Acids, Bases and Salts

Comprehensive Study Notes for RBSE Class 10 Science Chapter 2

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1. INTRODUCTION TO ACIDS AND BASES

Definition and Properties

Acids:

- Substances with sour taste
- Change blue litmus paper to red
- Examples: HCl, H_2SO_4, HNO_3, CH_3COOH

Bases:

- Substances with bitter taste
- Change red litmus paper to blue
- Soapy to touch
- Examples: NaOH, $Ca(OH)_2$, KOH, $Mg(OH)_2$

Key Observation

A stain of curry (turmeric) on a white cloth becomes reddish-brown when soap (basic) is applied, and turns yellow again when washed with water.

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2. ACID-BASE INDICATORS

Definition

Substances used to distinguish acids and bases by a change in color.

Types of Indicators

Indicator Type	Examples	Behavior
Color Indicators	Litmus, Methyl orange, Phenolphthalein	Change color based on pH
Natural Indicators	Red cabbage, Turmeric, Flower petals (Hydrangea, Petunia, Geranium)	Show color changes in acidic/basic media
Olfactory Indicators	Onion, Vanilla, Clove oil	Change odor in acidic/basic solutions
Synthetic Indicators	Methyl orange, Phenolphthalein	Specific color changes at certain pH ranges

Litmus Paper Behavior

- **Red litmus:** Turns blue in basic solution
- **Blue litmus:** Turns red in acidic solution
- **Purple litmus solution:** Indicates neutral solution

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3. CHEMICAL PROPERTIES OF ACIDS AND BASES

3.1 Reaction of Acids with Metals

General Reaction

$$\text{Acid} + \text{Metal} \rightarrow \text{Salt} + \text{Hydrogen gas}$$

Characteristics

- Hydrogen gas is evolved
- Forms a salt
- Hydrogen gas burns with a **pop sound** when a burning candle is brought near

Examples

Dilute H_2SO_4 with Zn:

$$\mathrm{Zn}(s) + \mathrm{H_2SO_4}(aq) \rightarrow \mathrm{ZnSO_4}(aq) + \mathrm{H_2}(g)$$

HCl with Mg:

$$\mathrm{Mg}(s) + 2\mathrm{HCl}(aq) \rightarrow \mathrm{MgCl_2}(aq) + \mathrm{H_2}(g)$$

Test for Hydrogen Gas

- Bring a burning candle near the gas
- Hydrogen gas burns with a **characteristic pop sound**

3.2 Reaction of Bases with Metals

General Reaction

- Hydrogen gas is evolved
- Forms a salt with negative ion composed of metal and oxygen
- **Not all metals react with bases**

Example

Zn with NaOH (when warmed):

$$2\text{NaOH}(aq) + \text{Zn}(s) \rightarrow \text{Na}_2\text{ZnO}_2(s) + \text{H}_2(g)$$

(Sodium zincate)

3.3 Reaction of Metal Carbonates with Acids

General Reaction

$$\text{Metal carbonate/Hydrogencarbonate} + \text{Acid} \rightarrow \text{Salt} + \text{CO}_2 + \text{H}_2\text{O}$$

Characteristics

- Carbon dioxide gas is produced
- CO_2 turns lime water milky white
- Excess CO_2 turns milky solution clear again

Examples

Sodium carbonate with HCl:

$$\text{Na}_2\text{CO}_3(s) + 2\text{HCl}(aq) \rightarrow 2\text{NaCl}(aq) + \text{H}_2\text{O}(l) + \text{CO}_2(g)$$

Sodium hydrogencarbonate with HCl:

$$\text{NaHCO}_3(s) + \text{HCl}(aq) \rightarrow \text{NaCl}(aq) + \text{H}_2\text{O}(l) + \text{CO}_2(g)$$

Test for CO_2

- Pass gas through **lime water** $Ca(OH)_2$
- **White precipitate** of $CaCO_3$ forms
- Excess CO_2 dissolves the precipitate:

$$\text{CaCO}_3(s) + \text{H}_2\text{O}(l) + \text{CO}_2(g) \rightarrow \text{Ca(HCO}_3)_2(aq)$$

