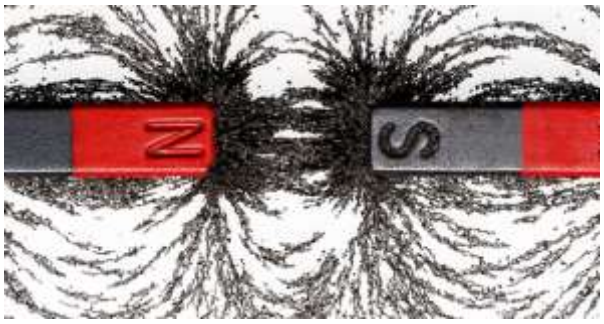
Chapter: Electricity and Magnetism

Magnetism

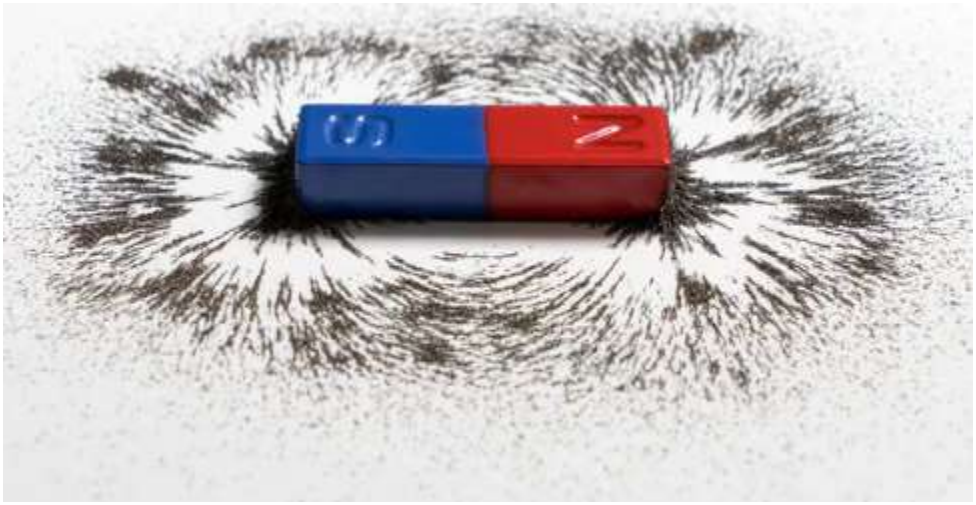


- Substances that have the property of attracting iron are called as magnets.
- The property of attraction is known as magnetism and the force exerted by a magnet is called as magnetic force.
- The two ends of a magnet are called as its poles, and all the magnets have two poles called as the North pole and the South pole.

Properties of a Magnet

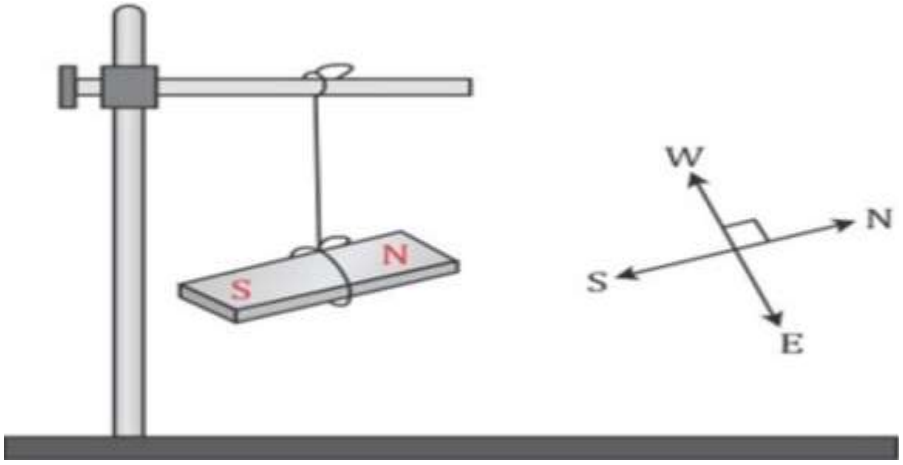
Attractive property

- A magnet has an attracting property that attracts small pieces of iron towards it.
- This property is not the same along the length of a bar magnet, but shows a maximum attraction near the ends of a bar magnet.
- The two ends of the magnets which have the maximum attractive property are called as the poles of the magnet.



