Chapter-12

Magnetic Effects of Electric Current

→ What is Magnetism? :-

Aspect of the combined electromagnetic force that exists in nature.

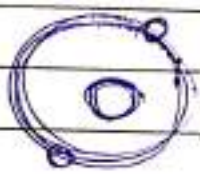
Fundamental forces exist in nature :-

- Gravitational Force
- Strong Nuclear Force
- Weak Nuclear Force
- Electromagnetic Force

Magnetism ⟶ Physical phenomenon arising from the force caused by the magnets, objects that produce fields that attract or repel other objects.

→ Magnetism in our Nature

i.) Moving Charges (Electric Current) can be observed in solenoids and motors etc, when V is constant



ii.) Permanent Natural / Synthetic Materials like Iron, Nickel and Cobalt and alloys can be magnetised

iii.) Motion of Ions and Charges at the Core of the Earth creates Earth's Magnetism.

Core के अंदर Ions melt Hokar flow unke Charges flow karne मतलब है बिजली उत्पन्न होती Electricity generate Hoti Hai aur Magnetic effect Ho Hai

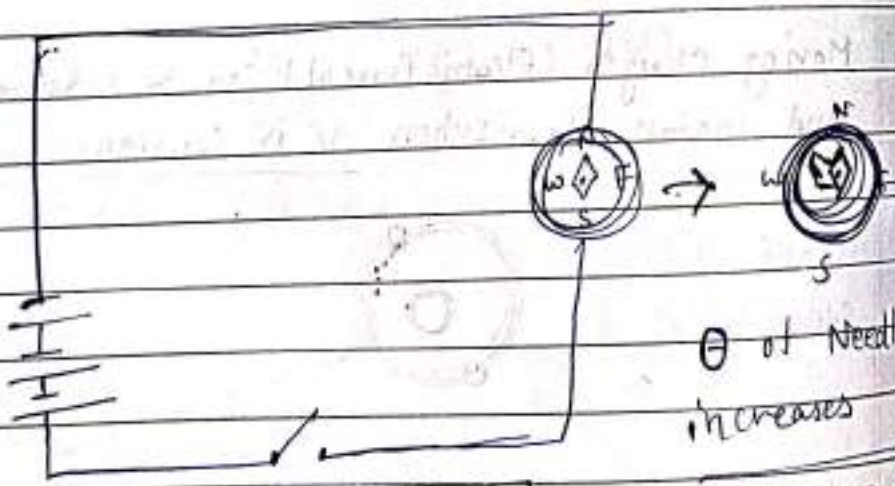
→ Why majorly shows North

→ Because the magnetism inside the core's South Pole is Earth's North Pole

→ Oersted Experiment:-

Hans Christian Oersted — Crucial role in electromagnetism

In 1820 he did an experiment he place a compass on the circuit and noticed that when the electricity flows into the circuit the compass started deflecting