3.4 Reaction of Metal Oxides with Acids

General Reaction

$$\text{Metal oxide} + \text{Acid} \rightarrow \text{Salt} + \text{Water}$$

Example

$$\text{CuO}(s) + 2\text{HCl}(aq) \rightarrow \text{CuCl}_2(aq) + \text{H}_2\text{O}(l)$$

Observation: Black copper oxide dissolves, solution becomes blue-green (due to $CuCl_2$)

Classification

- **Metal oxides** = **Basic oxides** (react with acids like bases)

3.5 Reaction of Non-metallic Oxides with Bases

General Reaction

$$\text{Non-metallic oxide} + \text{Base} \rightarrow \text{Salt} + \text{Water}$$

Example

$$\text{CO}_2(g) + \text{Ca(OH)}_2(aq) \rightarrow \text{CaCO}_3(s) + \text{H}_2\text{O}(l)$$

Classification

- **Non-metallic oxides** = **Acidic oxides** (react with bases like acids)

3.6 Neutralisation Reaction

Definition

Reaction between an acid and a base to form salt and water.

General Reaction

$$\text{Base} + \text{Acid} \rightarrow \text{Salt} + \text{Water}$$

Ionic Equation

$$\text{H}^+(aq) + \text{OH}^-(aq) \rightarrow \text{H}_2\text{O}(l)$$

Example

$$\text{NaOH}(aq) + \text{HCl}(aq) \rightarrow \text{NaCl}(aq) + \text{H}_2\text{O}(l)$$

Activity Observation

- Phenolphthalein turns pink in basic solution
- Phenolphthalein becomes colorless when acid is added
- Pink color reappears when base is added again

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4. WHAT DO ALL ACIDS AND BASES HAVE IN COMMON?

4.1 Ions in Acids and Bases

Acids Contain H^+ Ions

- All acids generate **H^+ ions** (hydrogen ions) in solution
- This is the **common feature** in all acids
- **Examples:**
  - HCl provides Cl^- as anion
  - H_2SO_4 provides SO_4^{2-} as anion
  - HNO_3 provides NO_3^- as anion
  - CH_3COOH provides CH_3COO^- as anion

Bases Contain OH^- Ions

- All bases generate **OH^- ions** (hydroxide ions) in solution
- This is the **common feature** in all bases
- **Examples:**
  - NaOH → $Na^+ + OH^-$
  - $Ca(OH)_2$ → $Ca^{2+} + 2OH^-$
  - KOH → $K^+ + OH^-$

4.2 Formation of Ions in Aqueous Solution

Acids in Water

HCl in water:

$$\mathrm{HCl}(aq) \rightarrow \mathrm{H^+}(aq) + \mathrm{Cl^-}(aq)$$

H^+ combines with water:

$$\mathrm{H^+} + \mathrm{H_2O} \rightarrow \mathrm{H_3O^+}(aq)$$

(Hydronium ion)

Important: H^+ cannot exist alone; always shown as $H^+(aq)$ or H_3O^+

Bases in Water

NaOH in water:

$$\mathrm{NaOH}(s) \xrightarrow{\mathrm{H_2O}} \mathrm{Na^+}(aq) + \mathrm{OH^-}(aq)$$

$Ca(OH)_2$ in water:

$$\mathrm{Ca(OH)_2}(s) \xrightarrow{\mathrm{H_2O}} \mathrm{Ca^{2+}}(aq) + 2\mathrm{OH^-}(aq)$$

4.3 Dry HCl Gas Does NOT Show Acidic Properties

Key Experiment

- **Dry HCl gas:** Does NOT change color of dry litmus paper
- **HCl solution (in water):** Changes blue litmus to red

Conclusion

Acids show acidic properties ONLY in aqueous (water) solution because H^+ ions form only in presence of water.

