MAGNETIC EFFECTS OF ELECTRIC CURRENT.

- The concept of magnetism emerged when it was observed that Earth's core contains a substance known as lodestone, which attracts certain material.
  ↓
  Fe_3O_4

OERSTED'S EXPERIMENT

- Han's Christian Oersted one of the leading scientists in 19th century played a crucial role in understanding electromagnetism.
- In 1820 he accidentally discovered that a compass needle got deflected when an electric current passed through metallic wire placed nearby.
- Oersted concluded that there is relation between Electricity and magnetism

MAGNET: an object that attracts pieces of iron, steel etc. towards itself.

Properties of Bar Magnet:-

- When a magnet is freely suspended, it always align towards north-south direction.
- Like poles repel; opposite poles attract.
  or
  opposite.
- magnet always exist as dipole.
- 2 poles can never be separated. [if we cut them also both poles will evenly exist on small piece of magnet].
- A magnet always develops certain area around it where its effect can be felt. i.e → magnetic field.

MAGNETIC FIELD:
Magnetic field is the area around a magnet in which the magnetic force can be experienced by other ferro-magnetic substances.

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★ **Magnetic field lines:** Magnetic field lines are imaginary lines used to represent magnetic field around a magnetic substance.

- They help us describe the direction of magnetic force acting on magnetic substance.

★ **Properties of magnetic field lines:-**

- They always originate from North pole and terminates at the south pole.
- The place where they are closer indicates a strong magnetic field ie. at the poles.
- Magnetic field lines give the direction of magnetic force.
- vector quantity.
- magnetic field lines are closed continuous curves.

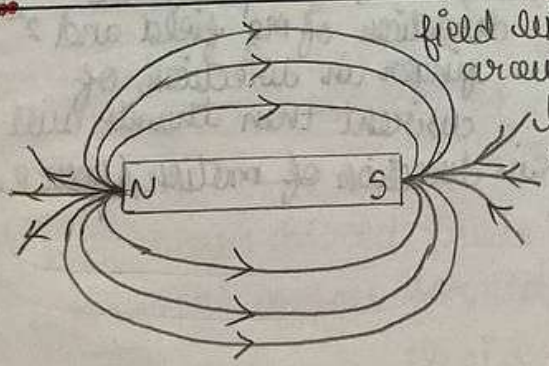
Q. **What Represents the strength of Magnetic field?**

A. • The relative strength of magnetic field is shown by degree of closeness of the field lines.

- The field is stronger, that is, the force acting on the poles of another magnet placed is greater where the field lines are crowded.

Q. **Why 2 Magnetic field lines cannot intersect each other?**

A. No, 2 field lines are found to cross each other. If they did it would mean that at the point of intersection the compass needle would point towards 2 directions. which is not possible.



field lines around bar magnet

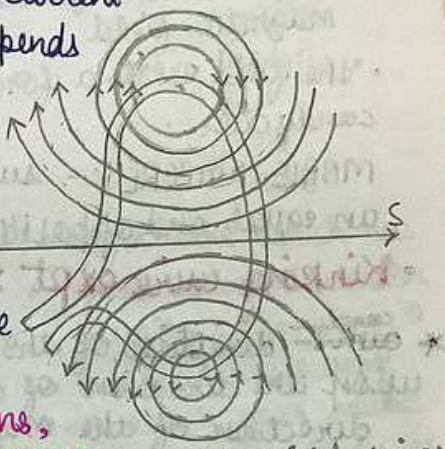
- Deflection of compass needle increases as the needle moves towards the pole.

- **CURRENT:**
  - south to north → west
  - north to south → east

MAGNETIC FIELD DUE TO A CURRENT THROUGH A CIRCULAR LOOP.

magnetic field lines produced by a current carrying conductor straight wire depends inversely on the distance from it.

→ similarly at every point of a current carrying conductor (circular loop) the concentric circles representing the magnetic field around it would become larger and larger as we move away.



