



# CHAPTER 2: ACIDS, BASES AND SALTS

## Introduction

Many substances we use in everyday life are **acids, bases or salts**.

Examples from daily life:

SUBSTANCE	NATURE	ACID/BASE PRESENT
LEMON JUICE	Acidic	Citric acid
VINEGAR	Acidic	Acetic acid
CURD	Acidic	Lactic acid
TAMARIND	Acidic	Tartaric acid
SOAP	Basic	Sodium salts
TOOTHPASTE	Basic	Mild bases

These substances show acidic or basic properties mainly when dissolved in water.

## Acids

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

Example reaction:



The presence of  **$H^+$  ions** gives acids their properties.

### Examples of Acids

ACID	CHEMICAL FORMULA	SOURCE
HYDROCHLORIC ACID	HCl	Stomach
SULPHURIC ACID	$H_2SO_4$	Batteries
NITRIC ACID	$HNO_3$	Fertilizer industry
ACETIC ACID	$CH_3COOH$	Vinegar



<b>CITRIC ACID</b>	$C_6H_8O_7$	Citrus fruits
<b>LACTIC ACID</b>	$C_3H_6O_3$	Curd

### Characteristics of Acids

1. Sour taste
2. Turn **blue litmus red**
3. Conduct electricity in aqueous solution
4. React with metals to produce **hydrogen gas**

## 3. Bases

**Bases** are substances that produce hydroxide ions ( $OH^-$ ) in aqueous solution.

Example:



### Examples of Bases

<b>BASE</b>	<b>FORMULA</b>
<b>SODIUM HYDROXIDE</b>	NaOH
<b>POTASSIUM HYDROXIDE</b>	KOH
<b>CALCIUM HYDROXIDE</b>	$Ca(OH)_2$
<b>MAGNESIUM HYDROXIDE</b>	$Mg(OH)_2$

### Characteristics of Bases

1. Bitter taste
2. Soapy touch
3. Turn red litmus blue
4. Conduct electricity in aqueous solution

## 4. Alkalis

**Alkalis** are bases that dissolve in water.

Examples:



## ALKALI

## FORMULA

SODIUM HYDROXIDE	NaOH
POTASSIUM HYDROXIDE	KOH
CALCIUM HYDROXIDE	Ca(OH) <sub>2</sub>
AMMONIUM HYDROXIDE	NH <sub>4</sub> OH

All alkalis are bases but all bases are not alkalis.

Example:

Copper oxide (CuO) is a base but **not soluble in water**, so it is not an alkali.

## 5. Indicators

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

They help identify whether a substance is **acidic or basic**.

### Types of Indicators

#### 1. Natural Indicators

Obtained from plants.

Examples:

INDICATOR	ACIDIC COLOUR	BASIC COLOUR
LITMUS	Red	Blue
TURMERIC	Yellow	Reddish brown
CHINA ROSE	Dark pink	Green
RED CABBAGE	Red	Green

#### 2. Synthetic Indicators

Prepared in laboratories.

Examples:

INDICATOR	ACIDIC	BASIC
PHENOLPHTHALEIN	Colourless	Pink
METHYL ORANGE	Red	Yellow



### 3. Olfactory Indicators

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

Examples:

- Onion (Onion smell **disappears in base** but remains in acid)
- Vanilla
- Clove oil

## 6. Chemical Properties of Acids

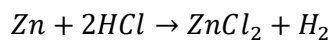
### 1. Reaction with Metals

Acids react with metals to produce **salt and hydrogen gas**.

General Reaction:



Example:



Hydrogen gas test:

Burning matchstick gives **pop sound**.

### 2. Reaction with Metal Carbonates

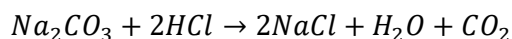
Acids react with carbonates to produce:

- Salt
- Water
- Carbon dioxide

Reaction:



Example:

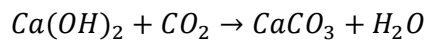


### Test of Carbon Dioxide

CO<sub>2</sub> passed through **lime water**.