4.4 Electrical Conductivity

Acids and Bases Conduct Electricity

- Acidic solutions conduct electricity (light bulb glows)
- Basic solutions conduct electricity (light bulb glows)
- **Reason:** Both contain ions (H^+ from acids, OH^- from bases)

Non-acidic Compounds Do NOT Conduct

- Glucose solution: Does NOT conduct electricity
- Alcohol solution: Does NOT conduct electricity
- **Reason:** They do NOT produce ions

4.5 Exothermic Nature of Mixing Acid/Base with Water

Key Point

Dissolving an acid or base in water is HIGHLY EXOTHERMIC

Safety Precautions

- **MUST:** Add acid slowly to water with constant stirring
- **NEVER:** Add water to concentrated acid
- **Reason:** Heat generated may cause splashing, burns, or glass breakage
- **Warning sign:** Displayed on concentrated acid and base containers

Dilution Process

- Adding water to acid/base reduces concentration of ions per unit volume
- Process called **dilution**
- Effect on H^+/OH^- concentration: **Decreases** with dilution

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5. pH SCALE AND STRENGTH OF ACIDS/BASES

5.1 pH Scale Concept

Definition

- **pH** stands for **"potenz"** (German for power)
- Measures **hydrogen ion concentration** in a solution
- Range: **0 to 14**

pH Values and Solution Nature

pH Range	Nature	Ion Concentration
0-7	Acidic	H^+ concentration > OH^-
7	Neutral	H^+ concentration = OH^-
7-14	Basic/Alkaline	OH^- concentration > H^+

Key Relationship

Higher H^+ concentration = Lower pH
Lower H^+ concentration = Higher pH

5.2 Universal Indicator and pH Paper

Universal Indicator

- Mixture of several indicators
- Shows different colors at different pH values
- More accurate than single indicators

pH Paper

- Paper impregnated with universal indicator
- Changes color based on pH
- Can be compared with color scale

5.3 Strength of Acids and Bases

Strong Acids vs Weak Acids

- **Strong acids:** Produce more H^+ ions in solution
- **Weak acids:** Produce fewer H^+ ions in solution
- **Example:** HCl (strong) vs CH_3COOH (weak) at same concentration produce different amounts of H^+

Strong Bases vs Weak Bases

- **Strong bases:** Produce more OH^- ions
- **Weak bases:** Produce fewer OH^- ions
- **Example:** NaOH (strong) vs $Mg(OH)_2$ (weak)

Alkalis

- **Definition:** Bases that dissolve in water
- **Properties:** Soapy, bitter, corrosive
- **Warning:** Never taste or touch concentrated alkalis

5.4 pH of Common Substances

Substance	pH	Nature
Gastric juice	1.0	Strongly acidic
Lemon juice	2.2	Strongly acidic
Vinegar	3.0	Acidic
Tomato juice	4.0	Weakly acidic
Pure water, Blood	7.4, 7.0	Neutral to slightly basic
Milk of magnesia	10	Basic
Sodium hydroxide solution	14	Strongly basic

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6. IMPORTANCE OF pH IN EVERYDAY LIFE

6.1 pH and Living Organisms

Body pH Range

- **Human body:** Maintains pH between 7.0-7.8
- **Survival:** Living organisms can survive in narrow pH range only
- **Importance:** Fluctuations beyond this range can be harmful

6.2 Acid Rain

Definition

- **When:** pH of rain water < 5.6
- **Cause:** Pollution introduces acidic gases (SO_2, NO_x)
- **Effect:** Lowers pH of river water
- **Impact:** Makes survival of aquatic life difficult

6.3 Plant Growth and Soil pH

Soil pH Importance

- Plants require specific pH range for healthy growth
- Different plants prefer different pH ranges
- Farmers adjust soil pH by adding:
  - **Quick lime** Ca(O) - if soil is acidic
  - **Slaked lime** $Ca(OH)_2$ - if soil is acidic

    - **Chalk** $CaCO_3$ - if soil is acidic

Measurement Method

- Collect soil sample
- Add water and shake
- Filter and check pH of filtrate using pH paper

