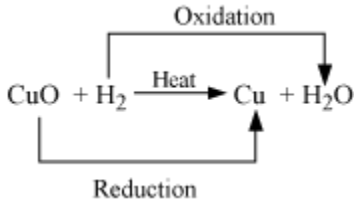
Synopsis – Grade 10 Science Term I

Chapter 1: Chemical Reactions and Equations

- In a chemical reaction, at least one of the following will occur:
  - Change in state
  - Change in colour
  - Evolution of a gas
  - Change in temperature
- **Chemical equation:** A symbolic representation of the reactants, products and their physical states.
- **Balanced chemical equation:** Here, the total number of atoms on the reactant side is equal to the total number of atoms on the product side.
- **How to balance an equation**
  - **Step - I:** Write reactants and products
  - **Step – II:** Balance the max. number of a particular atom on both sides
  - **Step – III:** Balance other atoms
- **Exothermic reactions:** In these types of reactions, heat is released.
- **Endothermic reactions:** In these types of reactions, heat is absorbed.
- **Types of reactions**
  - **Combination reaction:** Here, two or more reactants combine to form one single product. Example: $CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_{2\ (aq)}$
  - **Decomposition reaction:** Here, a single reactant breaks into several simple products. Example: $CaCO_3 \xrightarrow{Heat} CaO + CO_2$
  - **Displacement reaction:** Here, one element replaces another element from a compound and forms a new compound. Example: $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$
  - **Double displacement reaction:** The elements form two compounds which interchange their position. Example: $Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2NaCl$
  - **Oxidation and reduction reactions**
    - **Oxidation:** In this type of reaction, a substance gains oxygen or releases hydrogen. Example: $2Cu + O_2 \xrightarrow{Heat} 2CuO \qquad [\text{Oxidation of Cu}]$
    - **Reduction:** In this type of reaction, a substance gains hydrogen or releases oxygen. Example: $CuO + H_2 \xrightarrow{Heat} Cu + H_2O \qquad [\text{Reduction of CuO}]$
    - **Redox reactions:** Reactions where simultaneous oxidation and reduction reactions take place are called redox reactions. Example:



- **Corrosion** – The process of coating up of a metal by a layer of some other substance due to the presence of some external substances (such as acids and moisture) is called corrosion.
- **Rancidity** – The process of oxidation of fats and oils leading to the change of their taste and smell is called rancidity.

Chapter 2: Acids, Bases and Salts

- **Acids:** These are the substances having sour taste. They turn the colour of blue litmus to red.
- **Base:** These are the substances having bitter taste. They turn the colour of red litmus to blue.
- **Indicator:** It is a dye that gives different colours in acids and/ or bases. Turmeric is a natural indicator.
- **Reaction with metals:**

  Acid + Metals → Salt + Hydrogen gas

  $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

  Base + Metals → Salt + Hydrogen gas

  $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$
- **Reaction of acids with metal carbonates and metal hydrogen carbonates**