θ of Needle increases

Open switch

Closed Switch

$\theta \propto I$

Deflection ∝ Current

→ Observing Magnetic Field

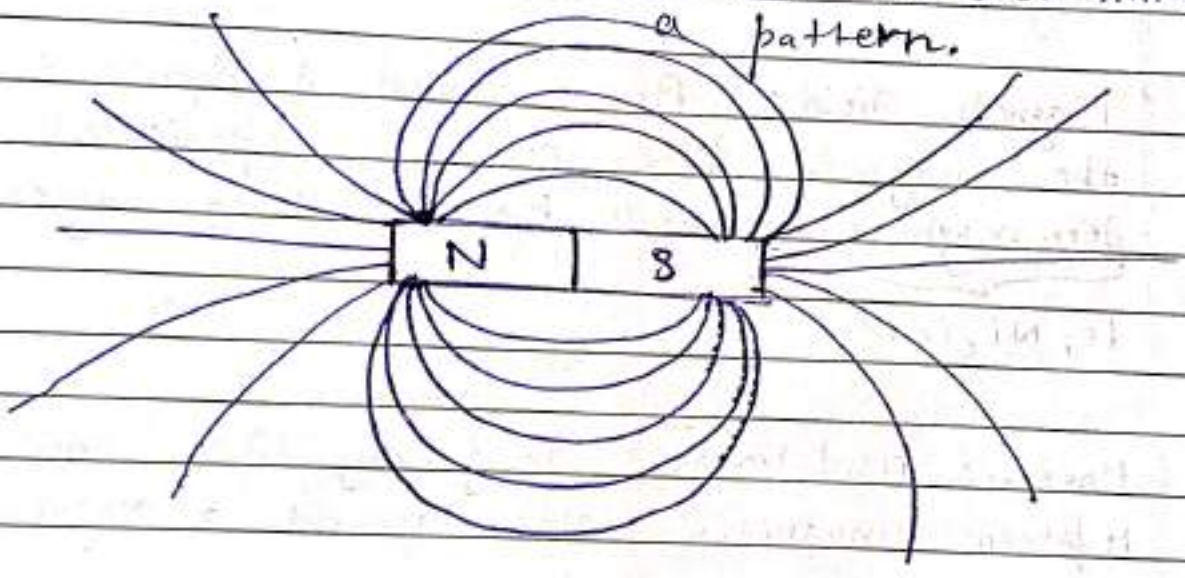
Oersted Realised —— Relation btw Electricity and Magnetism.

Numerous other experiments were carried out in different parts of the world, like :-

Iron fillings and Bar Magnet Experiment was performed

Concluded that the North and South Pole of the Bar Magnet is producing Magnetic field.

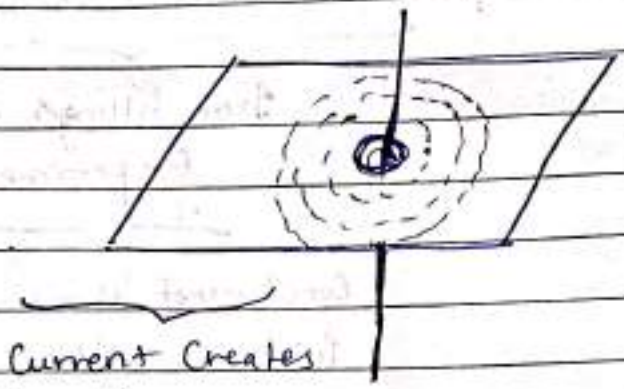
Attracts the Iron filling in a pattern.



Magnetic Field

- Similarly, an experiment was performed by current carrying wire also creates magnetic field.

When Iron fillings are put on it again create a concentric circle type pattern,



Current Creates Magnetism

→ Magnetic Field & its lines (Bar Magnet)

- Magnetic Field :- Area around a magnet in which the magnetic force can be experienced by other ferromagnetic materials magnets, moving charges etc.

Fe, Ni, Co etc

- Magnetic Field lines :- Imaginary lines used to represent magnetic fields around a magnetic substance.

Help to describe the direction of the magnetic force acting on Magnetic fields ?

help of tangent

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→ Properties of Magnetic Field lines

i.) By convention (परंपरा) the field lines — emerge from North pole & merge at the south pole. Inside the magnet — goes from South Poles to North Poles

ii.) These are Closed Curves

iii.) Field lines are crowded near poles (denser) — Shows Strength of the Magnetic Pole.

iv.) Two magnetic Field ~~never~~ doesn't intersect each other.

Why ?

If we draw the tanget then we got two direction which is not possible and creates sense of Chaos ~~dar~~ while using Compass.

Therefore they doesn't intersect each other.

→ Properties of Bar Magnet

i.) Two poles - North & South

ii.) Attracts iron & steel.