6.4 pH and Digestion

Stomach Acidity

- Stomach produces **hydrochloric acid** (HCl)
- **Function:** Helps in food digestion
- **pH:** Around 1-2 (strongly acidic)
- **Protection:** Stomach lining prevents damage

Indigestion Problem

- Excess acid production causes pain and irritation
- **Remedy:** Antacids (mild bases)
- **Example:** Magnesium hydroxide (Milk of magnesia)
- **Action:** Neutralizes excess acid

6.5 Tooth Decay and pH

Mechanism

- **Critical pH:** Below 5.5, tooth decay starts
- **Cause:** Bacteria produce acids from sugar/food particles
- **Target:** Tooth enamel (calcium hydroxyapatite)
- **Problem:** Enamel is corroded when pH < 5.5

Prevention Methods

- **Clean mouth:** After eating food
- **Use toothpaste:** Generally basic, neutralizes acid
- **pH management:** Maintain mouth pH > 5.5

6.6 Chemical Defense in Nature

Bee Sting

- Honey-bee venom is **acidic**
- Causes pain and irritation
- **Relief:** Mild base like baking soda

Nettle Sting

- Stinging hair secretes **methanoic acid**
- Causes burning pain
- **Traditional remedy:** Dock plant leaf (basic) rubs area

Neutralization by Nature

- Nettle often grows near dock plant
- Dock plant is basic
- **Traditional remedy:** Rub stung area with dock leaf

6.7 Naturally Occurring Acids

Source	Acid
Vinegar	Acetic acid
Lemon	Citric acid
Orange	Citric acid
Sour milk (Curd)	Lactic acid
Tamarind	Tartaric acid
Ant sting	Methanoic acid
Nettle sting	Methanoic acid
Tomato	Oxalic acid

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7. SALTS - PREPARATION, PROPERTIES AND USES

7.1 Family of Salts

Definition

- Salts with same **positive radical** or **negative radical** belong to a family

Examples

Sodium salts family:

- $NaCl$, Na_2SO_4, $NaNO_3$, Na_2CO_3, $NaHCO_3$

Chloride salts family:

- $NaCl$, KCl, $CaCl_2$, $MgCl_2$, $CuCl_2$

Classification Method

- **Positive radical family:** Same metal/NH_4^+
- **Negative radical family:** Same anion

7.2 pH of Salts

Classification Based on pH

Salt Type	pH	Example
Strong acid + Strong base	7 (Neutral)	NaCl, KNO_3
Strong acid + Weak base	< 7 (Acidic)	$AlCl_3$, $ZnSO_4$
Weak acid + Strong base	> 7 (Basic)	Na_2CO_3, $NaHCO_3$

Examples

- **Neutral salts:** NaCl (pH = 7), KNO_3
- **Acidic salts:** $AlCl_3$, $ZnSO_4$
- **Basic salts:** Na_2CO_3, $NaHCO_3$

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8. CHEMICALS FROM COMMON SALT

8.1 Sodium Chloride - Raw Material

Sources

- **Sea water:** Contains dissolved salts
- **Rock salt deposits:** Formed from dried ancient seas
- **Rock salt:** Large crystals, brown due to impurities, mined like coal

Importance

- Historical significance: Mahatma Gandhi's Dandi March
- Used to produce: NaOH, baking soda, washing soda, bleaching powder

8.2 Chlor-Alkali Process

Definition

Electrolysis of brine (NaCl solution) to produce useful chemicals

Overall Reaction

$$2\text{NaCl}(aq) + 2\text{H}_2\text{O}(l) \xrightarrow{\text{Electrolysis}} 2\text{NaOH}(aq) + \text{Cl}_2(g) + \text{H}_2(g)$$

Products Formed

- **At Anode:** Cl_2 (Chlorine gas)
- **At Cathode:** H_2 (Hydrogen gas)
- **Near Cathode:** NaOH (Sodium hydroxide solution)

Uses of Products

Chlorine (Cl_2):

- Water treatment and swimming pools
- PVC manufacturing
- Disinfectants and pesticides
- CFCs production

