# Acids, Bases and Salts

## Introduction

In chemistry, substances are classified as **acids, bases, and salts** based on their behavior in aqueous solutions. These substances are widely used in daily life, industries, medicines, and agriculture.

## ACIDS

Acids are substances that **produce $H^+$ ions (hydrogen ions)** in aqueous solution.

**General Properties:**

Sour in taste
Turn blue litmus red
Conduct electricity
Corrosive in nature

**Examples**:

HCl (Hydrochloric acid)
$H_2SO_4$ (Sulphuric acid)
$HNO_3$ (Nitric acid)
$CH_3COOH$ (Acetic acid)



## Bases and Alkalis

Bases produce **$OH^-$ ions** in aqueous solution.
Bases that are **soluble in water** are called alkalis.

**General Properties:**

Bitter in taste
Soapy/slippery feel
Turn red litmus blue
Conduct electricity

**Examples**:

NaOH (Sodium hydroxide)
KOH (Potassium hydroxide)
$Ca(OH)_2$ (Calcium hydroxide)

## Indicators

Indicators are substances that **change color** in acidic or basic solutions.

**Types:**

1. **Natural Indicators**

Litmus
Turmeric

2. **Synthetic Indicators**

Phenolphthalein → Colorless (acid), Pink (base)
Methyl orange → Red (acid), Yellow (base)

3. **Olfactory Indicators**

Substances whose **smell changes** in acidic or basic medium.

Onion
Vanilla
Clove oil

## Chemical Nature of Acids and Bases

Acids produce **$H^+$ ions only in aqueous solution**
Bases produce **$OH^-$ ions in aqueous solution**

**Dry HCl gas does not show acidic behavior without water.**

Q. Why Do Acids and Bases Conduct Electricity?

Ans- Because they produce **free ions** in water, which carry electric current.

## Chemical Reactions of Acids

1. **With Metals:**
Acid + Metal → Salt + Hydrogen gas
Example:
$Zn + 2HCl \rightarrow ZnCl_2 + H_2\uparrow$

2. **With Metal Carbonates:**
Acid + Carbonate → Salt + $CO_2$ + Water

Example:
$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

3. **With Metal Bicarbonates:**
Acid + Bicarbonate → Salt + $CO_2$ + Water

Example:
$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

## Chemical Reactions of Bases

1. **With Metals:**
Generally metal do not react with base because metal are basic in nature

Base + Metal → Salt + Hydrogen

Example:
$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2$

## Neutralisation:

Acid + Base → Salt + Water

Example:
$NaOH + HCl \rightarrow NaCl + H_2O$

**This reaction is exothermic**

**Oxides**

| Metal Oxides | Non-metal Oxides |
|---|---|
| • Basic in nature<br>• React with acids<br>• Example:<br>$CuO + HCl \rightarrow CuCl_2 + H_2O$ | • Acidic in nature<br>• React with bases<br>• Example:<br>$CO_2 + Ca(OH)_2 \rightarrow CaCO_3$ |

## Dilution

Adding water to acid or base to decrease its concentration.

- Always add **acid to water**, not water to acid (for safety).
- It is an **exothermic process**.

## Strength of Acids and Bases (pH Scale)



**pH Scale:**

- Range: 0 to 14

| $p^H$ Value | Nature |
|---|---|
| < 7 | Acidic |
| = 7 | Neutral |
| > 7 | Basic |

**Examples:**

- pH 1–3 → Strong acids
- pH 4–6 → Weak acids
- pH 7 → Neutral (water)
- pH 8–10 → Weak bases
- pH 11–14 → Strong bases

## Strong vs Weak Acids/Bases

**Strong Acid:**

- Completely ionize in water
- Examples: HCl, $H_2SO_4$

**Weak Acid:**

- Partially ionize
- Example: $CH_3COOH$

**Strong Base:**
Example:NaOH, KOH

**Weak Base:**
Example:$NH_4OH$

## Importance of pH in Everyday Life

**1. Digestive System:**

- Stomach contains HCl
- Too much acid → indigestion
- Treated with antacids

**2. Tooth Decay:**

- Starts below pH 5.5
- Toothpaste is basic to neutralize acid

**3. Soil Treatment:**

- Acidic soil → treated with quicklime/slaked lime
- Basic soil → treated with organic matter

**4. pH of Water Bodies:**

- Sudden pH change harms aquatic life

**5. Acid Rain:**

- pH < 5.6
- Damages plants, buildings, and water life



## Salts

Salts are formed from **neutralisation reactions**.
Types:
Neutral salts → NaCl
Acidic salts → $NH_4Cl$
Basic salts → $Na_2CO_3$

## Chemicals from Common Salt (NaCl)

**1. Sodium Hydroxide (NaOH)**

Prepared by **Chlor-alkali process**

**Chlor-Alkali Process**
Electrolysis of NaCl solution produces:

- NaOH
- $Cl_2$ gas
- $H_2$ gas

**2. Bleaching Powder ($CaOCl_2$)**
Preparation:
$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

Uses:

- Disinfecting water
- Bleaching cotton and linen

**3. Baking Soda ($NaHCO_3$)**
Uses:

- Baking (makes cakes fluffy)
- Antacid

Reaction on heating:
$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

**4. Washing Soda ($Na_2CO_3 \cdot 10H_2O$)**
Uses:

- Cleaning agent
- Softening hard water
- Glass and soap manufacturing

**5. Plaster of Paris (POP)**

Formula: $CaSO_4 \cdot \frac{1}{2}H_2O$

Preparation: Heating gypsum

Uses:

- Making toys
- Plaster casts
- Decoration

## Water of Crystallisation

Fixed number of water molecules in a salt crystal.

Example: $CuSO_4 \cdot 5H_2O$