

KARACHI EDU • CHEMISTRY CLASS X • CHAPTER 2

# Acids, Bases, and Salts

Comprehensive coaching notes covering Arrhenius, Brønsted-Lowry, and Lewis concepts, pH scale, indicators, and salt preparation.



# Properties of Acids and Bases

Fundamental physical and chemical characteristics observed in daily life and laboratory.



## Acids

Sour taste; turn blue litmus red.

React with reactive metals to liberate hydrogen gas ( $H_2$ ).

Conduct electricity in aqueous solution (electrolytes).



## Bases (Alkalis)

Bitter taste; soapy feel; turn red litmus blue.

Neutralize acids to form salt and water.

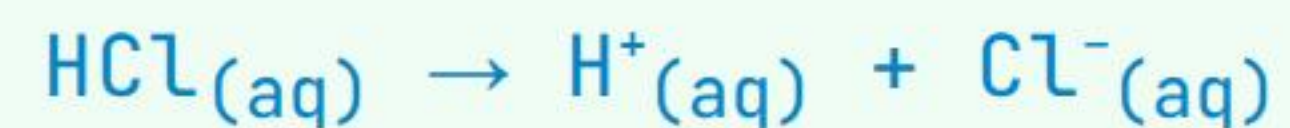
Corrosive in concentrated forms (e.g.,  $NaOH$ ).

# Arrhenius Concept of Acids & Bases (1887)

First theoretical framework based on ionization in aqueous solution.

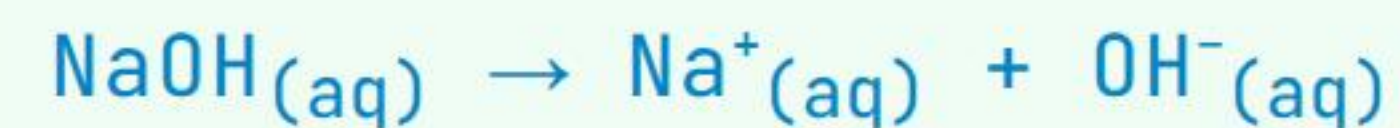
## Arrhenius Acid

Substance that dissociates in water to produce hydrogen ions ( $\text{H}^+$ ).



## Arrhenius Base

Substance that dissociates in water to produce hydroxide ions ( $\text{OH}^-$ ).



# Limitations of Arrhenius Concept

Why a broader definition was required in chemistry.

- 1 Applicable only in aqueous (water) mediums; fails in non-aqueous solvents like benzene or liquid ammonia.
- 2 Cannot explain acidic character of certain non-protonic oxides like  $\text{CO}_2$  or  $\text{SO}_2$ .
- 3 Cannot explain basic properties of substances like ammonia ( $\text{NH}_3$ ) which lack  $\text{OH}^-$  ions.

# Brønsted–Lowry Concept (1923)

Proton transfer theory defining acids and bases through particle exchange.

## Proton Donor (Acid)

Any species (molecule or ion) that donates a proton ( $\text{H}^+$ ).



## Proton Acceptor (Base)

Any species that accepts a proton ( $\text{H}^+$ ).



# Conjugate Acid–Base Pairs

Pairs differing by a single proton ( $\text{H}^+$ ).



**Acid<sub>1</sub>:**  $\text{CH}_3\text{COOH} \Rightarrow$  **Conjugate Base<sub>1</sub>:**  $\text{CH}_3\text{COO}^-$

**Base<sub>2</sub>:**  $\text{H}_2\text{O} \Rightarrow$  **Conjugate Acid<sub>2</sub>:**  $\text{H}_3\text{O}^+$

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Water acts as an **amphoteric substance** (can act as both acid and base depending on reaction partners).

# Lewis Concept of Acids & Bases (1923)

Electron-pair transfer theory expanding definition to non-protonic systems.

## Lewis Acid

An electron-pair **acceptor** (electrophile). Must have vacant orbitals (e.g.,  $\text{BF}_3$ ,  $\text{AlCl}_3$ ,  $\text{H}^+$ ).

## Lewis Base

An electron-pair **donor** (nucleophile). Must possess a lone pair of electrons (e.g.,  $\text{NH}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{Cl}^-$ ).

# The pH Scale & Self-Ionization of Water

Quantifying acidity and alkalinity through hydrogen ion concentration.

## pH Definition

Negative logarithm of hydrogen ion concentration:  $\text{pH} = -\log[\text{H}^+]$ .

## Neutral Point

At 25°C, pure water has  $[\text{H}^+] = 10^{-7} \text{ M}$ , giving a neutral  $\text{pH} = 7$ .

## Scale Range

$\text{pH} < 7$  is acidic,  $\text{pH} = 7$  is neutral, and  $\text{pH} > 7$  is basic (alkaline).

# Acid–Base Indicators

Organic substances that change color in response to pH variations.

## Litmus Paper

Turns red in acidic solutions and blue in basic solutions.

## Phenolphthalein

Colorless in acidic solutions; turns pink/magenta in alkaline solutions.

## Methyl Orange

Turns red in acidic solutions and yellow in basic solutions.

# Salts and Methods of Preparation

Ionic compounds formed by neutralizing acids with bases.

## Direct Combination

Reaction of constituent elements  
(e.g.,  $\text{Fe} + \text{Cl}_2 \rightarrow \text{FeCl}_3$ ).

## Neutralization

Acid + Base  $\rightarrow$  Salt + Water (e.g.,  
 $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$ ).

## Acid + Metal

Displacement reaction liberating  
hydrogen ( $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$ ).

# Types of Salts

Classification based on chemical composition and ion content.

## Normal / Neutral Salts

Contains no replaceable  $\text{H}^+$  or  $\text{OH}^-$  ions (e.g.,  $\text{NaCl}$ ,  $\text{K}_2\text{SO}_4$ ).

## Acidic Salts

Formed by incomplete neutralization of polybasic acids (e.g.,  $\text{NaHSO}_4$ ).

## Basic Salts

Formed by incomplete neutralization of polyacidic bases (e.g.,  $\text{Mg}(\text{OH})\text{Cl}$ ).

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# Chapter 2 Complete

Review acid-base theories, conjugate pairs, pH equations, and salt preparation exercises for your board examinations.

