

UNIQUE STUDY POINT

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Class: X	Subject: Science	Session: 2025-26
Chapter: 02 - Acids, Bases and Salts	Time: 1½ Hours	Max. Marks: 40

General Instructions:

1. All questions are compulsory.
2. This question paper contains 20 questions divided into five sections A, B, C, D and E.
3. Section A contains 10 MCQs of 1 mark each.
4. Section B contains 4 questions of 2 marks each.
5. Section C contains 3 questions of 3 marks each.
6. Section D contains 1 question of 5 marks.
7. Section E contains 2 Case Study Based questions of 4 marks each.

SECTION A - Multiple Choice Questions (1 mark each)

Q1. Which of the following will turn red litmus blue?

- (a) Lemon juice
- (b) Vinegar
- (c) Lime water
- (d) Curd

Q2. The formula of hydronium ion is:

- (a) H^+
- (b) OH^-
- (c) H_3O^+
- (d) H_2O

Q3. When blue copper sulphate crystals are heated, they turn:

- (a) Green
- (b) White
- (c) Black
- (d) Red

Q4. A solution with pH 4 is:

- (a) Strongly acidic
- (b) Weakly acidic
- (c) Neutral
- (d) Basic

Q5. Rock salt is:

- (a) Sodium chloride
- (b) Calcium chloride

- (c) Magnesium chloride
- (d) Potassium chloride

Q6. Which of the following is present in vinegar?

- (a) Citric acid
- (b) Tartaric acid
- (c) Acetic acid
- (d) Oxalic acid

Q7. When a solution of baking soda is heated, one of the products is:

- (a) Water
- (b) Oxygen
- (c) Hydrogen
- (d) Nitrogen

Q8. A base that does not dissolve in water is called:

- (a) Salt
- (b) Alkali
- (c) Insoluble base
- (d) Acid

Q9. The number of water molecules present in washing soda is:

- (a) 1
- (b) 2
- (c) 5
- (d) 10

Q10. Universal indicator shows which color in neutral solution?

- (a) Red
- (b) Green
- (c) Blue
- (d) Yellow

SECTION B - Short Answer Questions (2 marks each)

Q11. Name two strong acids and two weak acids.

Q12. What is meant by neutralization reaction? Give one example.

Q13. A compound X on treatment with chlorine gas produces bleaching powder. Name X and write the equation.

Q14. Why is plaster of Paris stored in a moisture-proof container?

SECTION C - Short Answer Questions (3 marks each)

Q15. Explain why glucose and alcohol also contain hydrogen but do not show acidic properties. Design an activity to prove this.

Q16. What is baking powder? How does it make the cake soft and spongy? Write the equation involved.

Q17. Define the following terms with one example each:

- (a) Family of salts
- (b) Water of crystallization
- (c) Alkali

SECTION D - Long Answer Question (5 marks)

- Q18.** (a) What is meant by pH? How is it useful in our daily life?
(b) Two solutions A and B have pH values of 3 and 10 respectively. Which solution will give pink colour with phenolphthalein indicator? Which is more acidic?
(c) Fresh milk has pH 6. How does pH change when it turns into curd? Explain.

SECTION E - Case Study Based Questions (4 marks each)

Q19. Case Study 1:

Washing soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) is a basic salt used for various purposes. It is prepared from baking soda by heating. Sodium carbonate can be used as a cleaning agent for domestic purposes and is used in the manufacture of glass, soap and paper. It is also used for removing permanent hardness of water by precipitating calcium and magnesium salts.

- (a) What is the chemical formula of washing soda? (1 mark)
- (b) How is washing soda prepared from baking soda? Write equations. (1 mark)
- (c) Why is it used for removing hardness of water? (1 mark)
- (d) Give two industrial uses of washing soda. (1 mark)

Q20. Case Study 2:

A student took solutions of HCl, H_2SO_4 , HNO_3 and CH_3COOH of equal concentration. He set up an apparatus with two nails fixed on a cork and connected them to a battery through a bulb. When he tested these solutions one by one, he found that the bulb glows differently with different acids. With some acids it glows brightly while with others it glows dimly.