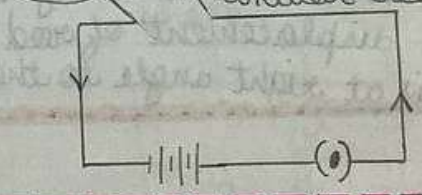
magnetic field lines of the field produced by a current carrying circular loop.

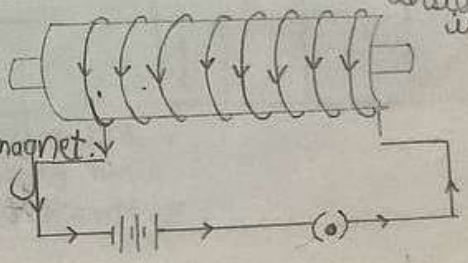
- if there is a circular coils having n turns, the field produced is n times as large as that produced by a single turn. This is because the current in each circular turn has the same direction and the field due to each turn adds up.

MAGNETIC FIELD DUE TO CURRENT IN SOLENOID

- a coils of many circular turns of insulated copper wire wrapped closely in shape of a cylinder is called solenoid.
- the field lines inside the solenoid are in form of parallel straight lines.
- a strong magnetic field produced inside a solenoid can be used as to magnetise a piece of magnetic material like SOFT iron when placed inside a coil. The magnet formed is electromagnet.


magnetic field produced by a current carrying circular coil.


a current carrying solenoid coil is used to magnetise steel rod inside it.



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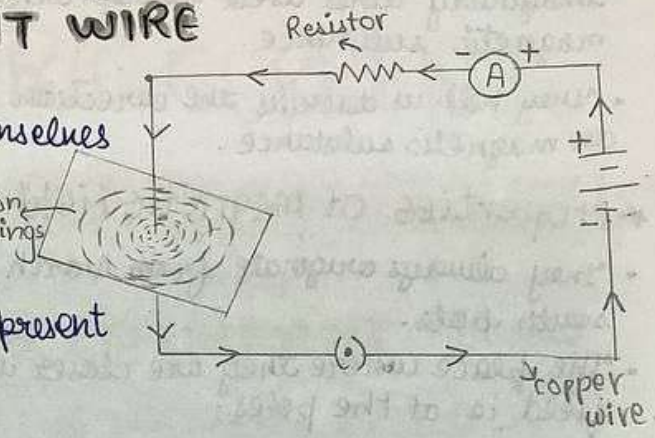
Aim: THE PATTERN OF FIELD LINES AROUND STRAIGHT WIRE



Observation:

i] iron fillings align themselves showing a pattern of concentric circles around copper wire.

ii] The concentric circles represent magnetic field lines.

• conclusion:

The magnetic field lines produced by a given current in a conductor decreases as the distance from it increases.

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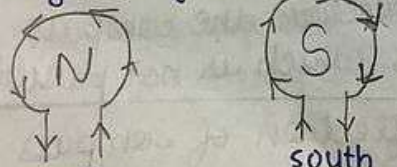
Right-Hand Thumb Rule or Maxwell's corkscrew rule

a convenient way to find the directth of mg field lines associated with a current carrying conductor

→ if we hold current carrying conductor in our right hand such that thumb points in direction of flow of current then fingers encircle the wire in direction of magnetic field lines.



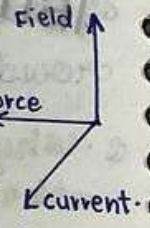
north direct^{n}
• outwards
• anti-clock wise

south direct^{h}
• inwards
• clockwise

• Current ↑ Magnetic field ↑

Fleming's left hand Rule.

• direction of force of conductor depends upon the direction of current and direction of magnetic field



⇒ Strech the thumb, index and middle finger such that they are mutually perpendi.

⇒ first finger points in direction of mg field and 2nd finger in direction of current then thumb will point in direction of motion/force.

