Electrolysis

- Flow of electrons through a conductor is called electric current. The substances which do not allow the electric current to pass through them are called **insulators**.
- **An ionic compound or electrovalent compound** is formed when electropositive atoms donate electrons and electronegative atoms accept them.
- **Electrolysis** is the process due to which a chemical compound in fused state or in aqueous solution undergoes a chemical change on passing the current through it.
- The graphite or metal rods through which electric current enters or leaves from an electrolyte are called **electrodes**.
- Cathode is the electrode, which is connected to negative terminal of the battery. It has an excess of electrons.
- Anode is the electrode, which is connected to positive terminal of the battery. It has a deficiency of electrons.
- **Electrolytes** refer to the compound which in fused state or in aqueous state conducts electric current.
- **Non-electrolyte** is the chemical compound which does not conduct electric current in a fused state or in an aqueous solution.
- When a chemical compound in a fused state or in an aqueous solution breaks up into electrically charged atoms or group of atoms, the charged particles are called **ions**.
- A positively charged ion is a cation. They migrate towards the cathode.
- A negatively charged ion is an anion. They migrate towards anode.

Characteristics of electrolysis

- On passing the electric current, cations migrate towards cathode while the anions migrate towards anode.

- The number of electrons accepted by an anode is equal to the number of electrons donated by cathode.
- The products of electrolysis are formed on the surface of the cathode where an exchange of electrons occurs.
- The preferential discharge of ions depends upon their position in electrochemical series and the concentration of ions.
- Neutral atoms of metals and hydrogen are liberated at cathode. Therefore, they are called electropositive elements. Neutral atoms of non-metals are liberated at anode. Therefore, they are called electronegative elements.
- According to Faraday's law of electrolysis, the mass of a substance discharged at an electrode is directly proportional to the quantitiy of electricity passing through the electrolyte.
- Direct current is suitable to carry out electrolysis.
- Electrolysis is a redox reaction, where reduction occurs at cathode and oxidation occurs at anode.

- Depending on the ease with which metals lose or gain electrons to form ion, they are arranged in a vertical column called **electrochemical series.**

- Depending on the ease with which elements lose electrons to form ions, they are arranged in a vertical column called electropositive series.
- **Selective discharge of ions** refers to preferential discharge of one particular cation at cathode and one particular anion at anode when a solution contains two or more anions or cations.

Electrolysis of lead bromide requires:

- **Electrolytic cell**: Silica crucible containing fused lead bromide and graphite electrodes are used.

- **Electrolyte:** Molten fused lead bromide is used.

- **Electrodes:** Inert electrodes are used. Graphite is used as cathode as well as anode.

- **Temperature:** A temperature of 380ºC or above is maintained.

- Lead metal is formed at cathode, which settles down at base of crucible.
- Bromine vapours are formed at anode.

Electrolysis of acidulated water

- **Electrolytic cell**: Hofmann's voltameter is used.
- **Electrolyte:** Distilled water containing 2% sulphuric acid is used.
- **Electrodes:** Inert electrodes are used. Platinum strip is used as cathode as well as anode.
- **Temperature:** The electrolysis is carried out at room temperature.
- Hydrogen atoms are formed at cathode and oxygen gas is liberated at anode.

Electrolysis of aqueous acidulated copper sulphate solution

- **Electrolytic cell**: A glass container is used.
- **Electrolyte:** Copper sulphate solution acidified with sulphuric acid is used.
- **Electrodes:** Inert electrodes are used. Copper plate or copper rod is used as cathode and anode.
- **Temperature:** The electrolysis is carried out at room temperature.
- Copper metal is formed at cathode. The concentration of Cu^{2+} ions does not change. It is because number of ions deposited at cathode is equal to number of copper atoms, which ionise at anode.

Electrolysis is used for following purposes:

- Electroplating
- Electro-refining
- Extraction of metals by electrolysis
- The process of depositing a thin and compact layer of superior metal over the inferior metal by process of electrolysis is called **electroplating.**

- **In silver plating,** the electrolyte used is the saturated aqueous solution of sodium argento cyanide acidified with hydrocyanic acid. A highly cleaned article is used as a cathode while a hollow cylinder of silver surrounding cathode is used as an anode.

- **In nickel plating**, the electrolyte used is the saturated aqueous solution of nickel sulphate acidified with sulphuric acid. A highly cleaned article is used as a cathode while a hollow cylinder of nickel surrounding cathode is used as an anode.

- **Electro-refining** is the process by which impurities are removed from an impure metal. Metals such as silver, copper are refined using electro-refining.

- In electro-refining of copper**,** the electrolyte used is the saturated aqueous solution of copper sulphate acidified with sulphuric acid. Pure copper thin sheets connected in parallel are used as a cathode while impure copper thin sheets connected in parallel are used as an anode.

- **Electro-metallurgy** refers to the process of extraction of metals from their fused ores by the process of electrolysis.
- Fused KBr, NaCl and $MgCl_2$ are used as the electrolyte for the extraction of K, Na and Mg respectively.

- Arrhenius concept of acids and bases
    - Strong acids and bases completely dissociate in aqueous solutions producing H_3O^+ and OH^- ions, respectively
- Bronsted-Lowry concept of acids and bases
    - Based on conjugate pairs of acids and bases
    - Strong acid or base has weak conjugate base or acid
- Strong and weak electrolytes
    - Strong electrolytes ionise in wate completely
    - Weak electrolytes undergo partial ionisation in water
- Degree of dissociation
    - Extent to which an electrolyte dissociates in a solvent
    - Depends on the following factors:
        - Nature of solvent and electrolyte
        - Dilution
        - Temperature
- The pH scale
    - $pH = -\log [H^+]$
    - $pK_w = pH + pOH = 14$

- For acidic solution, $pH < 7$
- For basic solution, $pH > 7$
- For neutral solution, $pH = 7$