Magnetic Effect of Electric Current

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Magnet: is any substance that attracts iron or iron like substances.

Properties of Bar Magnet:

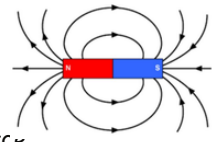
- A freely suspended bar magnet aligns in the Earth's north-south direction.
- Attractive and Repulsive Forces: Like poles repel, opposite poles attract.
- Dipole Nature: Always has two poles (north and south); cutting the magnet creates smaller magnets, each with two poles.
- Creates a magnetic field around it where its effect can be felt.
- It retains its magnetic properties over time.

Magnetic Field: is the area around a magnet in which the effect of magnetism is felt.

Magnetic field lines are imaginary lines that show the strength and direction of a magnetic field.

Properties of Magnetic Filed Lines:

- Magnetic field lines start at the north pole and end at the south pole.
- Closer lines mean a stronger magnetic field (near poles).
- Field lines never cross each other.
- They form closed continuous curves.
- They show the direction of magnetic force.

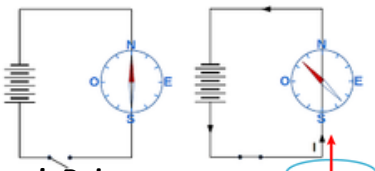


Horseshoe shaped

Bar magnet

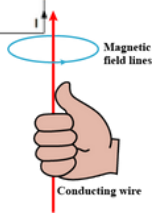
Hans Christian Oersted (1820):
Discovered that electric current deflects a compass needle, proving the link between electricity and magnetism.

Hans Christian Oersted



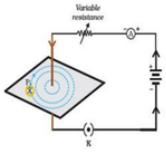
Maxwell's Right Hand Thumb Rule

The rule states that if a straight conductor carrying current is held in the right hand such that the thumb is pointed in the direction of the current, then the direction in which your fingers encircle the wire gives the direction of the magnetic lines of force around the wire

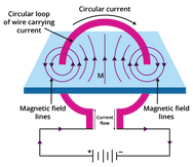


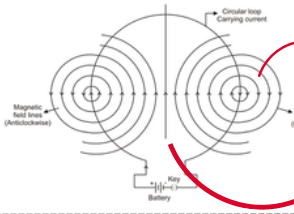
Thumb = upwards, curled fingers = magnetic field (clockwise), the field direction = anticlockwise.
Thumb = downwards, curled fingers = magnetic field (anticlockwise), the field direction = clockwise

Magnetic field lines due to Straight conductor



Magnetic field lines due to current carrying loop

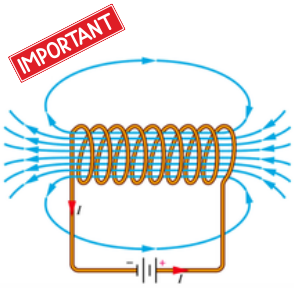




circular pattern around the arms

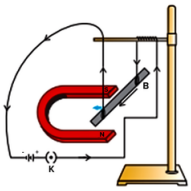
straight at the center of the loop

Magnetic field lines due to Solenoid → electromagnet.



A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder.
Outside the solenoid: North to South
Inside the solenoid: South to North
Factors: number of turns in the coil, amount of current flowing through it, radius of coil, Material of core of the solenoid.

Force on a current carrying conductor in a magnetic field



- Andre Marie Ampere's Suggestion (Magnet exerts equal and opposite force)
- Force on a current-carrying conductor in a magnetic field
- Maximum displacement (When current is at a right angle to the magnetic field)
- Reversing current direction → Force direction is reversed

Electromagnet	Permanent Magnet
Works only when current flows.	Always magnetic once magnetized.
Strength changes with current.	Strength depends on material.
Loses magnetism when current stops.	Loses magnetism permanently if demagnetized.
Needs electricity to stay magnetic.	No electricity required.
Made of soft materials.	Made of hard materials.
Poles can switch with current.	Poles stay the same.

Fleming's Left Hand Rule

When a current-carrying conductor is placed in an external magnetic field, the conductor experiences a force which is mutually perpendicular to both the Magnetic field and to the direction of the current flow.
Stretch the thumb, forefinger, and middle finger of your left hand perpendicular to each other.

- Forefinger = Magnetic field direction, Middle finger = Current direction, Thumb = Force/motion direction.

Domestic Circuit

1/100 second in India, i.e. the frequency of A.C in India is 50 Hz.

Potential Difference in India: 220V at 50Hz.

Alternating Current (AC)	Direct Current (DC)
AC can travel safely over long distances, even between cities.	DC cannot travel long distances; it loses power.
Frequency is 50 or 60 Hz, depending on the country.	DC has zero frequency.
Current direction reverses periodically.	Current flows steadily in one direction.
Cheaper then DC generation	Expensive then AC generation

Wire in Domestic Circuit

Earth Wire

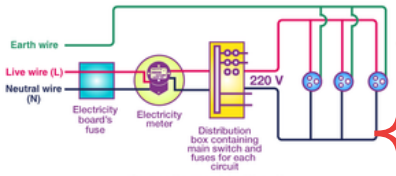
- Generally green in color, connected to a metal plate in the earth as a safety measure.
- Grounds gadgets with metallic bodies, preventing shocks by grounding leaked charges.

Live Wire

Positive, usually red, carries current in the circuit.

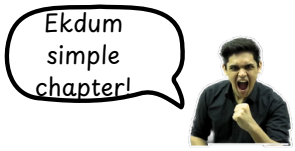
Neutral Wire

Negative, usually black, returns electricity to the power source



Power sockets (15A): For high-power appliances (geyser, fridge, AC).

Normal sockets (5A): For low-power appliances (TV, bulbs, fans).



Short Circuit : occurs when a live wire and a neutral wire come into direct contact, causing a sudden and large amount of current to flow in the circuit.

Reasons: damage of insulation in power lines, fault in an electrical appliance.

Overloading: If the total current drawn through a wire by the appliances connected to it exceeds the safety limit for that wire, it gets overheated.

Electrical fuse: is a low melting point copper or other metal wire that breaks due to heat caused by overvoltage or high load to avoid short circuit or failure to the device.

Chapter ka KAZAANA:

- **Fleming's left hand rule (Numerical)**
- **Solenoid (Diagram)**
- **Properties of Magnetic field lines**
- **Live wire, Neutral and earth wire.**