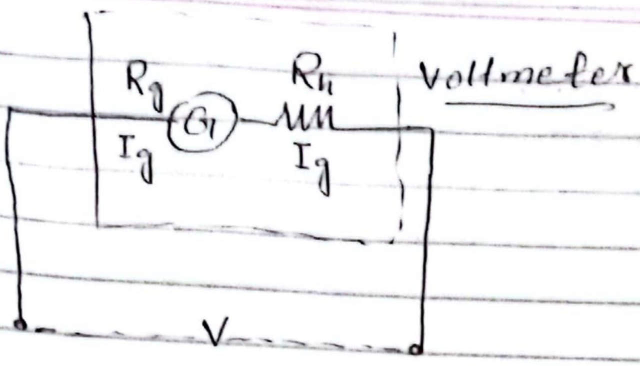
S = Shunt Resistance...

An Ideal Ammetre has Zero Resistance.

Conversion of Galvanometere ~~to~~ to Voltmetre :-

Def " A device which is used to measure potential difference b/w two points in a Circut is Called Voltmetre.

* Galvanometre Can be Converted into voltmetre by conecting a high resistance (R_h) in ~~parallel~~ Series with galvanometre.



$V = V_g + V_h$

$V = I_g R_g + I_g R_h$

$V = I_g (R_g + R_h)$

$$R_h = \frac{V}{I_g} - R_g$$

This is the equation for the resistance to be conected with galvonometer in series...

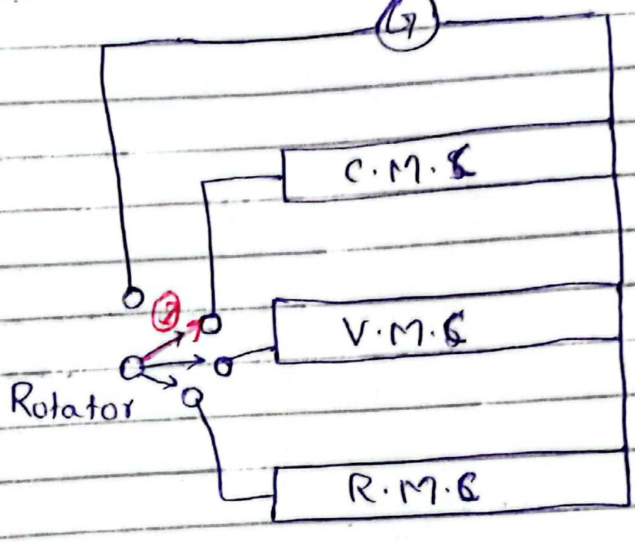
* The value of R_h is High. So the equivelent resistance of voltmeter is High.

Due to its high resistance the voltmeter Do not draw any current from the circuit. Only it measure the potential difference b/w two points.

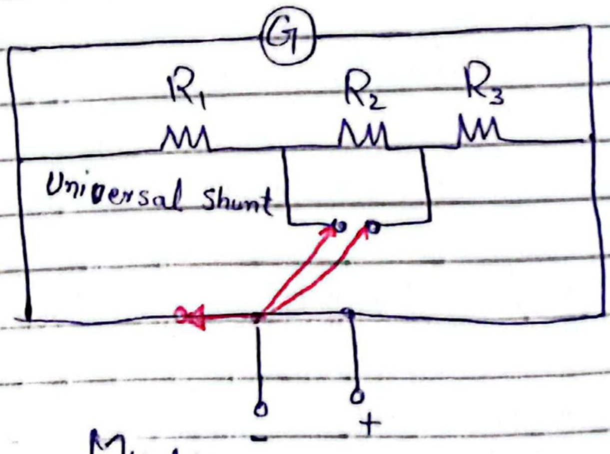
01/Nov/2017

Avo metre (Multi-metre):-

A V O
↓ ↓ ↓
I V R, A Device by which we measure Current, voltage and Resistance is Called Avo-metre or Multi-metre.



