Acids, Bases and Salts - Class 10 Science Notes

1. Introduction to Acids and Bases

What are Acids?

Acids are substances that produce hydrogen ions (H^+) when dissolved in water. They have a sour taste and turn blue litmus paper red.

Examples of Common Acids:

- Hydrochloric acid (HCl) - found in stomach
- Sulfuric acid (H_2SO_4) - battery acid
- Nitric acid (HNO_3) - used in fertilizers
- Acetic acid (CH_3COOH) - vinegar
- Citric acid - found in citrus fruits

What are Bases?

Bases are substances that produce hydroxide ions (OH^-) when dissolved in water. They have a bitter taste, feel slippery, and turn red litmus paper blue.

Examples of Common Bases:

- Sodium hydroxide (NaOH) - caustic soda
- Potassium hydroxide (KOH) - caustic potash
- Calcium hydroxide [$Ca(OH)_2$] - lime water
- Magnesium hydroxide [$Mg(OH)_2$] - milk of magnesia
- Ammonia (NH_3) - household cleaner

2. Properties of Acids

Physical Properties

- Sour taste (never taste acids in laboratory)
- Turn blue litmus paper red
- Conduct electricity due to presence of ions
- Corrosive in nature

Chemical Properties

1. Reaction with Metals

Acid + Metal → Salt + Hydrogen gas

- Example: $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$
- Test: Hydrogen gas burns with a 'pop' sound

2. Reaction with Metal Carbonates and Bicarbonates

Acid + Metal Carbonate → Salt + Water + Carbon dioxide

- Example: $HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$
- Test: CO_2 turns lime water milky

3. Reaction with Bases (Neutralization)

Acid + Base → Salt + Water

- Example: $HCl + NaOH \rightarrow NaCl + H_2O$
- This is called neutralization reaction

3. Properties of Bases

Physical Properties

- Bitter taste (never taste bases in laboratory)
- Slippery or soapy feel
- Turn red litmus paper blue
- Conduct electricity
- Corrosive in nature

Chemical Properties

1. Reaction with Metals

Some bases react with metals to produce hydrogen gas

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

2. Reaction with Acids (Neutralization)

Base + Acid → Salt + Water

- Example: $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$

4. Indicators

Natural Indicators

- **Litmus**: Extracted from lichens
  - Blue litmus turns red in acid
  - Red litmus turns blue in base
- **Turmeric**: Yellow in base, red in acid
- **Red cabbage**: Different colors in different pH

Synthetic Indicators

- **Methyl orange**: Red in acid, yellow in base
- **Phenolphthalein**: Colorless in acid, pink in base

Universal Indicator

Shows different colors for different pH values (0-14 scale)

5. Strength of Acids and Bases - pH Scale

pH Scale

- Ranges from 0 to 14
- pH < 7: Acidic solution
- pH = 7: Neutral solution
- pH > 7: Basic solution

Strong vs Weak Acids and Bases

Strong Acids: Completely ionize in water

- HCl, H_2SO_4, HNO_3

Weak Acids: Partially ionize in water

- CH_3COOH, H_2CO_3

Strong Bases: Completely ionize in water

- NaOH, KOH

Weak Bases: Partially ionize in water

- NH_4OH

6. Important Acids and Bases in Daily Life

Acids in Daily Life

- **Hydrochloric acid**: Stomach acid for digestion
- **Acetic acid**: Vinegar for cooking
- **Citric acid**: Citrus fruits
- **Lactic acid**: Sour milk
- **Tartaric acid**: Tamarind

Bases in Daily Life

- **Calcium hydroxide**: Whitewashing
- **Sodium hydroxide**: Soap making
- **Magnesium hydroxide**: Antacid
- **Ammonium hydroxide**: Window cleaner

7. Salts

Definition

Salts are ionic compounds formed by the neutralization reaction between acids and bases.