Reaction:



Result:

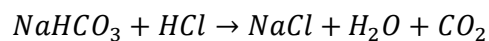
Lime water becomes **milky**.

### 3. Reaction with Metal Bicarbonates

Reaction:



Example:



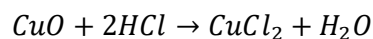
### 4. Reaction with Metal Oxides

Metal oxides are **basic in nature**.

Reaction:



Example:



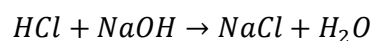
## 7. Chemical Properties of Bases

### 1. Reaction with Acids (Neutralization)

Neutralization reaction:



Example:

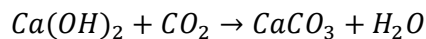


### 2. Reaction with Non-metal Oxides

Non-metal oxides are acidic.



Example:



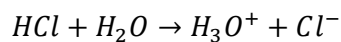
## 8. Acids and Bases in Aqueous Solutions

Acids and bases show their properties **only in aqueous solution**.

Example:

Dry HCl gas **does not show acidic nature**.

When dissolved in water:



Hydrogen ions exist as **hydronium ions (H<sub>3</sub>O<sup>+</sup>)**.

## 9. Strength of Acids and Bases

Strength depends on **degree of ionization in water**.

### Strong Acids

Completely ionize in water.

Examples:

- HCl
- HNO<sub>3</sub>
- H<sub>2</sub>SO<sub>4</sub>

### Weak Acids

Partially ionize.

Examples:

- CH<sub>3</sub>COOH
- H<sub>2</sub>CO<sub>3</sub>

### Strong Bases

Completely ionize in water

Examples:

- NaOH
- KOH

### Weak Bases

Partially ionize in water

Examples:

- NH<sub>4</sub>OH
- NH<sub>3</sub>
- Al(OH)<sub>3</sub>

## 10. pH Scale

pH measures **strength of acid or base**.



Range: 0 – 14

PH	NATURE
0–3	Strong acid
4–6	Weak acid
7	Neutral
8–10	Weak base
11–14	Strong base

Example values:

SUBSTANCE	PH
LEMON JUICE	2
VINEGAR	3
WATER	7
BLOOD	7.4
SOAP	9–10

## Importance of pH in Everyday Life

### 1. Tooth decay

Bacteria produce acids that lower pH **below 5.5**, damaging teeth.

Toothpaste is **basic** to neutralize acid.

### 2. Soil pH

If soil is too acidic:

Farmers add **quicklime (CaO)** or **slaked lime (Ca(OH)<sub>2</sub>)**.

### 3. pH of Digestive System

Stomach contains **hydrochloric acid**.

Excess acid causes indigestion.

Treatment: **Antacids**.

Example:

Magnesium hydroxide.



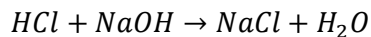
#### 4. pH of Water Bodies

Acid rain lowers pH of rivers and lakes → harms aquatic life.

## 11. Salts

Salts are substances formed by neutralization reaction between an acid and a base.

Example:



NaCl is salt.

## 12. Nature of Salt Solution

Depends on **strength of acid and base used.**

ACID	BASE	SALT NATURE
STRONG	Strong	Neutral
STRONG	Weak	Acidic
WEAK	Strong	Basic

Examples:

SALT	NATURE
NaCl	Neutral
NH <sub>4</sub> Cl	Acidic
Na <sub>2</sub> CO <sub>3</sub>	Basic

## 13. Family of Salts

Salts having **same positive or negative ion** belong to same family.