Directive property

- A bar magnet, when suspended freely with a silk thread comes to rest along the north-south direction of the Earth.
- The end of the bar magnet which points to the north pole of the Earth is called as the north pole of the magnet and which points to the south pole of the Earth is called as the south pole of the magnet. This property of pointing the north-south direction is called as the directive property.



Law of Magnetism

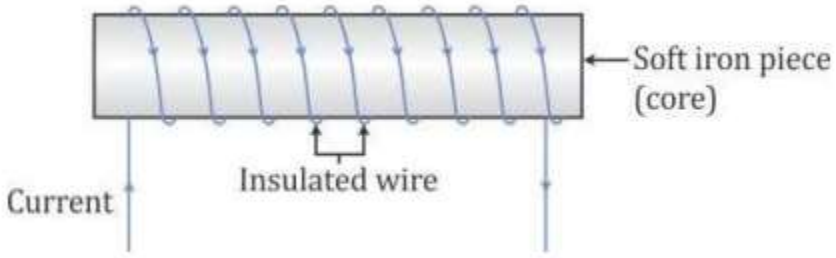
- Like poles repel and unlike poles attract
- Poles always exists in pairs

Test for Magnetism – Repulsion

- Repulsion is a sure test for magnetism. This is because:
  (a) A magnet will get attracted to a magnetic substance like iron.
  (b) A magnet will get attracted to another magnet with unlike poles facing each other.
  (c) A magnet will be repelled when a magnet with like pole is brought near it.

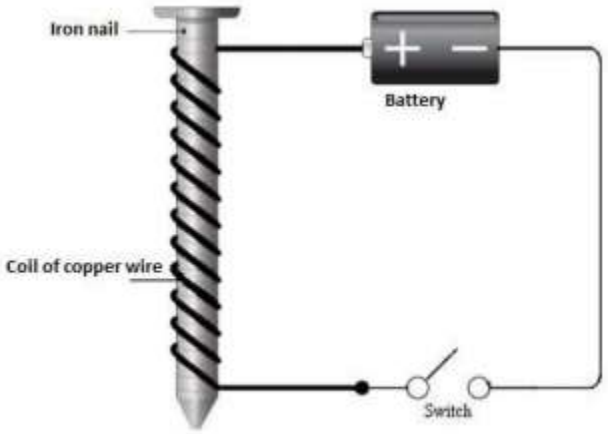
An Electromagnet

- An electromagnet consists of a soft iron piece on which an insulated copper wire is wound.



- The soft iron is called a core and the insulated copper wire is used to cover the soft iron bar.
- An electromagnet is a temporary magnet.
- So unlike a permanent magnet, the strength of an electromagnet can be changed by changing the amount of electric current that flows through it.
- Electromagnets are used in electrical devices such as the motors, generators, relays, loudspeakers, hard disks, MRI machines, scientific instruments, etc.

Construction of an Electromagnet



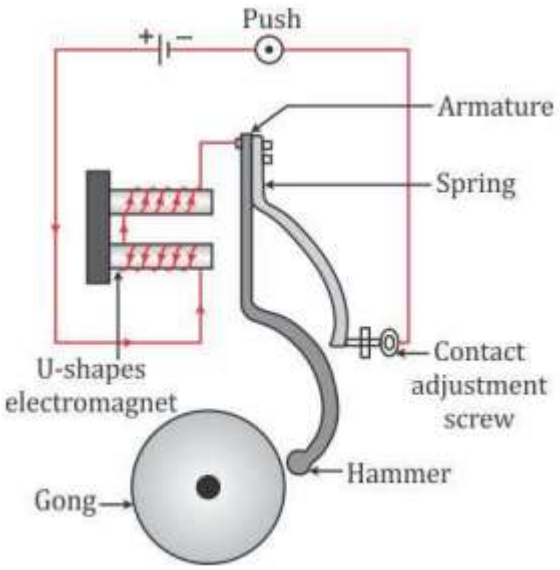
- When you switch on the current, the paper clips will cling to the nail. This is because the nail becomes an electromagnet.
- When the battery is disconnected, the nail is no more an electromagnet. The paper clips will not cling to the nail.

Uses of Electromagnets

Electromagnets are used

- In electrical appliances such as the electric bell, electric fan, electric motors, etc.
- In lifting heavy loads of iron scrap.
- To remove the tiny particles of iron from a wound.
- In separation of iron ores from impurities.
- In loading the furnaces with iron.
- In medical science to cure certain ailments.
- In preparation of strong permanent magnets.
- In electromagnetic trains called Maglev's.