  Metal carbonate/ Metal hydrogen carbonate + Acid → Salt + Water + CO_2

  $Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$
- **Metal oxide + Acid**

  Metal oxide + Acid → Salt + Water
- **Non-metal oxide + Base**

  Non-metal oxide + Base → Salt + Water
- **Acid–Base reaction**

  Acid + Base → Salt + Water

  $NaOH + HCl \longrightarrow NaCl + H_2O$
- **In water solution:**

  Acid releases H^+ ion

  $H^+ + H_2O \rightarrow H_3O^+$

  $HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

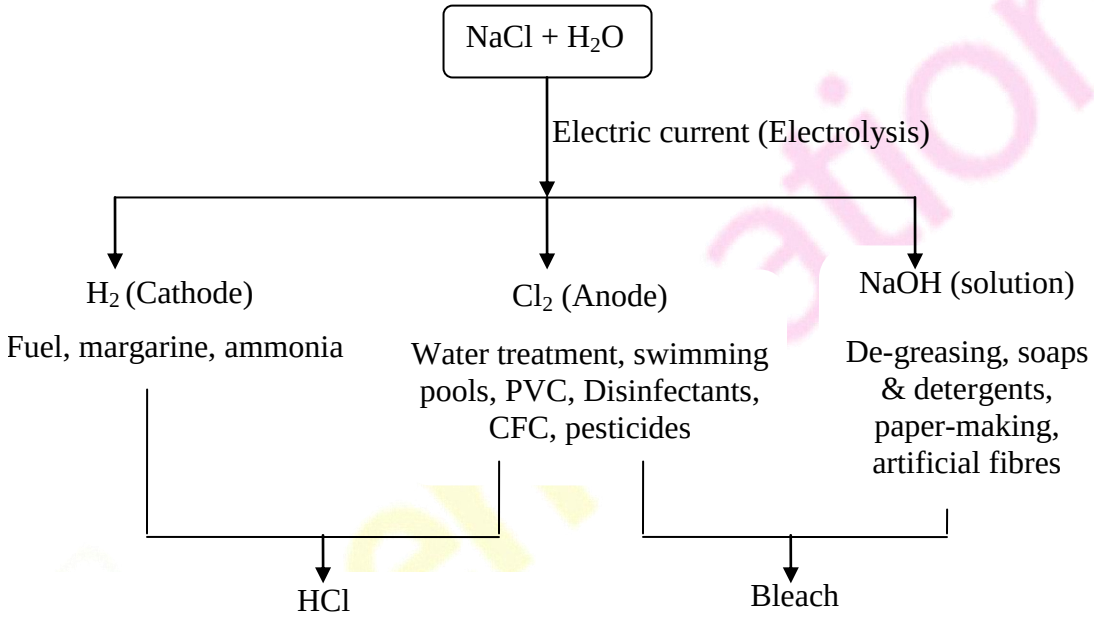
  Base releases OH^- ion

  $NaOH \xrightarrow{H_2O} Na^+ + OH^-$

- Higher H^+ concentration → Strong acid
- Lower H^+ concentration → Weak acid
- Higher OH^- concentration → Strong base

❖ pH → The measure of acidity or alkalinity (Measured on a scale of 0 to 14)
pH 7 → Neutral solution
pH < 7 → Acidic solution
pH > 7 → Basic solution
Human body pH = 7.0 – 7.8
Change in pH in body causes → Tooth decay, stomach pain, burning pain (Honey bee)

❖ **Common salt** (NaCl) **:** Has pH = 7



❖ **Bleaching powder** → $CaOCl_2$ (calcium oxychloride)

- **Preparation:**
  $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$
- **Use:**
  - Bleaching of → cotton in textile industry, → wood pulp, → clothes in laundry
  - Oxidising agent
  - Disinfecting material

❖ **Baking soda** → $NaHCO_3$ (Sodium hydrogen carbonate)

- **Preparation:**

$$NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$$

- **Use:**
  - Making baking powder
  - Ingredient for antacids
  - Soda–acid fire extinguisher

❖ **Washing soda** → $Na_2CO_3.10H_2O$

- **Preparation:**

$$Na_2CO_3 + 10H_2O \longrightarrow Na_2CO_3.H_2O$$

- **Use:**
  - In glass, soap, paper industries
  - Making sodium compounds such as borax
  - As domestic cleaning agent
  - Removing permanent hardness of water

❖ **Plaster of Paris** → $CaSO_4 \cdot \frac{1}{2}H_2O$

- **Preparation:**

$$CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O \longrightarrow \underset{(\text{Gypsum})}{CaSO_4 \cdot 2H_2O} \quad (\text{solid})$$

- **Use:**
  - For making toys
  - For making decorations
  - For setting fractured bones

Chapter 3: Metals and Non-metals

❖ **Metals**

- **Physical properties**
  - Shining surface (in pure state) [called metallic lustre]
  - Generally hard [varies from metal to metal]
  - Malleability [ability to make thin sheets by beating]
  - Ductility [ability to make wire by drawing] [Gold is the most ductile element]
  - Good conductor of heat
  - High melting point
  - Conduct electricity
  - Sonorous [Produce sound]
- **Chemical properties**
  - **Combine with oxygen to form oxides:** Example: $2Cu + O_2 \rightarrow 2CuO$

Soluble metal oxides are called alkali. Na and K react very easily with O_2. So, they are kept immersed in kerosene.