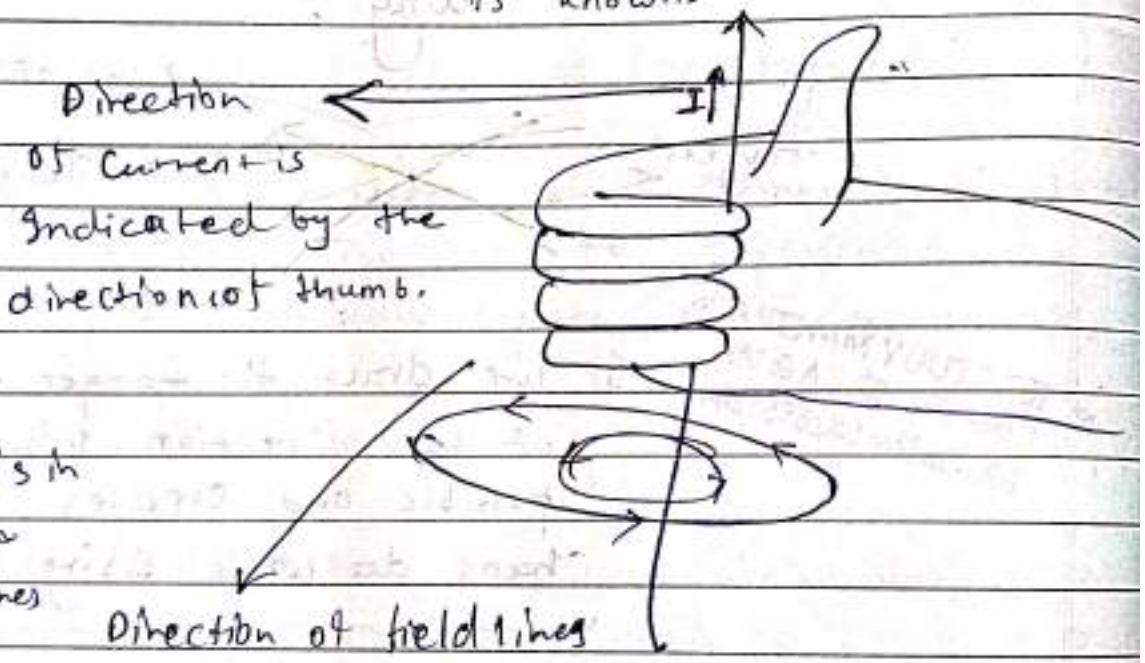
iii) like poles — repel each other
unlike poles — Attract each other.

iv) Bar Magnet when suspended freely then North pole of magnet points towards North Pole of earth.

v) They are permanent magnets — they do not lose their magnetism until hammered

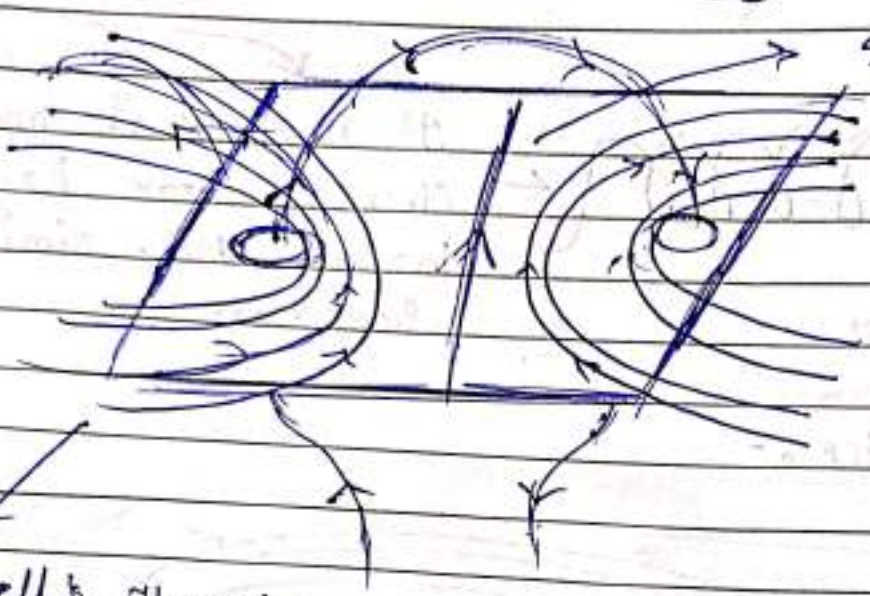
→ Maxwell's Right Hand Thumb Rule :-

indicates direction of magnetic field if current direction is known.