Electric Bell



- An electric bell is a bell that works on the principle of an electromagnet.
- When a circuit is closed by a switch, the current flows through the U-shaped electromagnet and the core turns into an electromagnet which attracts the armature made of iron.
- The hammer strikes the gong bell as the armature moves towards the electromagnet and the contact of the adjustment screw breaks the circuit, due to which the current stops flowing through the coil.
- Electric bells are used at railroad crossings, in telephones, fire and burglar alarms, schools bells, doorbells, etc.

Sources of Electricity

- A device that produces electric current is called as a source of electric current or electricity.
- The different sources are the electric cell and battery, the electric mains, the electric generators and the solar cells.

The Electric Cell

- An electric cell is used to operate things such as the clocks, calculators, phones, etc.
- It converts chemical energy into electrical energy.
- There are two types of cells:

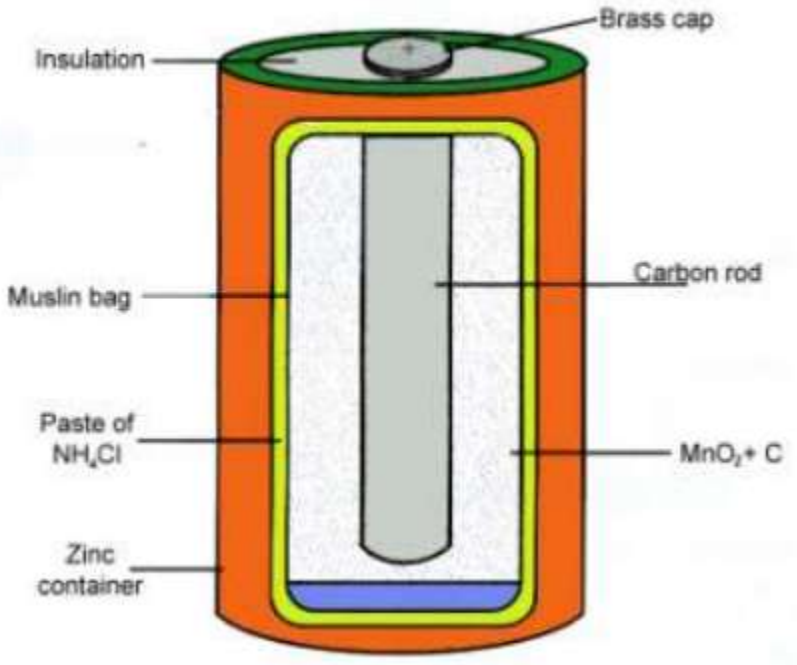
Primary cells
These cells are non-rechargeable cells and they cannot be reused. They provide electricity because of an irreversible chemical reaction. Example: Simple dry cells, Daniel cells, Leclanche cells, mercury cells, etc.

Secondary cells
These cells are rechargeable cells and can be reused. They provide electricity because of a reversible chemical reaction. They are also called as storage cells. Example: Lead cells, nickel-iron cells, nickel-cadmium cells.

Dry Cell

Construction

- It consists of a zinc container with a small brass cap on one side of the cell which is labeled as positive (+) and a metal base at the other side of the cell which is labeled as negative (-).
- The positive and negative sides of the cells are called as positive terminal and negative terminal of the cell respectively.
- A carbon rod is placed at the centre of the cell surrounded by a mixture of manganese dioxide (MnO_2) and charcoal (C) in a muslin bag.
- The electrolyte is a moist paste of ammonium chloride (NH_4CI), plaster of paris, flour, etc. and the outer body (except for the base) of a zinc container is insulated with a thick cardboard or plastic material.



Working

- When the cell is connected to a bulb, the chemical reaction inside the cell becomes fast and the current starts flowing through the bulb. Hence, the bulb glows.
- These dry cells are a small source of electricity.

Advantages of a Dry Cell

1. Dry cells are light in weight and smaller in size.
2. They can be easily transported from one place to another.
3. There is no fear of leakage/spillage in the dry cells.

Electric Current

- An electric current is a flow of electric charge when a voltage is present in a conductor and is measured in ampere.
- When two charged conductors are joined together or brought in contact by a metallic wire, the electrons flow from one conductor to the other.

Flow of Charges Constitutes Current

- When two charged bodies are connected with the help of a conductor, the electrons flow through the conductor from the body with higher concentration of electrons to the body with lower concentration of electrons.
- The flow of electrons takes place from
    1. A negatively charged conductor to a positively charged conductor.
    2. A negatively charged conductor to an uncharged conductor.
    3. An uncharged conductor to a positively charged conductor.
- The flow of electrons constitutes an electric current.
- The direction of current is taken opposite to the direction of movement of electrons.
- If Q is the charge that flows through a conductor in time t, then the strength of the current through the conductor.

$$I = \frac{\text{charge that flows}}{\text{time taken}}$$

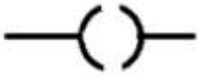
$$I = \frac{Q}{t}$$

- The SI unit of current is ampere (A).