- **Reaction with water:**

  $\text{Metal} + \text{Water} \longrightarrow \text{Metal oxide} + H_2$

  If oxide is soluble, then metal hydroxide is formed.

  $2K + H_2O \rightarrow 2KOH + H_2 + \text{Heat}$

- **Reaction with Acids**

  Metal + Dilute acid → Salt + H_2

  Reactivity: Mg > Al > Zn > Fe > Cu

  Aqua regia: Freshly-prepared concentrated HCl^+ and concentrated HNO_3 in 3:1 ratio

  It can dissolve gold and platinum.

- **Reaction with solutions of other metal salts:** Displacement reactions

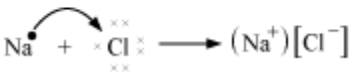
  Reactivity series: K > Na > Ca > Mg > Al > Zn > Fe > Cu > An > Ag

❖ **Non-metals**

- **Physical properties**
  - Do not have lustre
  - Generally, exist in liquid and gaseous states
  - Are neither malleable nor ductile
  - Bad conductors of heat and electricity
  - Are non-sonorous

❖ **Metals + Non-metals**

$$\underset{2,8,1}{Na} \longrightarrow \underset{2,8}{Na^+} + e^- \qquad \underset{2,8,7}{Cl} + e^- \longrightarrow \underset{2,8,8}{Cl^-}$$



❖ **Physical properties of Ionic compounds**

- They are usually found in solid state
- Hard [because of strong attraction force]
- Are usually brittle in nature
- High melting and boiling points
- Soluble in H_2O; insoluble in kerosene, petrol
- Conduct electricity in H_2O solution

❖ **Extraction of metals**

K Na Ca Mg Ac	Zn Fe Cu	Ag An
Highly reactive metals	Medium reactive metals	Found in native form
–	–	
Electrolysis	Carbon reduction	

❖ **Less active metals**

$2HgS + 3O_2 \longrightarrow 2HgO + SO_2$ } Heated in air

❖ **Moderately active metals**

- **Roasting** – Heating of sulphide ore in **excess air**

  $2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$

- **Calcination –** Heating of carbonate ores in **limited air**

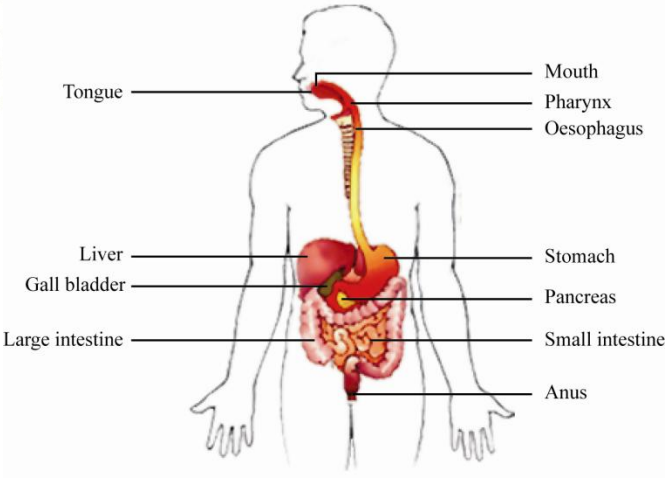
  $ZnCO_3 \longrightarrow ZnO + CO_2$

Chapter 4: Life Processes

❖ **Life processes:** Continuously perform the functions of maintenance in living organisms. Examples: digestion, respiration, circulation etc.