- (a) Why do acidic solutions conduct electricity? (1 mark)
- (b) With which acid will the bulb glow most brightly? Why? (1 mark)
- (c) With which acid will the bulb glow dimly? Why? (1 mark)
- (d) Will glucose solution conduct electricity? Give reason. (1 mark)

SECTION A - Answers to MCQs

Ans 1. (c) Lime water

Lime water is calcium hydroxide $[\text{Ca}(\text{OH})_2]$ solution which is basic in nature. Bases turn red litmus blue. All other options (lemon juice, vinegar, curd) are acidic and will turn blue litmus red instead.

Ans 2. (c) H_3O^+

Hydronium ion has the formula H_3O^+ . It is formed when H^+ ion combines with water molecule: $\text{H}^+ + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+$. Hydrogen ions cannot exist alone in solution and always exist as hydronium ions.

Ans 3. (b) White

When blue copper sulphate crystals ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) are heated, they lose water of crystallization and turn white (anhydrous CuSO_4). On adding water again, the blue color reappears, showing the presence of water of crystallization.

Ans 4. (b) Weakly acidic

A solution with pH 4 is weakly acidic. pH less than 7 indicates acidic solution. pH 0-3 is strongly acidic, pH 4-6 is weakly acidic, pH 7 is neutral, and pH above 7 is basic.

Ans 5. (a) Sodium chloride

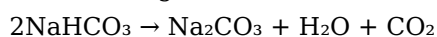
Rock salt is sodium chloride (NaCl) found in solid deposits. It was formed when seas of bygone ages dried up. It is mined like coal and often appears brown due to impurities.

Ans 6. (c) Acetic acid

Vinegar contains acetic acid (CH_3COOH), which is a weak acid with concentration of about 5-8%. It is used as a food preservative and flavoring agent.

Ans 7. (a) Water

When baking soda (NaHCO_3) is heated, it produces sodium carbonate, water, and carbon dioxide:



Water vapor condenses on the cooler parts of the container.

Ans 8. (c) Insoluble base

Bases that do not dissolve in water are simply called insoluble bases. Only bases that dissolve in water are called alkalis. Example: Copper hydroxide is an insoluble base while sodium hydroxide is an alkali.

Ans 9. (d) 10

Washing soda has the formula $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$, which contains 10 molecules of water of crystallization. These water molecules are an integral part of the crystal structure.

Ans 10. (b) Green

Universal indicator shows green color in neutral solution (pH 7). It shows red to orange in acidic solutions and blue to violet in basic solutions. The color gradually changes across the pH range.

Ans 11. Strong and Weak Acids

Two Strong Acids:

1. **Hydrochloric acid (HCl)** - Ionizes completely in water
2. **Sulphuric acid (H₂SO₄)** - Ionizes completely in water

Two Weak Acids:

1. **Acetic acid (CH₃COOH)** - Partially ionizes in water
2. **Citric acid (C₆H₈O₇)** - Partially ionizes in water

Strong acids produce more H⁺ ions and have pH 0-3, while weak acids produce fewer H⁺ ions and have pH 4-6.

Ans 12. Neutralization Reaction

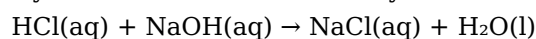
Definition: A neutralization reaction is the reaction between an acid and a base to produce salt and water.

General Equation:

Acid + Base → Salt + Water

Example:

Hydrochloric acid + Sodium hydroxide → Sodium chloride + Water

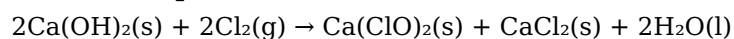


In this reaction, the acidic and basic properties are destroyed, and the products are salt (neutral) and water.

Ans 13. Preparation of Bleaching Powder

Compound X: Dry slaked lime [Calcium hydroxide - Ca(OH)₂]

Chemical Equation:



(Dry slaked lime) + (Chlorine gas) → (Bleaching powder) + (Calcium chloride) + Water

Note: It is important that slaked lime must be dry for this reaction to occur properly.