Conductors and Insulators

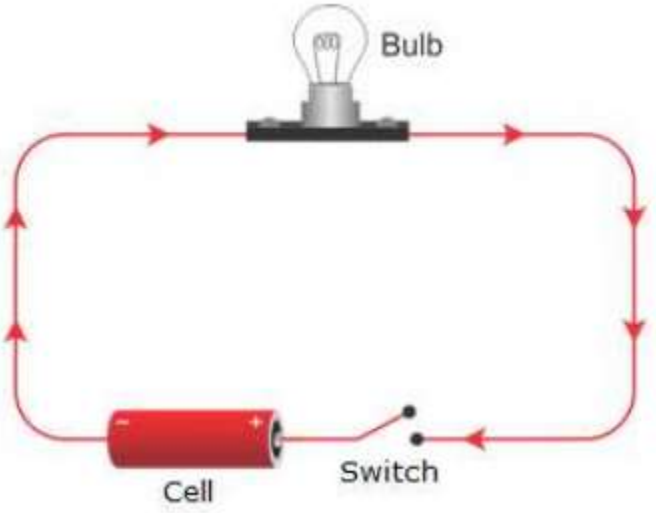
- Materials that allow electricity to pass through them are called as conductors.
- Materials that do not allow electricity to pass through them are called as insulators.
- Water is a good conductor of electricity. However, in its purest form, called as distilled water, it acts as an insulator and is used in batteries.

Electrical Symbols

Sr. No.	Electric Component	Symbol
1.	Electric Cell	
2.	Electric Bulb	
3.	Switch in 'ON' Position	
4.	Switch in 'OFF' Position	
5.	Battery	
6.	Wire	
7.	Resistance	
8.	Key open	
9.	Key closed	

Electric Circuit Diagrams

- An electric circuit consists of a complete path (or paths) for electricity to pass (i.e. current to flow) through.
- The common electric components of an electric circuit are a cell, battery, switch ON, switch OFF and a bulb.



Circuit System

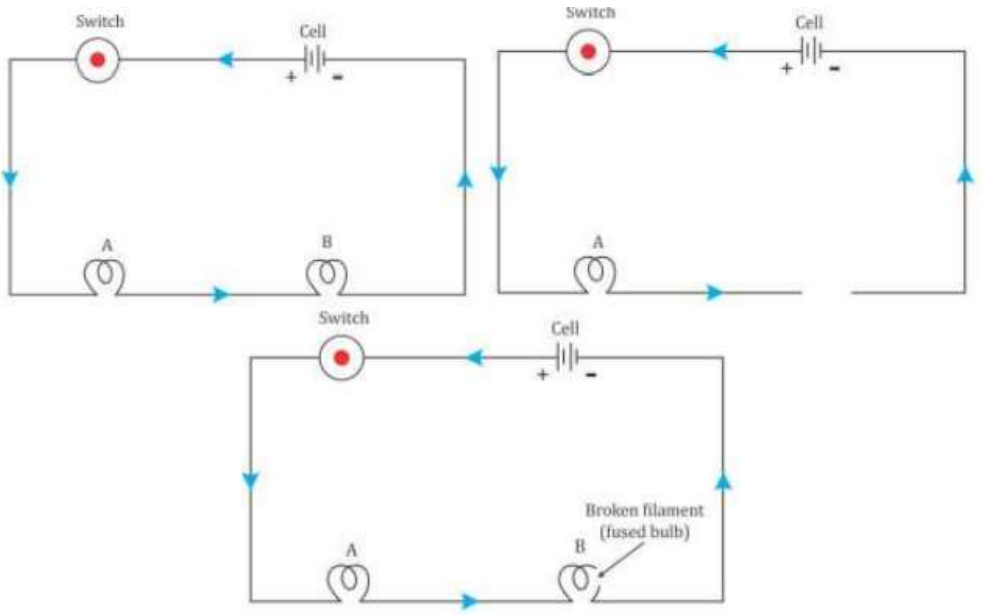
- The two types of circuit systems are
    1. Circuit in series
    2. Circuit in parallel

- In a series circuit, the appliances work simultaneously when the switch is closed and stops working when the switch is open. If any of the appliances goes out of order, then the other appliances also stop working because the circuit stands open at the point where the appliance (which has gone out of order) is installed. Thus, in a series circuit, the appliances in use are dependent upon each other.