❖ **Nutrition:** Process of obtaining nutrients from the environment**.** Two types- autotrophic and heterotrophic

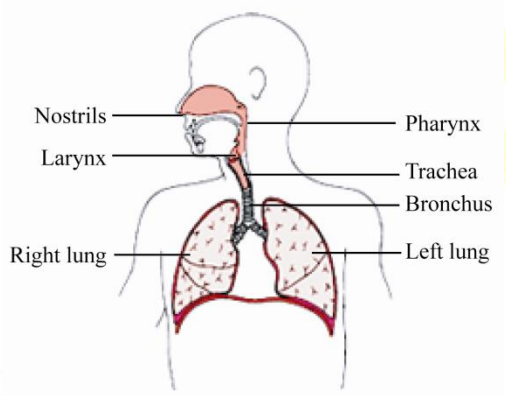
- **Autotrophic nutrition**
  - Synthesis of food by photosynthesis
  - **Photosynthesis equation**: $6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$
  - Two phases of photosynthesis- light and dark reactions
  - Light reaction: light energy absorbed, H_2O split into H_2 and O_2, ATP and $NADPH_2$ synthesized
  - Dark reaction: CO_2 reduced to carbohydrates
- **Heterotrophic nutrition**
  - Generally derive energy from plants and animal sources
  - Mainly of three types: holozoic, parasitic, and saprophytic
  - **Digestion**: mechanical and chemical reduction of ingested nutrients
  - Human digestive system: consists of the long alimentary canal
  - **Parts of alimentary canal**



- Accessory organs: pancreas, liver

❖ **Respiration**

- Enzymatically-controlled energy released from the breakdown of organic substances
- Two types- aerobic and anaerobic
- **Aerobic respiration**
  - Oxidation of food materials with the help of oxygen
  - Yields 36 ATP
  - **First step-** glycolysis (occurs in the cytoplasm), 2 pyruvate molecules produced
  - **Second step-** acetyl CoA produced
  - **Third step-** Kreb's cycle inside the mitochondrial matrix, energy produced
  - **Last step-** energy converted to ATP by ATP synthase enzyme
- **Anaerobic respiration**
  - Oxidation of nutrients without utilizing molecular oxygen
  - Yields 2 ATP
  - **First step-** glycolysis (occurs in the cytoplasm), 2 pyruvate produced
  - **Second step-** break down of pyruvic acid into waste products
- **Human respiration**

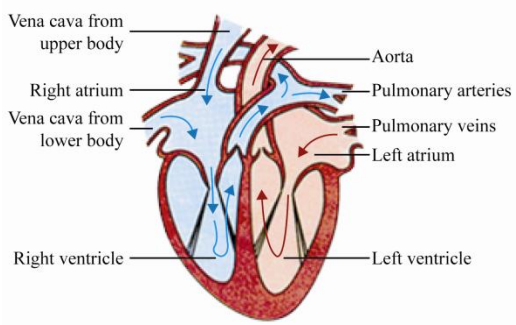


  - Bronchioles divide to form many alveoli
  - Alveoli are sites of gas exchange
  - O_2 present in alveolar blood vessels transported to body cells

❖ **Transportation**

- A liquid medium is required
- **Transportation in humans**
  - Blood, lymph- involved in transportation
  - Components of blood- RBCs, WBCs, platelets, and plasma
  - Two types of blood vessels- arteries and veins
  - Arteries carry oxygenated blood, except pulmonary artery
  - Veins carry deoxygenated blood, except pulmonary vein

- Human heart divided into four chambers – right auricle, right ventricle, left auricle, and left ventricle

