🧪 Chapter 2: Acids, Bases and Salts

📌 Introduction:

This chapter focuses on acids and bases, their properties, reactions, the pH scale, and the importance of salts in daily life.

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🔹 2.1 ACIDS AND BASES

🔸 Definition:

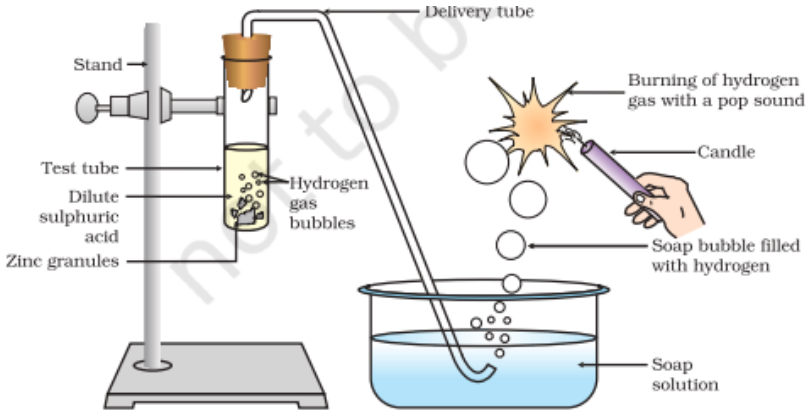
- **Acid:** A substance that produces H+ ions in aqueous solution. Example: HCl, H2SO4.
- **Base**: A substance that produces OH− ions in aqueous solution. Example: NaOH, KOH.

🔸 Indicators:

Indicators are substances used to test whether a solution is acidic or basic. They show a color change based on the nature of the solution.

🧪 Common indicators:

- **Litmus:** Red in acid, blue in base.
- **Phenolphthalein:** Colourless in acid, pink in base.
- **Methyl orange:** Red in acid, yellow in base.
- **Olfactory indicators:** Substances whose smell changes in acidic or basic media, e.g., onion, clove oil, vanilla.



📷 *Fig. 2.1 – Reaction of zinc with acid producing hydrogen gas (Activity 2.3).*

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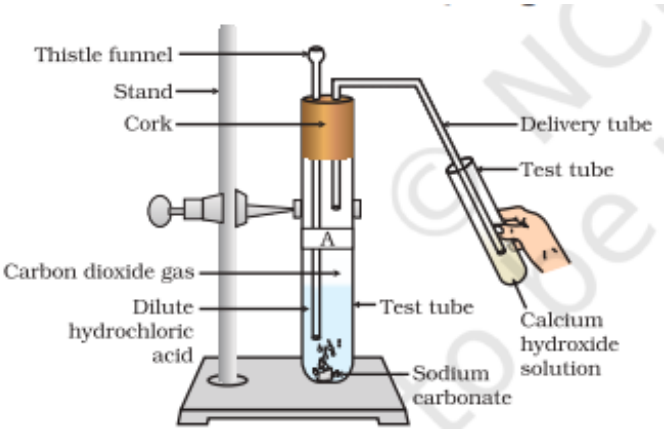
🔸 Reactions of Acids and Bases

1. 🧪 **Acid + Metal → Salt + Hydrogen Gas**
   Example: Zn + H2SO4 → ZnSO4 + H2↑
   (See Fig. 2.1)
2. 🧪 **Base + Metal → Salt + Hydrogen Gas**
   Example: Zn + 2NaOH → Na2ZnO2 + H2↑ (Sodium zincate)

3. 🧪 **Acid + Metal Carbonate/Hydrogencarbonate → Salt + CO2 + H2O**
   Example: Na2CO3 + HCl → NaCl + CO2↑ + H2O



📷 *Fig. 2.2 – Passing CO2 through lime water forms white precipitate of CaCO3.*

1. 🧪 **Acid + Base → Salt + Water**
   This is called a Neutralisation reaction.
   Example: NaOH + HCl → NaCl + H2O
2. 🧪 **Acid + Metal Oxide → Salt + Water**
   Example: CuO + HCl → CuCl2 + H2O
   (Metal oxides are basic in nature)
3. 🧪 **Base + Non-metallic Oxide → Salt + Water**
   Example: Ca(OH)2 + CO2 → CaCO3 + H2O
   (Non-metallic oxides like CO2 are acidic)