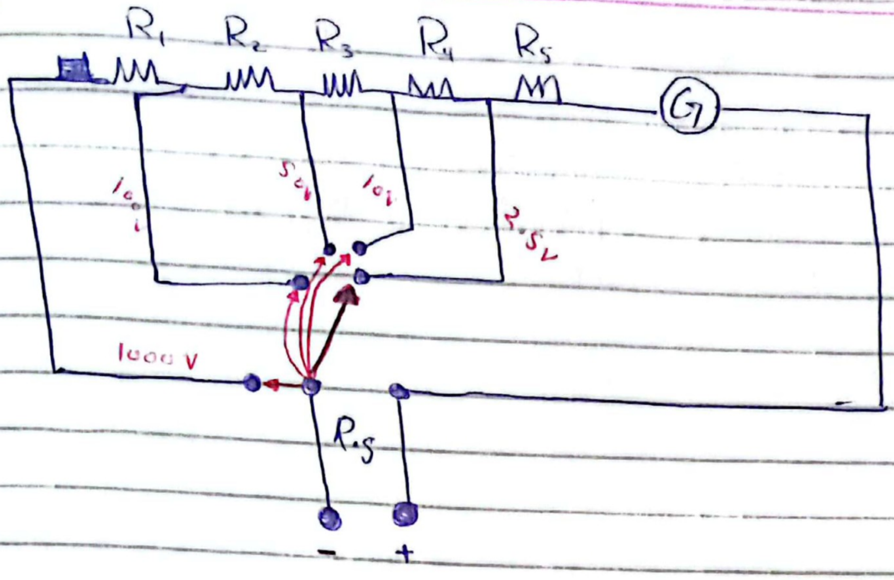
① As a Ammetre



Multi-range Ammetre

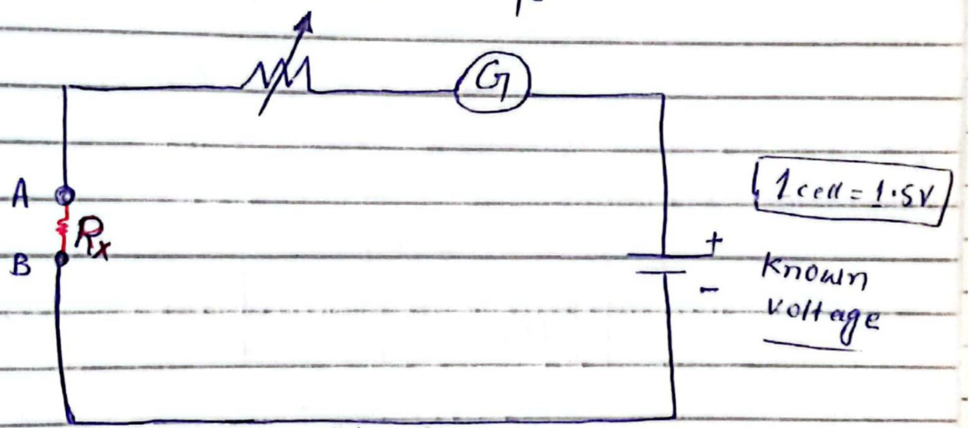
Range will increase

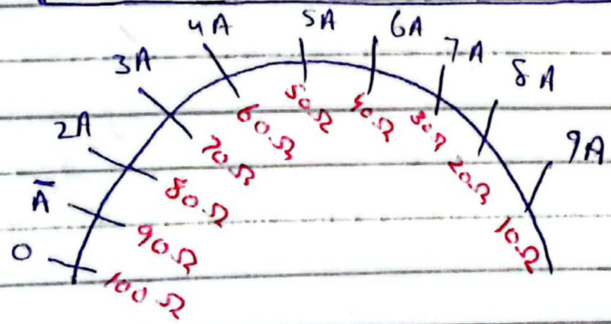
(2)



(3) As A Resistor (Ohmmometer)

Use to change the resistance.





$V = IR_x$

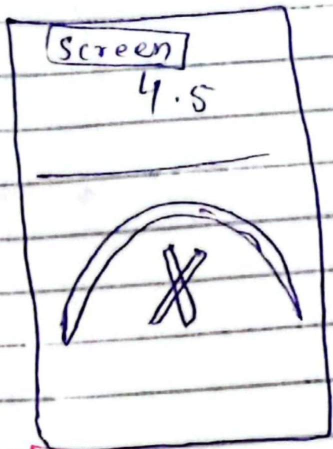
$$R_x = \frac{V}{I}$$

V = Known

I = From Scale

Digital Multi-metre (DMM):-

* No Scale.
* Screen is present which show the result.
* DMM is better then analogue multi-metre.



DMM

The End

31-01-2020