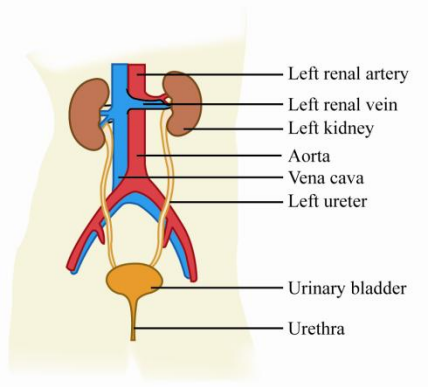


- Right side of the heart receives deoxygenated blood
- Left side of the heart receives oxygenated blood

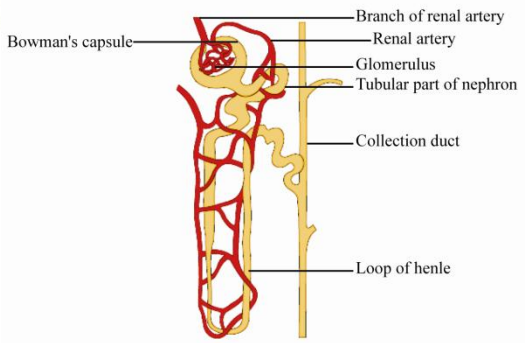
- **Transportation in plants**
  - Transport of water-xylem
  - Transport of food- phloem

❖ **Excretion:** Involves removal of harmful metabolic wastes from the body.

- **Excretion in humans**

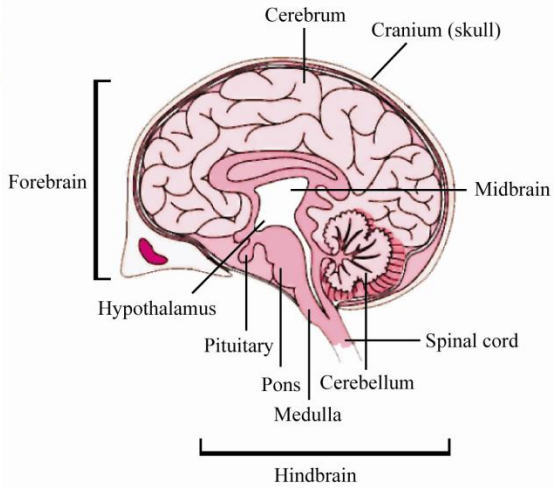


- Nitrogenous wastes such as urea and uric acid are removed
- **Nephron**- basic filtration unit
- Main components of the nephron are: glomerulus, Bowman's capsule, renal tube



Chapter 5: Control and Coordination

- **Control and coordination:** Working together of various integrated body systems in response to changes in the body for maintenance of bodily functions.
  - **Nervous and muscular tissues** provide control and coordination
  - **Neurons** -functional units of the nervous system, conduct messages in the form of impulses
  - **Synapse**- a small gap between the axon of one neuron and the dendrite of the next neuron
  - Three types of responses of the nervous system
  - **Reflex action**
    - Automated action in response to a stimulus
    - Possible due to quick detection by sensory receptors and the resultant movement of muscles
    - Reflex arc situated in the spinal cord
  - **Voluntary action:** Actions such as writing, talking etc. that are under the control of the body.
  - **Involuntary action:** Actions such as breathing, digestion etc. that are not under conscious control
- **Parts of the nervous system**
  - Human nervous system divided into- central nervous system (CNS) and peripheral nervous system (PNS)
  - CNS consists of the brain and spinal cord
  - PNS consists of the nerves that connects the CNS to different parts of the body
  - The Brain, spinal cord, and nerves are the important parts of the nervous system
  - **Brain**



- Human brain is classified into- forebrain, midbrain, and hindbrain
- Forebrain- cerebrum, thalamus, and hypothalamus
- Midbrain
- Hindbrain- pons, medulla, and cerebellum

❖ **Tropic movement**

- Directional movement of a specific part of the plant in response to an external stimulus
- Phototropism- response to light
- Geotropism- response to gravity
- Hydrotropism- response to water
- Chemotropism- response to chemicals
- Thigmotropism- response to touch

❖ **Chemical coordination in plants**

- Growth and development in plants is possible because of growth hormones or phytohormones
- Auxin, Gibberellin, cytokinin, abscisic acid and ethylene are examples of phytohormones

❖ **Chemical coordination in animals**

- Carried out with the help of hormones
- Hormones are secreted by endocrine glands such as the pituitary gland, thyroid gland, adrenal gland, pancreas etc.