Hydrogen (H_2):

- Fuel
- Margarine manufacturing
- Ammonia production for fertilizers

Sodium Hydroxide (NaOH):

- De-greasing metals
- Soap and detergent manufacturing
- Paper making
- Artificial fibers production

8.3 Bleaching Powder

Formation

$$2Ca(OH)_2 + 2Cl_2 \rightarrow Ca(ClO)_2 + CaCl_2 + 2H_2O$$

- **Process:** Chlorine gas reacts with dry slaked lime
- **Formula:** $Ca(ClO)_2$ (actual composition is complex)
- **Appearance:** White/pale yellow powder

Uses

- **Textile industry:** Bleaching cotton and linen
- **Paper industry:** Bleaching wood pulp
- **Laundry:** Bleaching washed clothes
- **Chemical industries:** As oxidizing agent
- **Water purification:** Making drinking water germ-free

8.4 Baking Soda (Sodium Hydrogencarbonate)

Production

$$NaCl + H_2O + CO_2 + NH_3 \rightarrow NH_4Cl + NaHCO_3$$

Chemical Formula

- **$NaHCO_3$** (Sodium hydrogencarbonate)
- **pH:** Basic (salt of strong base and weak acid)

Reaction on Heating

$$2NaHCO_3 \xrightarrow{\text{Heat}} Na_2CO_3 + H_2O + CO_2$$

Uses

1. In Baking:

- Component of baking powder
- Baking powder = Baking soda + mild edible acid (tartaric acid)
- Reaction: Generates CO_2 gas
- **Effect:** Makes bread/cake soft and spongy

2. As Antacid:

- Basic salt neutralizes excess stomach acid
- Provides relief from indigestion

Advantages

- Non-corrosive
- Mild base suitable for internal use

8.5 Washing Soda (Sodium Carbonate Decahydrate)

Chemical Formula

- **$Na_2CO_3.10H_2O$** (Sodium carbonate decahydrate)
- **Preparation:** Recrystallization of sodium carbonate

Formation

$$Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3.10H_2O$$

pH

- **Basic salt** (salt of strong base and weak acid)
- pH > 7

Uses

1. Industrial Applications:

- Glass manufacturing
- Soap and detergent production
- Paper industry
- Manufacturing sodium compounds (borax)

2. Domestic Applications:

- **Cleaning agent:** For household cleaning
- **Water softening:** Removes permanent hardness of water
- **Laundry:** Enhances detergent action

Removal of Water of Crystallization

- Heating removes water molecules
- **After heating:** White powder remains
- **10H_2O signifies:** 10 water molecules per formula unit of Na_2CO_3

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9. WATER OF CRYSTALLISATION

9.1 Definition

Fixed number of water molecules present in **one formula unit** of a salt crystal.

9.2 Examples and Structure

Copper Sulphate

- **Formula:** $CuSO_4.5H_2O$
- **Water molecules:** 5 per formula unit
- **Hydrated form:** Blue crystals
- **Anhydrous form:** White powder (after heating)

Gypsum

- **Formula:** $CaSO_4.2H_2O$
- **Water molecules:** 2 per formula unit
- **Common name:** Hydrated calcium sulphate

9.3 Activity Observation - Copper Sulphate Crystals

Experiment

- Heat copper sulphate crystals in boiling tube
- Observe color change and water droplets

Observations

- **Before heating:** Blue crystals (hydrated form)
- **During heating:** Water droplets appear in tube
- **After heating:** White powder (anhydrous form)

Reversal

- Add water to white powder
- **Result:** Blue color returns (reforms hydrated salt)

9.4 Plaster of Paris

Formation from Gypsum

$$CaSO_4.2H_2O \xrightarrow{373\ K} CaSO_4.\frac{1}{2}H_2O + \frac{3}{2}H_2O$$

(Gypsum) (Plaster of Paris)

Chemical Formula

- **$CaSO_4.½H_2O$** (Calcium sulphate hemihydrate)
- **Fraction explanation:** Two formula units of $CaSO_4$ share one H_2O molecule