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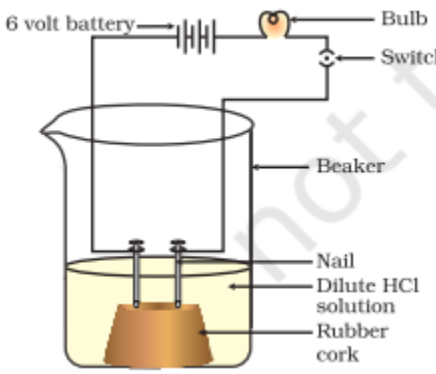
🔸 2.2 WHAT DO ALL ACIDS AND BASES HAVE IN COMMON?

- Acids in aqueous solution release H+ ions.
- Bases in aqueous solution release OH− ions.
- Example: HCl conducts electricity (contains ions) whereas alcohol/glucose do not (they lack free ions).



📷 *Fig. 2.3 – Electricity conduction setup using acid solution.*

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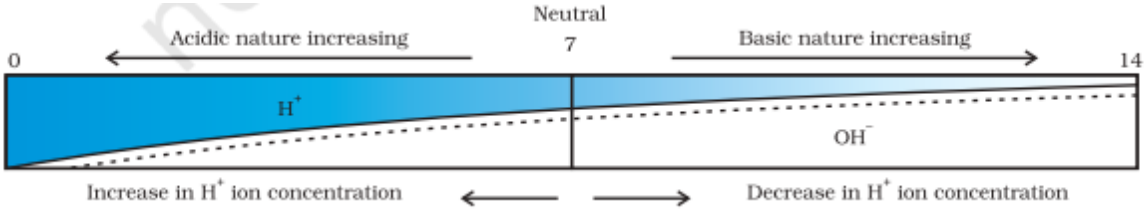
🔹 2.3 HOW STRONG ARE ACID OR BASE SOLUTIONS?

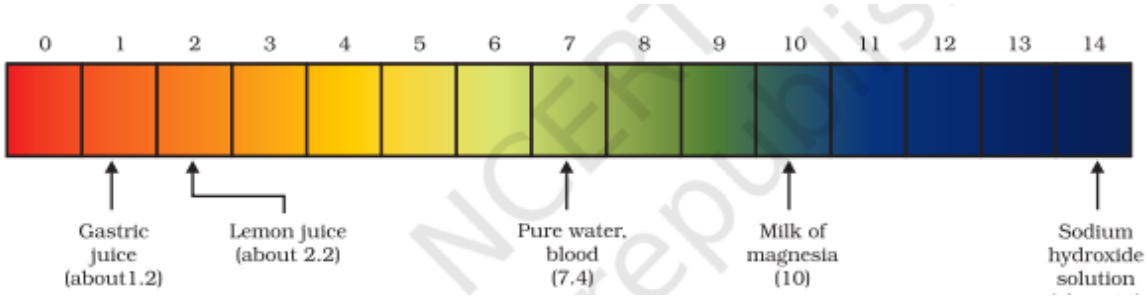
🔸 pH Scale:

The pH scale measures the concentration of hydrogen ions (H+) in a solution.

- pH < 7: Acidic
- pH = 7: Neutral
- pH > 7: Basic



📷 *Fig. 2.6 – pH scale representation*



📷 *Fig. 2.7 – pH of common substances*

💡 **Universal Indicator:** A mixture of dyes that shows different colors at different pH levels.

🧪 **Activity 2.11** – Testing pH of various substances using universal indicator.

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🔸 Importance of pH in Everyday Life

1. 🧬 Human body works best at pH 7.0–7.8.
2. 🌧️ Acid rain: Rain with pH < 5.6 harms aquatic life.
3. 🦷 Tooth decay occurs below pH 5.5.
4. 🧪 Antacids like milk of magnesia (Mg(OH)2) neutralise stomach acid.
5. 🪴 Soil pH affects plant growth.