Chapter 6: Electricity

❖ **Electric current:** Amount of charge flowing per unit time.

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

I = current

Q = net charge flowing

t = time

❖ **Unit:** I→Ampere $1\text{A} = \frac{1\text{C}}{1\text{s}}$

Q → Coulomb (C)

t = Second (s)

❖ **Potential difference:**

The potential difference between two separate points is defined as the work done to move a unit positive charge from one point to another.

$V = \frac{W}{Q}$

❖ **Unit:** Volt, 1 Volt $= \frac{1 \text{ joule}}{1 \text{ coulomb}}$ $\boxed{1\text{ V} = 1\text{J C}^{-1}}$

❖ **Ohm's law:**
Under constant physical conditions (i.e., constant temperature, pressure etc.), the current flowing through a conductor is directly proportional to the potential difference across the conductor.

- Current ∝ potential difference ($V \propto I$)
  $V = IR$ Where, R = resistance
- Unit of resistance (R) → Ω (Ohm)
  $1\Omega = \frac{1\text{V}}{1\text{A}}$

❖ **Factors on which resistance depends**

- $R \propto l$, when area of cross-section and material are constant l = length
- $R \propto A$, when l and material are constant A = perpendicular cross-section
- Overall, $R \propto \frac{l}{A}$
- Or, $R = \rho\frac{l}{A}$, where ρ is resistivity which is different for different material
- Resistivity of a substance is equal to the resistance of a unit square of that substance.
- Unit (ρ) →Ω. m

❖ Net resistance of resistors in series connection
$R_{net} = R_1 + R_2 + R_3 + \ldots + R_n$

❖ Net resistance of resistors in parallel
$\frac{1}{R_{net}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}$

❖ Heating Effect of current, heat produced depends on:

- Potential difference (V)
- Electric current (I)
- Time for which current passes (t)
- Electric energy = VIt
- It can be written as: E = $I^2Rt = \frac{V^2}{R}t$
- Unit – 1 kWh = 3.6×10^6 J

❖ **Application:** Electric iron, toaster, fused wire

Fuse wire: a low-melting point wire connected in series with electric devices for safety.

❖ Electric power: $P = VI = I^2R = \frac{V^2}{R}$

- Unit: 1 W = 1V × 1A

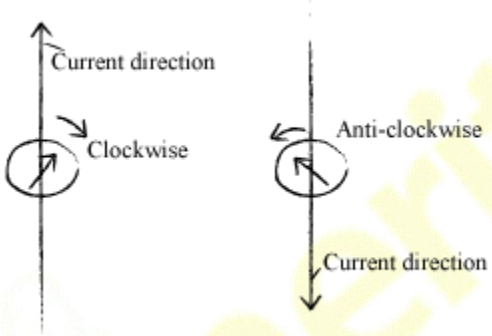
Chapter 7: Magnetic Effects of Current

❖ **Properties of magnetic field lines**

- Originate from the North pole and end at the South pole [outside the magnet]
- They are closed continuous lines
- Density of the lines increases near the poles and decreases away from the poles
- Lines never cross each other

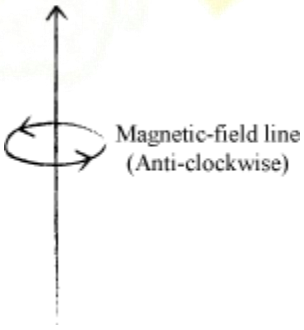
❖ **Magnetic field lines of current carrying wire**

- It is circular with axis as the wire.
- Varies with distance from wire. (Inversely proportional)
- Direction depends on direction of current.
- Deflection of compass near a conductor (Shown by arrow):



❖ **Right-hand thumb rule:**

When thumb is in direction of current, the curl of fingers gives direction of circular magnetic field.