This rule is also applied on Positive charges

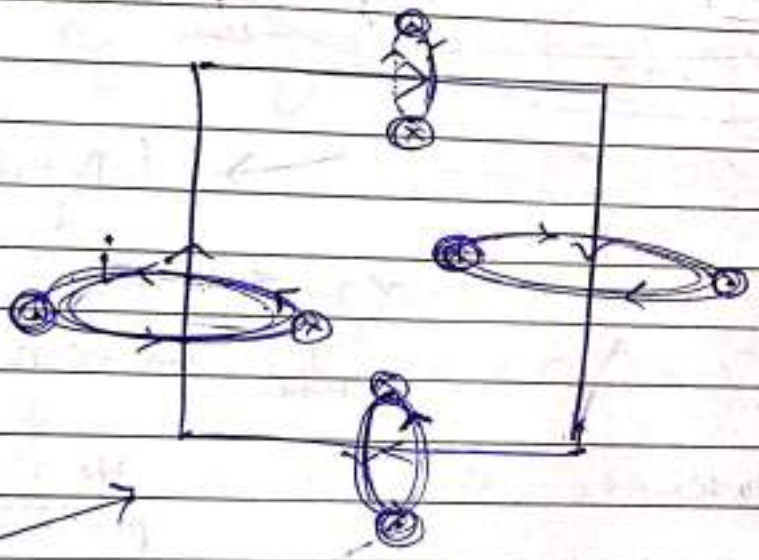
→ Magnetic field lines: Current carrying loop

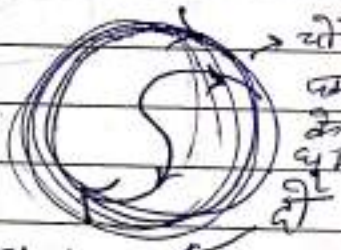


In centre the field lines are same.

Maxwell's Thumb Rule

* Practice





Clock wise

Anti Clock wise

Clockwise → South Pole

Magnetic field (Inwards)

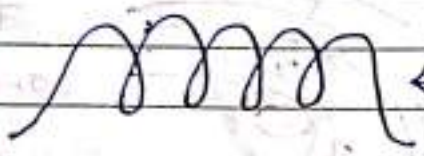
South Pole

N | S

बाहर

अंदर

→ Magnetic field lines :- Current carrying Solenoid



It is a coil of multiple circulars look here current produces M.F. similar to Bar magnet.