- In a parallel circuit, the appliances work independently. So, in our household wiring system, all the circuits are connected in parallel. When an appliance is switched ON, it works on its own without the interruption of the other appliance.

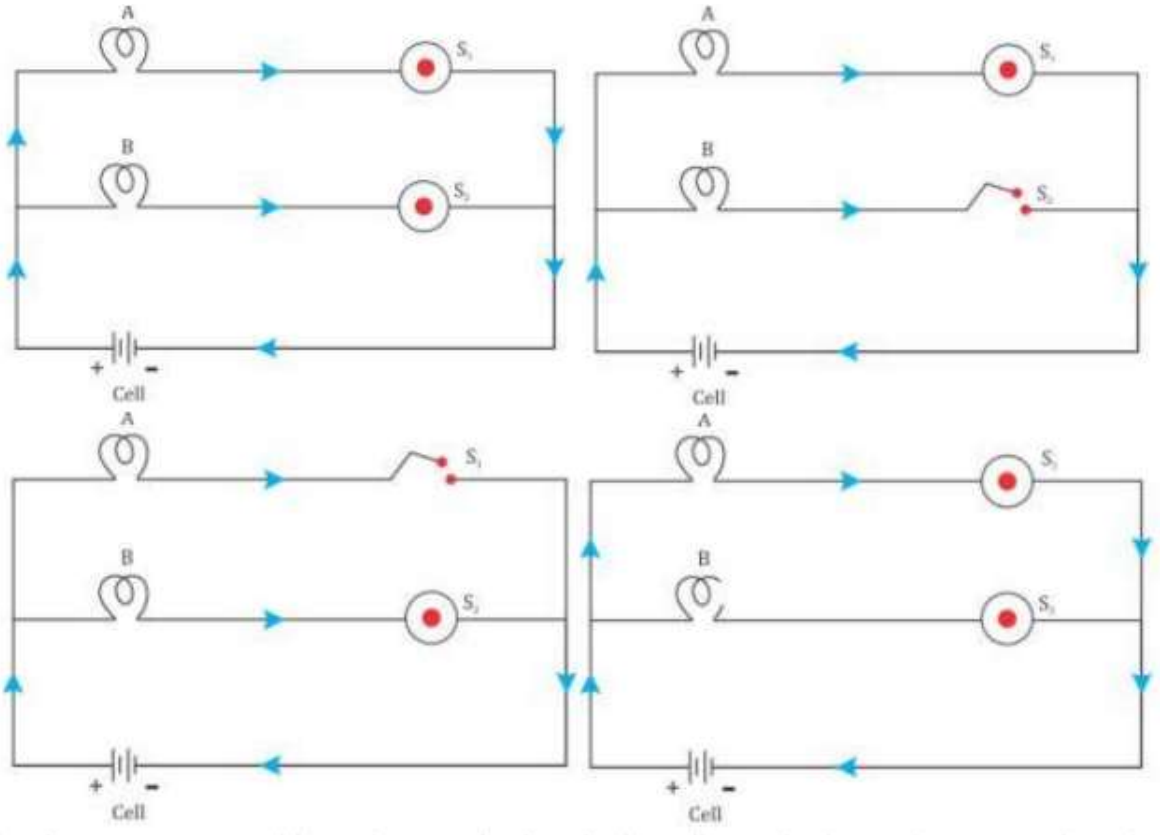
1. Circuit in series

- When the switch is closed (i.e. the circuit is complete), both the bulbs glow.
- If the circuit is incomplete, then bulb A does not glow.
- If the bulb B is replaced by a fused bulb and the switch is closed, then bulb A does not glow because the circuit is incomplete.



2. Circuit in parallel

- The bulbs glow when the switches are closed.
- If switch S1 is closed and switch S2 is open, then bulb A glows and bulb B does not glow.
- If switch S1 is open and switch S2 is closed, then bulb A glows and bulb B does not glow.
- If bulb B is replaced by a fused bulb and both the switches are closed, then only bulb A will glow and the fused bulb B does not glow. But it will not affect bulb A.



- When circuits are connected in series, each electrical appliance is dependent upon the other.
- But when the circuits are connected in parallel, they work on their individual paths.
- That is why, all the electrical appliances in houses, offices, schools, factories, etc. are connected in parallel.