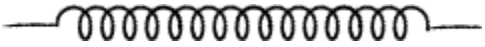


❖ **Corkscrew rule**

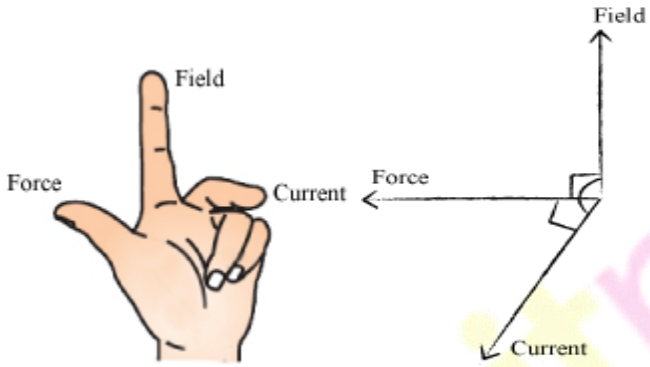
If one drives a corkscrew in the direction of the current, then the direction in which the handle is turned is the direction of the magnetic field on the magnetic field lines.

❖ **Solenoid**

Solenoid is a cylindrical coil having many turns of insulated wires wrapped closely. When current is passed through the coil, a magnetic field is produced along the axis of the coil.



❖ Direction of force on a current carrying conductor in a magnetic field can be given by **Fleming's left-hand rule**.



❖ **Application of magnetic force – Electric motor**

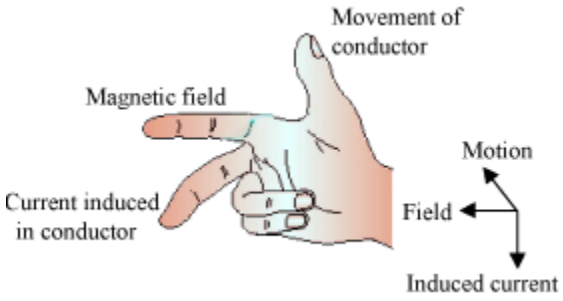
When current is passed through a coil kept in a magnetic field, a force acts on it which rotates the electric motor.

❖ **Electromagnetic Induction**

Generation of a current in the conductor due to a varying magnetic field (moving magnet, or moving conductor)

- Application – AC/DC generator

❖ Direction of induced current in a conductor moving in a magnetic fierld can be given by **Fleming's right hand rule**.



Chapter 8: Sources of Energy

- **Qualities of a good fuel/source of energy are:**
  - That would do a large amount of work per unit volume or mass
  - Easily accessible
  - Easy to store and transport
  - Economical

- **Factors to be considered for choosing fuel are:**
  - How much heat it produces
  - Less smoke generation
  - Easy availability

- **Conventional sources of energy:**
  - Fossil fuels – Coal, petroleum and natural gas
  - **Advantages**
    - Easy availability
    - Generate heat that is easily converted into electricity
  - **Disadvantages**
    - Non-renewable
    - Limited reserve
    - Cause air pollution
- **Non-conventional sources of energy**
  - Solar energy – Solar cooker, solar water heater (very efficient for small scale electricity production)
  - Tidal energy, wave energy, ocean thermal energy
  - Geothermal energy – Heat energy inside the earth
  - Wind energy
  - Nuclear energy – Not dependent on solar energy, never-ending source, very efficient source, more environment friendly
- **Thermal power plant –** Coal and petroleum are burned to produce heat
- **Hydro power plant –** (Renewable source)
  - Problems – Limited places for construction (only Hilly areas)
- **Technological improvement**
  - Bio-mass – Charcoal, cow-dung, vegetable waste, sewage
  - Wind energy – Environment friendly, renewable