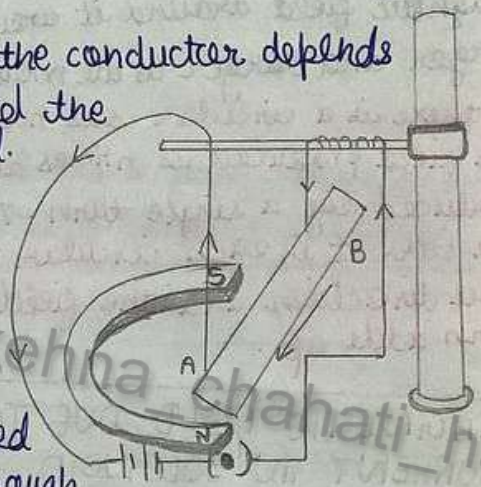
FORCE ON A CURRENT CARRYING CONDUCTOR IN A MAGNETIC FIELD:-

- electric current flowing through a conductor produces a magnetic field.
- The field exerts a force on a magnet placed close by of the conductor.

MARIE AMPERE :- suggested that the magnet must also exert an equal and opposite force on the current carrying conductr.

- **Rocking wire expt :-**

* Conclu:- direction of the force on the conductor depends upon the direction of current and the direction of the magnetic field.



- **Aim:-**

i] force is exerted on the current carrying aluminium rod when it is placed in a magnetic field.

observation :-

i] direction of force is also reversed when the direction of current through the conductor is reversed.

ii] when the direction of field is changed to vertically downward by interchanging the 2 poles of the magnet. It is observed that current carrying rod gets reversed.

iii] displacement of rod is largest when direction of current is at right angle to the direction of magnetic field.

~~DOMESTIC ELECTRIC CIRCUITS~~

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RED insulator → live / positive wire

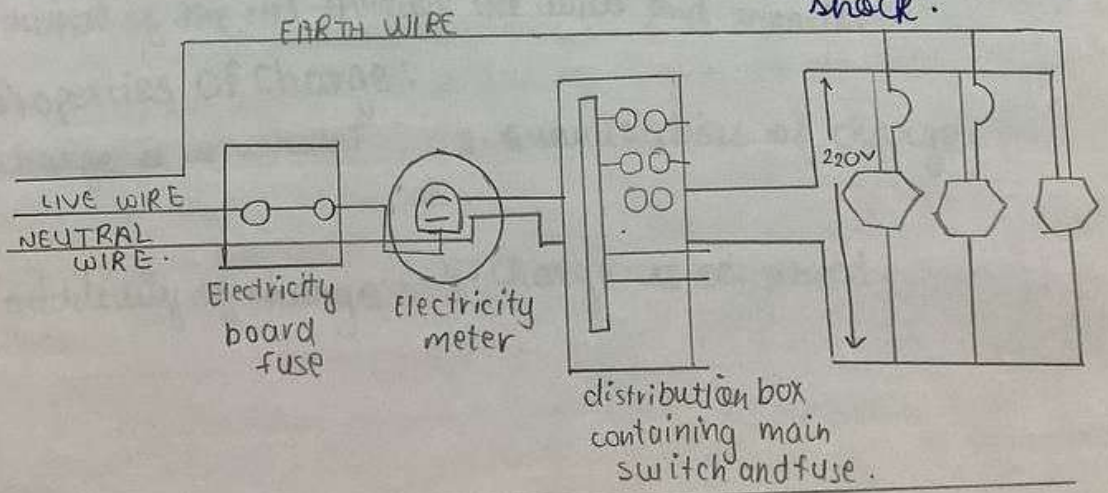
BLACK insulator → neutral / negative wire

GREEN insulator → earth wire.

- earth wire which has green colour insulator usually connected to a metal plate deep in earth near house.
- This metallic body is connected to earth wire which provides a low resistance conducting path for the current.

Funct^{h}:- it ensures that any leakage of current to the metallic body of the appliance keeps its potential to that of the earth, and the user may not recieve a severe shock.

domestic circuit



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OVERLOADING

what?
- overloading can occur when the live wire and the neutral wire comes into direct contact.

consequence:
- In such situation, the current in the circuit abruptly increase. This is called short-circuiting.

prevention:
- The use of electric fuse prevents the electric circuit and appliance from a possible damage by stopping the flow of unduly high electric current.

How?
- overloading can also occur due to an accidental hike in the supply voltage. sometimes overloading is caused by connecting too many appliances by a single socket.