-:(Applied Physics):-

Semester 01:-

Ch # 08:-

-: Magnetic Field :-

Q No1:-

What is magnetism? Write its various propertise & uses?

Answer:-

Magnetism:-

The body which attracts small piece of iron and points north south when suspended freely is called magnet and its power of attraction is called magnetization.

"The study of properties associated with magnet is called magnetism."

Types of Magnet:-

The magnets have two types called permanent magnets and electromagnets.

1:- PERMANENT MAGNET :-

The permanent magnetic material comes from ores. The permanent magnet are also made from hard magnetic materials such as cobalt, steel or alnico (alloy), which are magnetized by electromagnetic induction.

-: PROPERTIES :-

(i) The magnet has two poles called north pole and south pole.

(ii) The north pole and south pole attracts each other.

(iii) The north pole repels another north pole while a south pole repels another south pole.

(iv) The pole of a magnet never be seperated from a magnet. The seperate end is again magnet when it is seperated.

(v) The magnetic lines of force came out from north pole.
The magnetic lines of force enter into south pole.

2. ELECTROMAGNET :-

"The magnetic field is generated around a straight conductor in the form of circles when current flows through it. This conductor is called Electromagnet."

"The power of attraction of electromagnet is called electromagnetization."

"The study of properties associated with electromagnet is called electromagnetism."

Electromagnetic Field :-

The magnitude of generated electromagnetic field depends upon the amount of

current in conductor whose value is given by Ampere's law.
The direction of electromagnetic field is given by "Right Hand Rule."

Right Hand Rule:-

Hold the current carrying conductor in your right hand in such a way that exact thumb is along the direction of current. The curled fingertips indicate the direction of magnetic field which will be clockwise or anticlockwise depending upon the direction of current.

-: Uses of Magnet :-

(i) The magnetism is used by physicians to make images of organs deep within the body.

(ii) Spacecrafts have measured the magnetism of earth and other planets to learn about their internal structure.

(iii) The electromagnet is used in electric bells, electric motors, fans, radio, telephones, galvanometer etc.

(iv) Heavy pieces of iron can be lifted and shifted one place to another place by electromagnet.

(v) Doctors use electromagnet to remove iron fillings from eyes and bullets from wounds.

(vi) The electromagnet is used in cyclotron accelerator.

-:(Applied Physics):-

Ch # 08 :-

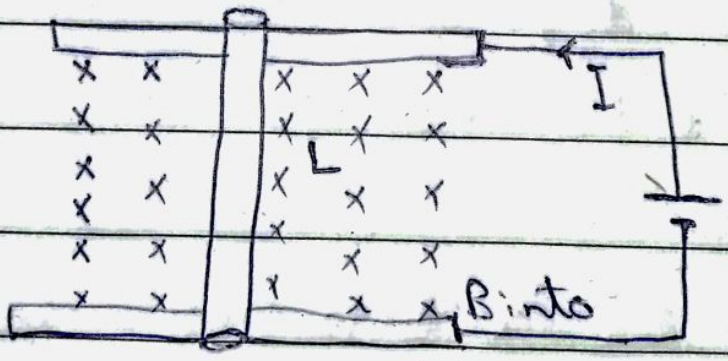
Semester 01:-

QNo2:-

Derive a formula for magnetic force acting on current carrying conductor placed in a magnetic field?

Ans:-

Diagram:-



Explanation:-

Consider a conductor having length L is plaved over a conducting rail in applied magnetic field B perpendicularly.

It is experimentally observed that motion of conductor on rail becomes fast when amount of current or applied magnetic field is increases.

It is also observed that motion of conductor increases when its length increases.

The magnetic force F is directly proportional to the current I ∝ length L, magnetic field B and the orientation of conductor.

$$F \propto ILB \sin\theta$$

$$F = K\, ILB \sin\theta$$

where K is constant. SI unit is unity.

$$F = ILB \sin\theta$$

In vector Form:

$$\vec{F} = I(\vec{L} \times \vec{B}) = ILB \sin\theta\, \hat{n}$$

The magnetic force on each segment is:

$$d\vec{F} = I(d\vec{S} \times \vec{B})$$

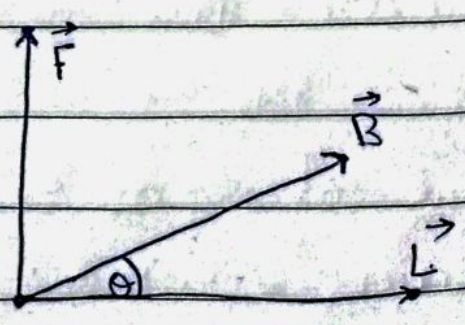
Integrate:

$$\vec{F} = \int I(d\vec{S} \times \vec{B})$$

Direction of Magnetic force:-

The direction of magnetic force is given by right hand rule:

Place right hand at a location where magnetic field vectors are joined together then fingertips along the direction of rotation and the thumbs indicates the direction of magnetic force.