→ Practice :-

→ i ↑ M.F. ↑

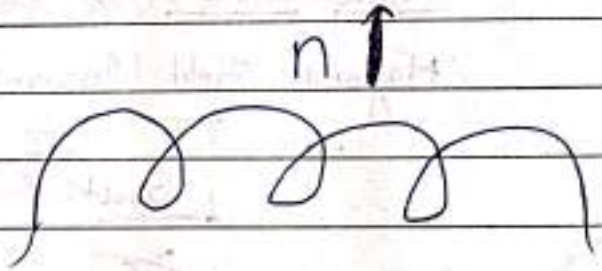
M.F. ∝ i

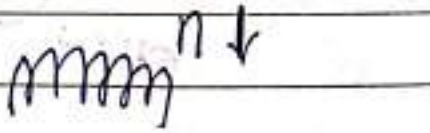
∝ Zero ← magnetic Material

∝ n → Turned density

No. of turns per unit length

→ Clockwise



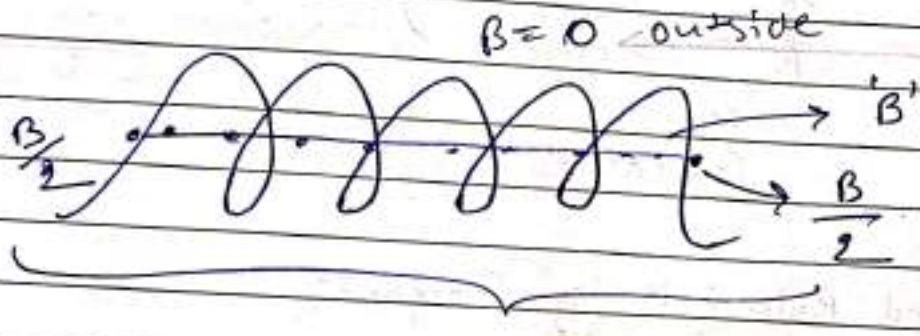


→ Application of Current Carrying Solenoid

If Core is made up of

Soft Ferromagnetic material → Temporary Magnet.

Hard Ferromagnetic Material → Permanent Magnet.

* 

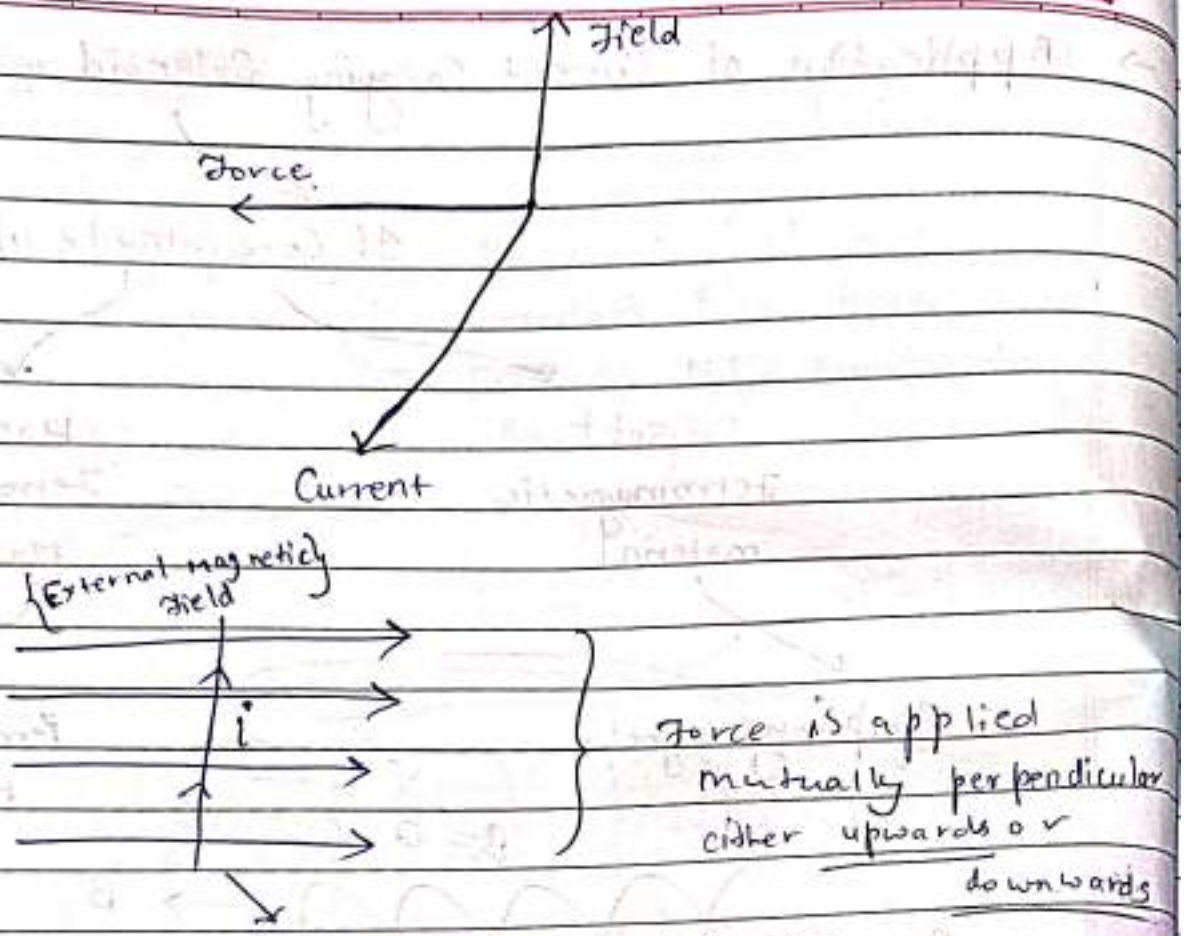
At ends (Poles)