Properties

- White powder
- Hardens when mixed with water
- Reforms gypsum on setting

Uses

- **Medical:** Plaster for supporting fractured bones
- **Decorative:** Making toys and decorative materials
- **Construction:** Making surfaces smooth

Reformation Reaction

$$CaSO_4.\frac{1}{2}H_2O + \frac{3}{2}H_2O \rightarrow CaSO_4.2H_2O$$

9.5 Storage of Plaster of Paris

MUST be stored in moisture-proof container because atmospheric moisture will convert it back to gypsum.

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10. KEY DEFINITIONS AND CONCEPTS

Acid-Base Indicators

Dyes or mixtures of dyes used to detect presence of acids and bases through color changes.

Neutralisation Reaction

Reaction between acid and base to form salt and water, nullifying each other's effects.

pH Scale

Numerical scale (0-14) measuring hydrogen ion concentration in a solution.

Hydronium Ion (H_3O^+)

H^+ ion combined with water molecule; the form in which H^+ exists in aqueous solution.

Alkali

Base that dissolves in water; produces OH^- ions.

Dilution

Process of decreasing concentration of ions by adding water.

Water of Crystallisation

Fixed number of water molecules in crystal structure of a salt.

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11. IMPORTANT REACTIONS SUMMARY

Metal + Acid

$$\text{Metal} + \text{Acid} \rightarrow \text{Salt} + \text{H}_2 \uparrow$$

Metal Carbonate + Acid

$$\text{Metal carbonate} + \text{Acid} \rightarrow \text{Salt} + \text{H}_2\text{O} + \text{CO}_2 \uparrow$$

Metal Oxide + Acid

$$\text{Metal oxide} + \text{Acid} \rightarrow \text{Salt} + \text{H}_2\text{O}$$

Non-metallic Oxide + Base

$$\text{Non-metallic oxide} + \text{Base} \rightarrow \text{Salt} + \text{H}_2\text{O}$$

Acid + Base (Neutralisation)

$$\text{Acid} + \text{Base} \rightarrow \text{Salt} + \text{H}_2\text{O}$$

Chlor-Alkali Process

$$2\text{NaCl}(aq) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{NaOH}(aq) + \text{Cl}_2(g) + \text{H}_2(g)$$

Bleaching Powder Preparation

$$2\text{Ca(OH)}_2 + 2\text{Cl}_2 \rightarrow \text{Ca(ClO)}_2 + \text{CaCl}_2 + 2\text{H}_2\text{O}$$

Baking Soda Heating

$$2\text{NaHCO}_3 \xrightarrow{\text{Heat}} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$$

Plaster of Paris Formation

$$\text{CaSO}_4.2\text{H}_2\text{O} \xrightarrow{373\ \text{K}} \text{CaSO}_4.\ \frac{1}{2}\text{H}_2\text{O} + \frac{3}{2}\text{H}_2\text{O}$$

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12. QUESTIONS FOR EXAM PREPARATION

Multiple Choice Questions

1. A solution turns red litmus blue, its pH is likely to be:

- (a) 1
- (b) 4
- (c) 5
- **(d) 10**

2. Which gas is liberated when acid reacts with metal?

- **(a) Hydrogen**
- (b) Carbon dioxide
- (c) Oxygen
- (d) Nitrogen

3. Salts of strong acid and weak base are:

- (a) Neutral
- **(b) Acidic**
- (c) Basic
- (d) Amphoteric

4. Which one is used for treating indigestion?

- (a) Antibiotic
- (b) Analgesic
- **(c) Antacid**
- (d) Antiseptic

5. Water of crystallisation in $CuSO_4.5H_2O$ represents:

- (a) 1 water molecule
- (b) 2 water molecules
- **(c) 5 water molecules**
- (d) 10 water molecules

Short Answer Questions

6. Why should curd and sour substances not be kept in brass and copper vessels?

Answer: Curd and sour substances contain acids that react with brass and copper metals, forming toxic compounds that make the food unsafe for consumption.