:(Applied Physics):-

Semester 01:-

Ch # 08:-

Q.No3:- (V.Imp)

Calculate magnetic force on a moving charge in a magnetic field?

Answer:-

Consider a conductor having length L and cross-sectional Area A and place it in a uniform magnetic field B perpendicularly. The volume of a conductor is AL. The conductor has many charge carriers.

Charge Carriers :-

The conductor has many charge carries.

Unit volume of conductor has charge carriers = n

AL volume of conductor has

charge carrier = nAL

Total charge carriers = nAL

Total Charge:-

One charge carrier has

charge = q

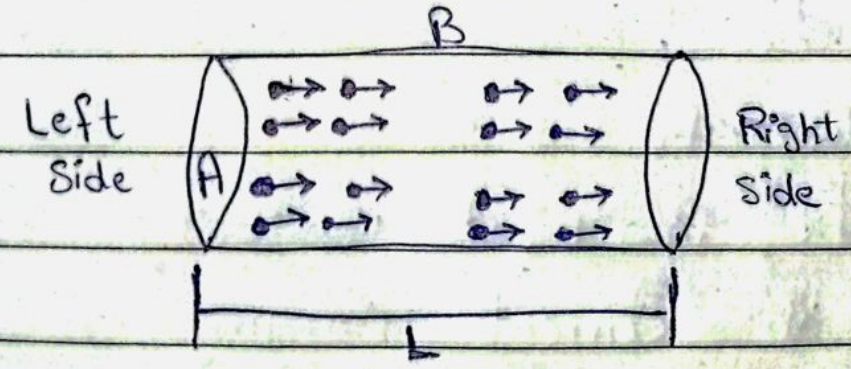
All charge carriers have

charge = nAL

Total charge is:

$$\Delta Q = n.AL q \quad \text{---------- (i)}$$

(i) Current flowing through Conductor:-



The carrier charge move from left side of a conductor with velocity V and come out at right side after coming

the distance in time (Δt) is given.

$$\Delta t = \frac{L}{V}$$

we know that

$$I = \frac{\Delta Q}{\Delta t} = \frac{\Delta Q}{\frac{L}{V}}$$

from eq (i)

$$I = \frac{nAkqV}{k/V}$$

$$\boxed{I = nAqV} \quad \text{---------- (ii)}$$

(ii) **Magnetic force on Current Carrying Conductor:-**

The ~~magnitude~~ magnetic force $\vec{F}_L$ on current carrying conductor having length vector $\vec{L}$ placed in applied magnetic field $\vec{B}$ is:

$$\vec{F}_L = I(\vec{L} \times \vec{B})$$

from eqr (ii)

$$F = nAqV(\vec{l} \times \vec{B})$$

where $\vec{l} = \vec{V}$ because direction of legth vector and velocity vector is same.

$$\boxed{\vec{F_L} = nAqVL(\vec{V} \times \vec{B})} \quad \text{(iii)}$$

(iii) **Magnetic force on Single charge:-**

The magnetic force $\vec{F}$ on a single charge q moving with velocity $\vec{V}$ in Applied magnetic field $\vec{B}$

$$\vec{F_m} = \frac{\vec{F_L}}{nAqL}$$

from eqr (iii)

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

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

$$\vec{F_m} = qVB \sin\theta \, \hat{n} \quad \text{(iv)}$$

(iv) Magnitude of magnetic force :-

The magnitude of magnetic force is:

$$F_m = qvB \sin\theta$$

The magnetic force is maximum when angle between V and B is 90°.

$$F_{max} = qvB \sin 90^\circ$$

$$\boxed{F_{max} = qvB}$$

The magnet force is minimum when angle between V and B is 0° and 180°

$$F_{min} = qvB \sin 0^\circ$$

$$F_{min} = 0$$

$\theta = 180^\circ$

$$F_{min} = qvB \sin 180$$

$$F_{min} = 0$$

(v) **Direction of Magnetic Force:-**

The direction of magnetic force F_m is given by Righ hand Rule.

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

The direction of magnetic force is reversed when charge is negative.

(vi) **Second definition of Right Hand Rule:-**

The right hand rule can also stated as:

Point the thumb of your right hand in the direction of velocity $\vec{V}$ of $+q$ charges.

Finger in the direction of magnetic field $\vec{B}$.

Palm direction is the direction of magnetic force.

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

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(vii) Magnetic force on electron:-

The magnetic force acting on an electron entering with velocity V in applied magnetic field B is:

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