B = 0 → Outside

Tesla is the SI unit of magnetic field

→ Fleming's Left Hand Rule :-

thumb - Father - Force
Index finger - Mother - Magnetic field
middle finger - Child - Current



→ Left Hand Rule : Moving Charges :-

Positive	Negative	Neutral
I	e^-	n^0
p^+	β^-	γ^0
α^{++}	Anion	Atom
Cation		
Use left Hand Rule in the the direction of charge	use left Hand Rule in the opposite direction of Positive Charge	No Force

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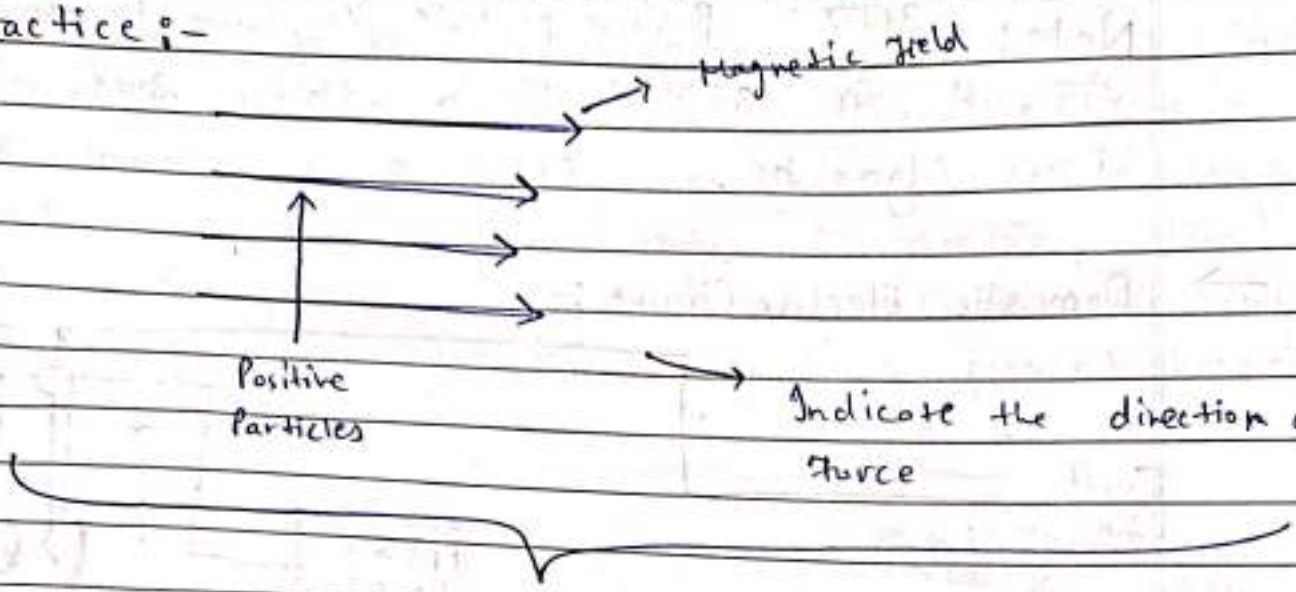
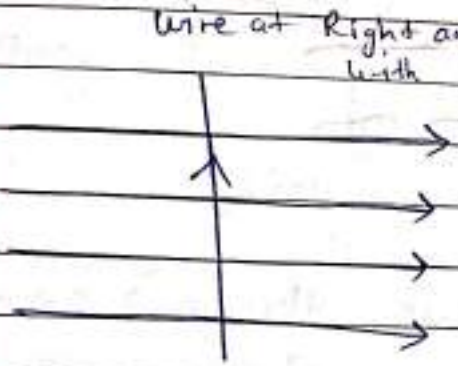
• Practice :-