Example:

SALT	FAMILY
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<b>NaCl</b>	Chloride family
<b>KCl</b>	Chloride family

## 14. Chemicals from Common Salt (NaCl)

Common salt is used to prepare many chemicals:

1. Sodium hydroxide
2. Bleaching powder
3. Baking soda
4. Washing soda

## 15. Chlor-Alkali Process

Process used to produce **sodium hydroxide (NaOH)** by electrolysis of brine.

Brine = concentrated solution of NaCl.

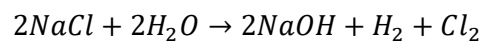
### Process Steps

1. Prepare concentrated NaCl solution (brine).
2. Pass electricity through brine.
3. Electrolysis occurs.

Products formed:

- Sodium hydroxide
- Hydrogen gas
- Chlorine gas

Reaction:



### Uses of Products

#### Sodium hydroxide

- Soap manufacturing
- Paper industry
- Artificial fibres



## Hydrogen gas

- Fuel
- Hydrogenation of oils

## Chlorine gas

- Water purification
- PVC manufacturing

# 16. Bleaching Powder

## Formula

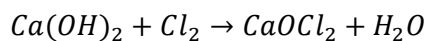


## Preparation

**Step 1:** Take **dry slaked lime**.

**Step 2:** Pass **chlorine gas** over it.

Reaction:



## Uses

- Disinfecting drinking water
- Bleaching cotton and linen
- Oxidizing agent
- Making chloroform

# 17. Baking Soda

## Formula

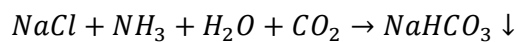


## Preparation



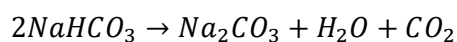
Step 1:  
Pass  $\text{CO}_2$  gas through brine saturated with ammonia.

Reaction:



$\text{NaHCO}_3$  precipitates out.

### Heating Baking Soda



### Uses

- Baking powder
- Antacid
- Fire extinguishers
- Making soda acid fire extinguishers

### Baking Powder

Mixture of:

- Baking soda
- Tartaric acid

$\text{CO}_2$  released makes cakes **soft and fluffy**.

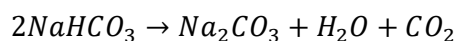
## 18. Washing Soda

### Formula



### Preparation Steps

**Step 1:** Heat baking soda.



**Step 2:** Recrystallization with water forms washing soda.



## Uses

- Cleaning agent
- Softening hard water
- Glass manufacturing
- Soap production

## 19. Water of Crystallization

Fixed number of water molecules present in a salt.

Example:

SALT	FORMULA
COPPER SULPHATE	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
GYPSUM	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
WASHING SODA	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

Example:

Heating copper sulphate:

Blue crystals → white powder.

Adding water restores blue colour.

## 20. Plaster of Paris (POP)

**Plaster of Paris** is a white powder obtained by heating **gypsum** at a high temperature.

### Chemical Formula



(Calcium sulphate hemihydrate)

### Preparation of Plaster of Paris

Plaster of Paris is prepared by **heating gypsum** at about **100–120°C**.

Chemical reaction:



Gypsum  $\rightarrow$  Plaster of Paris + Water

If gypsum is heated above **120°C**, it loses all water and forms **anhydrous calcium sulphate**, which does not set properly.

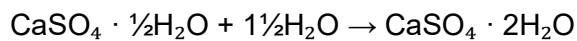
### Properties of Plaster of Paris

- It is a **white powder**.
- When mixed with water, it forms a **smooth paste**.
- The paste **hardens quickly** to form a solid mass.
- It sets into a **hard solid when water is added**.

### Setting Reaction of Plaster of Paris

When Plaster of Paris is mixed with water, it converts back to **gypsum** and becomes hard.

Reaction:



Plaster of Paris + Water  $\rightarrow$  Gypsum

### Uses of Plaster of Paris

- Making **statues and decorative items**
- Making **toys and models**
- Used in **hospitals for plaster casts** to support fractured bones
- Making **false ceilings and wall decorations**
- Used in **moulds and chalk**