7. How will you identify the contents of three test tubes containing distilled water, acidic solution, and basic solution using only red litmus paper?

Answer:

- Test tube with acidic solution: No change in red litmus (remains red)
- Test tube with basic solution: Red litmus turns blue
- Test tube with distilled water: No change (remains red, neutral)

8. Why does dry HCl gas not show acidic character?

Answer: Dry HCl gas does not form H^+ ions because water is absent. H^+ ions form only when HCl dissolves in water, so acidic character is shown only in aqueous solution.

9. How will you prove that glucose is not an acid despite containing hydrogen?

Answer: Pass electric current through glucose solution. Unlike acids, glucose solution will not conduct electricity because it does not produce ions.

10. What is the pH of a neutral solution? What happens to pH when acid is diluted?

Answer: pH of neutral solution is 7. When acid is diluted with water, pH increases (becomes less acidic) because concentration of H^+ ions decreases.

Long Answer Questions

11. Write balanced equations for the reaction of dilute H_2SO_4 with: (i) Zn, (ii) Al, (iii) Na_2CO_3

Answers:

(i) Zn with dilute H_2SO_4:

$$\mathrm{Zn}(s) + \mathrm{H_2SO_4}(aq) \rightarrow \mathrm{ZnSO_4}(aq) + \mathrm{H_2}(g)$$

(ii) Al with dilute H_2SO_4:

$$2\mathrm{Al}(s) + 3\mathrm{H_2SO_4}(aq) \rightarrow \mathrm{Al_2(SO_4)_3}(aq) + 3\mathrm{H_2}(g)$$

(iii) Na_2CO_3 with dilute H_2SO_4:

$$\mathrm{Na_2CO_3}(s) + \mathrm{H_2SO_4}(aq) \rightarrow \mathrm{Na_2SO_4}(aq) + \mathrm{H_2O}(l) + \mathrm{CO_2}(g)$$

12. Explain the process of water softening using washing soda.

Answer: Hard water contains dissolved Ca^{2+} and Mg^{2+} ions. Washing soda (Na_2CO_3) reacts with these ions:

$$\mathrm{Na_2CO_3} + \mathrm{Ca^{2+}} \rightarrow \mathrm{CaCO_3}\downarrow + 2\mathrm{Na^+}$$

The insoluble $CaCO_3$ precipitate is removed by filtration, softening the water.

13. Give two important uses each of baking soda and washing soda.

Answer:

Baking Soda ($NaHCO_3$):

1. Component of baking powder for making cakes and breads soft and spongy
2. Used as mild antacid for treating indigestion

Washing Soda ($Na_2CO_3.10H_2O$):

1. Removes permanent hardness of water
2. Used as cleaning agent in households and industries

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13. EXAM-FOCUSED KEY POINTS

Must Remember

✓ Acids produce H^+ ions, bases produce OH^- ions in water solution

✓ Dry HCl gas does NOT show acidic character

✓ H_2 gas burns with POP sound - characteristic test

✓ CO_2 turns lime water milky - characteristic test

✓ pH scale: 0-7 acidic, 7 neutral, 7-14 basic

✓ Concentrated H_2SO_4 must be added to water, not vice versa (ALWAYS)

✓ Neutralisation: Acid + Base → Salt + Water

✓ Chlor-alkali process produces: NaOH, Cl_2, H_2

✓ $CuSO_4.5H_2O$: 5 water molecules per formula unit

✓ Plaster of Paris: $CaSO_4.½H_2O$, stored in moisture-proof container

Common Exam Patterns

- Name the acid/base from reactions shown
- Write balanced equations for given reactions
- Explain pH changes during dilution
- Uses of bleaching powder, baking soda, washing soda
- Describe water of crystallisation with examples
- Safety precautions while handling concentrated acids/bases

REFERENCES

- RBSE Class 10 Science Chapter 2: Acids, Bases and Salts
- NCERT Science Textbook Class 10
- Standard chemical equations and laboratory procedures