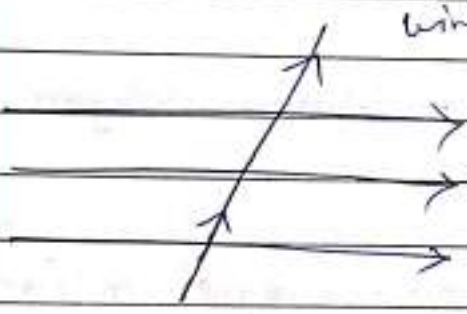


Using left hand rule
the force is applied downwards ⊗.

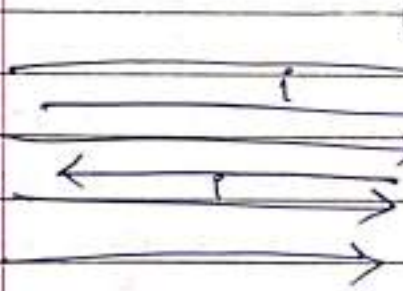
→ Changing orientation of Straight Conductor



F = Maximum



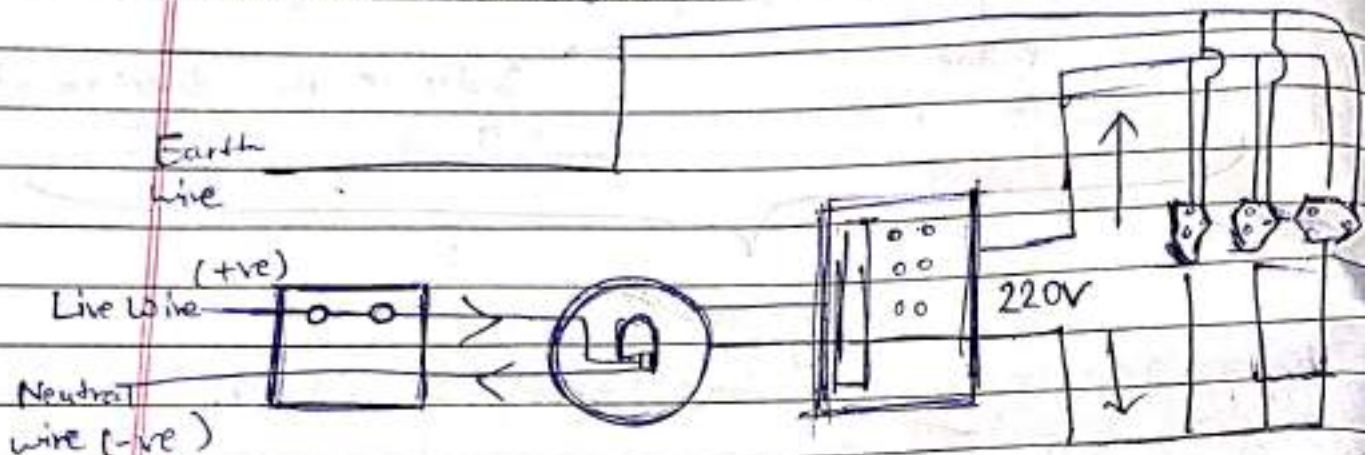
OK F < Max

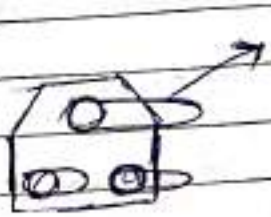


F = 0

Note:- अगर Positive particle या Current deflect होता है तो उसका मतलब उसके ऊपर कोई Force लग रहा है.

