Study of Acids, Bases and Salts

- Acid is a substance which dissolves in water to furnish ions as only positively charged ions.
- Basicity of the acid refers to the number of hydrogen ions furnished by one or more molecule of an acid, on dissolving in water.
- Organic acids are obtained from plants or the animals. Examples are acetic acid, ascorbic acid.
- Inorganic acids are obtained from minerals present in earth. Examples are sulphuric acid, carbonic acid.
- Strong acids are the acids in which more than 30% of the molecules ionize in water to furnish ions.
- Weak acids are the acids in which less than 30% of the molecules ionize in water to furnish ions.
- The acids are prepared by
    - Dissolving oxides of non-metal in water
    - Reaction of sulphuric acid with salts
    - Direct combination of hydrogen and halogens
    - Oxidation of non-metals
- They are sour tasting liquids, with pH less than 7 and good conductors of electricity.
- Acids turn blue litmus red, methyl orange solution pink.
- Metals like zinc, magnesium react with acids to form metal salt and hydrogen.
- All dilute mineral acids react with metallic hydroxides, sulphites, sulphides, chlorides, nitrates and carbonates to form their respective metallic salts.
- Acids react with metal oxides to produce metal salt and water.
- They react with bases in neutralisation reaction and form salt and water.

- Bases are the substances which react with acids to form salt and water.
- All bases which are soluble in water are called alkalis.
- The oxides and hydroxide of sodium and potassium are strong bases while the oxides and hydroxide of all other metals are weak bases.
- Bases are prepared by

    - Direct combination of metals like sodium, magnesium with oxygen
    - Reaction of metallic oxides with water
    - Double decomposition of salts with alkalis
    - Reaction of oxygen with metal sulphides
    - Decomposition of metal carbonates and nitrates
- The alkalis are prepared by dissolving basic oxides of calcium, magnesium etc in water.
- All bases/ alkalis have bitter taste and soapy touch.
- All bases/ alkalis produce blisters on coming in contact with skin.
- All bases/ alkalis turn red litmus blue, methyl orange solution from pink to yellow.
- They react with acids to form salt and water in neutralisation reaction.
- They absorb carbon dioxide from the air to form carbonates.
- They react with heavy metals to form insoluble metal hydroxides.
- Bases react with non-metal oxides to produce salt and water.
- Alkalis release ammonia gas on reaction with ammonium salts.

- Higher H^+ concentration → Strong acid
- Lower H^+ concentration →Weak acid
- Higher the OH^- concentration → Stronger the base
- **pH Measure**
- pH → Measure of acidity →Measure H^+ concentration on the scale (0 – 14)
- pH 7 → Neutral solution
- pH < 7 → Acidic solution
- pH > 7 → Basic solution
- **Salts' pH = 7**

- Human body pH = 7.0 – 7.8

- Change in pH in body causes → Tooth decay, stomach pain, burning pain (Honey bee sting)
- Plants and animals are sensitive to pH change
- Self defence by animals and plants through chemical wefare

Salts
They are prepared by the process of neutalisation reactions.
Properties

- They conduct electricity in the aqueous and molten state.
- They are non-volatile
- Most of the salts are soluble in water.

Preparation of soluble salts

- Direct Combination Method: by heating two elements together
- Simple Displacement Method: When active metals are reacted with dilute acids
- Decomposition by Acids Method: Decompostion of various elements by acids
- Neutralisation Method: reaction of an acid with a base
- Action of Alkali on some metals, their oxides and their hydroxides

Preparation of Insoluble Salts

- Direct Combination Method

$$Pb + S \xrightarrow{\Delta} PbS$$

- Acidic Oxide-Basic Oxide Combination Method

$$CO_2 + CaO \xrightarrow{\Delta} CaCO_3$$

- Double Decomposition (Precipitation Reaction) Method

$$AgNO_3 + HCl \rightarrow AgCl\downarrow + HNO_3$$

$$PbO + 2\ HNO_3 \xrightarrow[-H_2O]{} Pb(NO_3)_2 \xrightarrow{H_2SO_4} PbSO_4\downarrow + 2\ HNO_3$$

Laboratory preparation of some salts:

- When dried chlorine gas is passed over heated iron, it forms anhydrous iron (III) chloride.

- Copper sulphate is prepared in the reaction that takes place between copper oxide and dilute sulphuric acid.
- Iron (II) sulphate is prepared in the displacement reaction that takes place between iron metal and dilute sulphuric acid.
- Sodium carbonate is obtained by passing carbon dioxide gas into a cold solution of sodium carbonate.
- Sodium sulphate is prepared by the neutralisation of sodium hydroxide base with dilute sulphuric acid.
- Zinc Sulphate is prepared by the action of dil. sulphuric acid on zinc.
- When dil. hydrochloric acid or sodium chloride is added to the solution of lead nitrate, lead chloride is formed.
- Sodium carbonate is obtained by passing carbon dioxide gas into a cold solution of sodium carbonate.

- **Water of crystallisation :** It refers to a fixed number of water molecules present in one formula unit of salt.
- **Example -** In gypsum, the water of crystallisation is 2.

$$CaSO_4.\frac{1}{2}H_2O + 1\frac{1}{2}H_2O \rightarrow CaSO_4.2H_2O \ (solid)$$

(Gypsum)

- **Hydrated substances:** Substances containing water of crystallisation for example, hydrated copper sulphate ($CuSO_4.5H_2O$).
- **Anhydrous substances:** Substances either not containing water of crystallisation or from which water of crystallisation is removed, for example, sodium chloride (NaCl) and anhydrous copper sulphate ($CuSO_4$).
- **Drying agents:** Substances that absorb moisture without undergoing a chemical reaction, for example, anhydrous calcium chloride ($CaCl_2$).
- **Dehydrating agents:** Substances the remove chemically bonded water from a compound, for example, concentrated sulphuric acid (H_2SO_4).

Deliquescence

1. Substances which absorb water or moisture when exposed to the atmosphere at ordinary temperatures are called deliquescent substances and the phenomenon is known as deliquescence.

2. Solid sodium/potassium hydroxide, calcium chloride are examples of deliquescent substances.

3. Substances which are used to dry the surroundings by removing moisture from the air are called desiccants.

4. Concentrated sulphuric acid and calcium chloride are some examples of desiccants.

Efflorescence

1. Some substances, when exposed to the atmosphere, lose their water of hydration and become dry. These substances are called efflorescent substances and the phenomenon is known as efflorescence.

2. Sodium sulphate and sodium carbonate are examples of efflorescent substances.

Hygroscopy

1. Phenomenon of absorption of moisture from air upon exposure is known as hygroscopy. The substances showing this phenomenon are known as hygroscopic substances.

2. Phosphorous pentoxide (P_2O_5) and quicklime (CaO) are examples of hygroscopic substances.