Types of Salts

1. Normal Salts

Formed by complete neutralization of acid and base

- Example: NaCl, $CaSO_4$

2. Acidic Salts

Formed when a base is not completely neutralized by acid

- Example: $NaHSO_4$, $NaHCO_3$

3. Basic Salts

Formed when an acid is not completely neutralized by base

- Example: Mg(OH)Cl

Family of Salts

Salts having common positive or negative ions belong to same family

- Chloride family: NaCl, KCl, $CaCl_2$
- Sulfate family: $CuSO_4$, $FeSO_4$, Na_2SO_4

8. Important Salts and Their Uses

Sodium Chloride (NaCl) - Common Salt

Preparation:

- From sea water by evaporation
- Rock salt mining

Uses:

- Food preservation and flavoring
- Manufacturing of NaOH, Na_2CO_3, HCl
- De-icing roads

Raw Material for:

- Sodium hydroxide (NaOH)
- Sodium carbonate (Na_2CO_3)
- Hydrochloric acid (HCl)

Sodium Hydroxide (NaOH) - Caustic Soda

Preparation:

- Chlor-alkali process: $2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$

Uses:

- Soap and detergent manufacturing
- Paper industry
- Textile industry
- Metal refining

Bleaching Powder [$Ca(OCl)_2$]

Preparation:

- $Ca(OH)_2 + Cl_2 \rightarrow Ca(OCl)_2 + H_2O$

Uses:

- Bleaching cotton and linen
- Disinfectant for water treatment
- Oxidizing agent

Baking Soda ($NaHCO_3$) - Sodium Bicarbonate

Preparation:

- $NaCl + H_2O + CO_2 + NH_3 \rightarrow NaHCO_3 + NH_4Cl$ (Solvay process)

Uses:

- Baking powder (with tartaric acid)
- Antacid for acidity
- Fire extinguisher
- Cleaning agent

Thermal Decomposition: $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$

Washing Soda ($Na_2CO_3.10H_2O$) - Sodium Carbonate

Preparation:

- From baking soda: $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$
- Rehydration: $Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3.10H_2O$

Uses:

- Laundry and cleaning
- Glass and soap manufacturing
- Water softening
- Paper industry

Plaster of Paris [$CaSO_4.½H_2O$]

Preparation:

- $CaSO_4.2H_2O \rightarrow CaSO_4.½H_2O + 1½H_2O$ (heating at 373K)

Uses:

- Making casts for broken bones
- Making toys and decorative items
- Construction industry

Setting of Plaster: $CaSO_4.½H_2O + 1½H_2O \rightarrow CaSO_4.2H_2O$

9. Water of Crystallization

Definition

The fixed number of water molecules present in one formula unit of a salt is called water of crystallization.

Examples

- Copper sulfate: $CuSO_4.5H_2O$ (blue crystals)
- Washing soda: $Na_2CO_3.10H_2O$
- Gypsum: $CaSO_4.2H_2O$
- Plaster of Paris: $CaSO_4.½H_2O$

Heating Effect

When heated, hydrated salts lose water of crystallization and become anhydrous.

10. Key Chemical Equations

Neutralization Reactions

- $HCl + NaOH \rightarrow NaCl + H_2O$
- $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$
- $HNO_3 + NH_4OH \rightarrow NH_4NO_3 + H_2O$

Acid-Metal Reactions

- $2HCl + Zn \rightarrow ZnCl_2 + H_2$
- $H_2SO_4 + Mg \rightarrow MgSO_4 + H_2$

Acid-Carbonate Reactions

- $2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$
- $H_2SO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + H_2O + CO_2$

Important Industrial Reactions

- $2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$ (Chlor-alkali)
- $Ca(OH)_2 + Cl_2 \rightarrow Ca(OCl)_2 + H_2O$ (Bleaching powder)
- $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$ (Washing soda)

11. Important Points to Remember

1. Acids and bases are chemical opposites
2. Water is essential for acid-base properties

3. Neutralization produces salt and water
4. pH scale measures acidity/basicity
5. Many salts contain water of crystallization
6. Strong acids/bases ionize completely
7. Common salt is raw material for many chemicals
8. Handle acids and bases with extreme care
9. Use appropriate indicators for detection
10. Many everyday substances are acids, bases, or salts

12. Safety Precautions

- Never taste acids or bases
- Always add acid to water, not water to acid
- Wear safety goggles and gloves
- Work in well-ventilated areas
- Keep first aid materials nearby
- Wash immediately if contact with skin occurs
- Store acids and bases separately and properly labeled

These notes cover all major topics in the Acids, Bases and Salts chapter for Class 10 Science. Practice the chemical equations and understand the applications of various salts in daily life for better exam preparation.