→ Domestic Electric Circuit :-





Live wire (Red)
Neutral wire (Black)
Earth wire (Green)

We receive power in our house through a main supply, commonly called mains.

i.) It is supplied through overhead cables or underground cables.

ii.) The potential difference (or voltage) supplied in our country is 220V @ 50Hz.

iii.) Three types of wire :-

live
Neutral
Earth

* Earth wire :- It is generally green in color. It is usually connected to a metal plate placed in the earth near the house as a safety measure to ground gadgets that have a metallic body. (Refrigerator, toaster). In case of charges leaking on to the metallic body, the charges get grounded and thus prevent shocks.

x Live wire :- Red in color.

x Neutral wire :- Black in color.

→ Generally two types of electric circuit used at home :-

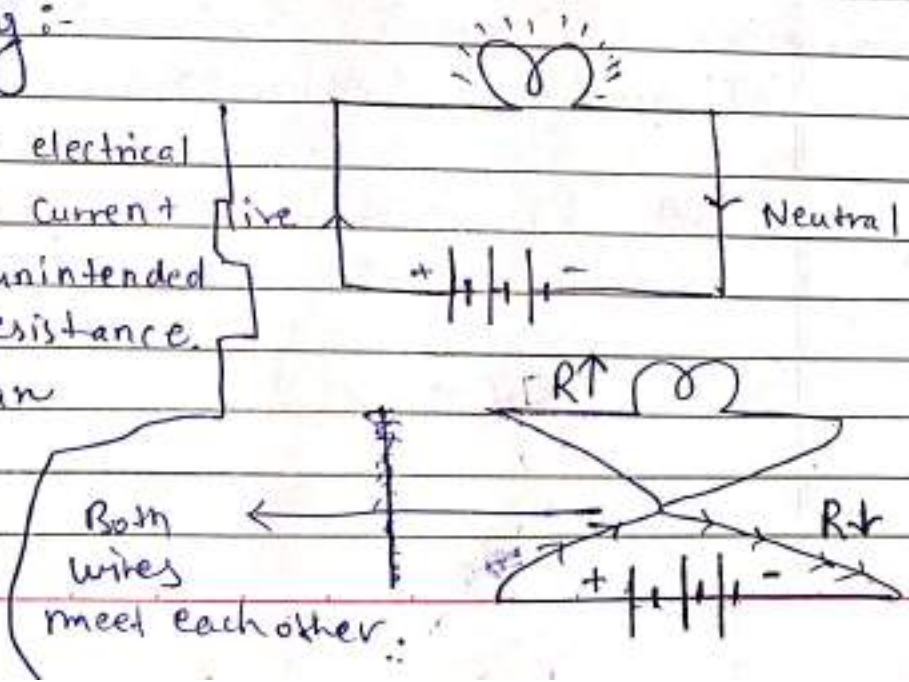
15A - Appliances which have higher power ratings. (geyser, fridge, ACs); Power Socket.

5A - Appliances which have lower power ratings. (Tv, bulbs, fans) : Normal Socket.

Important :-

1.) Short Circuiting :-

A short circuit is an electrical circuit that allows a current to travel along an unintended path with very low resistance. This results in an excessive current flowing through the circuit, which may cause the wire to break.



2-> Overloading:- It means an electric circuit when current flows in a circuit it becomes more than the capacity of components in the circuit to resist the current. When too much current passes an electric overload occurs through electric wires, which may cause fire to break.

The end