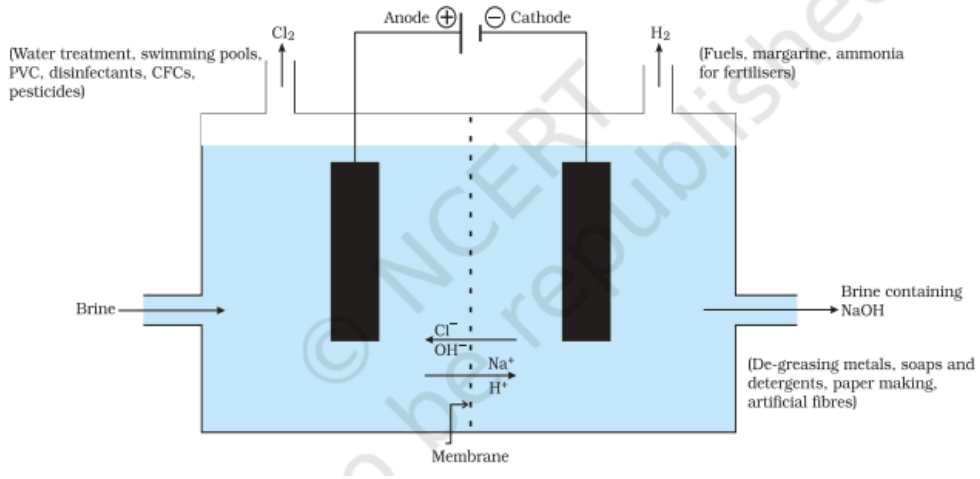

Fig. 2.8 – Use of salt products from chlor-alkali process.

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🔹 2.4 SALTS

🔸 Definition:

Salt is a compound formed when an acid reacts with a base. It contains the positive ion of a base and the negative ion of an acid.

🔸 Types of Salts (based on pH):

- Neutral Salt: pH = 7 (Strong acid + Strong base)
- Acidic Salt: pH < 7 (Strong acid + Weak base)
- Basic Salt: pH > 7 (Weak acid + Strong base)

🧪 **Activity 2.14** – Testing salts with universal indicator.

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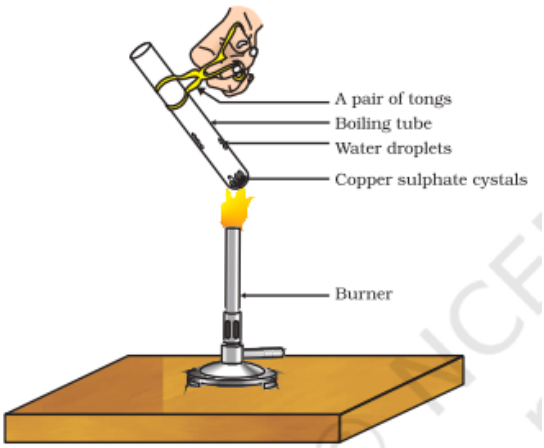
🔸 Chemicals from Common Salt

1. 🧪 **Sodium Hydroxide (NaOH)**
   Formed by electrolysis of brine in the chlor-alkali process:
   $2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$
   (Uses: soap, detergents, paper industry)
2. 🧪 **Bleaching Powder ($CaOCl_2$)**
   Produced by reaction of chlorine with slaked lime:
   $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$
   (Uses: disinfection, bleaching, oxidising agent)
3. 🧪 **Baking Soda ($NaHCO_3$)**
   $NaCl + H_2O + CO_2 + NH_3 \rightarrow NH_4Cl + NaHCO_3$
   (Uses: baking powder, antacid, fire extinguisher)
4. 🧪 **Washing Soda ($Na_2CO_3 \cdot 10H_2O$)**
   Produced by heating baking soda and recrystallising:
   (Uses: glass, paper industry, water softening)
5. 🧪 **Plaster of Paris ($CaSO_4 \cdot \frac{1}{2}H_2O$)**
   Obtained by heating gypsum ($CaSO_4 \cdot 2H_2O$) at 373 K.

On mixing with water, it sets to form hard gypsum.



📷 *Fig. 2.9 – Heating copper sulphate to remove water of crystallisation*

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🔸 Definitions Recap

- **Water of Crystallisation:** Fixed number of water molecules in a salt (e.g., $CuSO_4 \cdot 5H_2O$).
- **Neutralisation**: Reaction of acid and base to form salt and water.
- **Indicator:** Substance that changes color in presence of acid/base.
- **pH:** Scale to measure acidity or basicity of a solution (0–14).
- **Strong Acid:** Produces more H^+ (e.g., HCl)
- **Weak Acid:** Produces fewer H^+ (e.g., CH_3COOH)