Ans 14. Storage of Plaster of Paris

Plaster of Paris should be stored in a moisture-proof container because:

1. Plaster of Paris is calcium sulphate hemihydrate: CaSO₄·½H₂O
2. It has a strong affinity for water
3. When exposed to moisture in air, it absorbs water and converts to gypsum:
$$\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + 1\frac{1}{2}\text{H}_2\text{O} \rightarrow \text{CaSO}_4 \cdot 2\text{H}_2\text{O}$$

(Plaster of Paris) → (Gypsum - hard solid)
4. Once converted to gypsum, it cannot be used for its intended purposes
5. It becomes hard and useless for making casts or decorative materials
6. Therefore, it must be kept in airtight, moisture-proof containers

SECTION C - Answers to Short Answer Questions

Ans 15. Glucose and Alcohol - Not Acidic

Explanation:

Although glucose (C₆H₁₂O₆) and alcohol (C₂H₅OH) contain hydrogen, they do not show acidic properties because:

1. Acidic properties require ionizable hydrogen:

- Only those hydrogen atoms are acidic which can be released as H⁺ ions in solution
- In glucose and alcohol, hydrogen is covalently bonded to carbon
- This C-H bond is very strong and does not break to release H⁺ ions

2. No ionization in water:

- When glucose or alcohol dissolves in water, they do not produce H⁺ ions
- They exist as complete molecules in solution
- Without H⁺ ions, no acidic properties are shown

3. Contrast with acids:

- In acids like HCl, hydrogen is ionically bonded
- It easily separates as H⁺ ion in water: HCl → H⁺ + Cl⁻
- This is why acids show acidic properties

Activity to Prove:

Materials Required: Glucose solution, alcohol solution, dilute HCl, 6V battery, bulb, switch, two nails, cork, beakers

Procedure:

1. Fix two nails on a cork and place in a beaker
2. Connect nails to battery terminals through bulb and switch
3. Pour dilute HCl in the beaker and switch on
4. **Observation:** Bulb glows brightly (HCl produces H⁺ ions - conducts electricity)
5. Repeat with glucose solution
6. **Observation:** Bulb does not glow (no ions produced)
7. Repeat with alcohol solution
8. **Observation:** Bulb does not glow (no ions produced)

Conclusion: Glucose and alcohol do not ionize in water to produce H⁺ ions, hence they do not show acidic properties or conduct electricity, unlike acids.

Ans 16. Baking Powder and Its Function**What is Baking Powder:**

Baking powder is a mixture of:

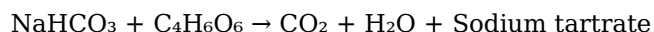
1. Baking soda (sodium hydrogencarbonate - NaHCO₃)
2. A mild edible acid (usually tartaric acid - C₄H₆O₆)

How it Makes Cake Soft and Spongy:

1. When baking powder is mixed in cake batter and heated or mixed with water, a chemical reaction occurs between baking soda and tartaric acid
2. This reaction produces carbon dioxide gas:
$$\text{NaHCO}_3 + \text{H}^+ \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{Sodium salt of acid}$$

(From tartaric acid)

3. Detailed equation:



4. The CO_2 gas produced gets trapped in the batter
5. These gas bubbles try to expand when heated in the oven
6. As the batter bakes, it sets around these bubbles
7. This creates a porous, airy structure
8. The result is a soft, spongy, and fluffy cake
9. Without baking powder, the cake would be hard and dense

Why use baking powder instead of just baking soda:

Pure baking soda needs an acidic ingredient in the recipe to produce CO_2 . Baking powder already contains the acid, so it works in any recipe.

Ans 17. Definitions with Examples

(a) Family of Salts:

Salts having the same positive or negative radicals (ions) are said to belong to a family of salts.

Example 1 - Chloride Family:

Salts containing Cl^- ion belong to the chloride family:

- NaCl (Sodium chloride)
- KCl (Potassium chloride)
- CaCl_2 (Calcium chloride)
- NH_4Cl (Ammonium chloride)

Example 2 - Sodium Family:

Salts containing Na^+ ion belong to the sodium family:

- NaCl (Sodium chloride)
- Na_2SO_4 (Sodium sulphate)
- NaNO_3 (Sodium nitrate)
- Na_2CO_3 (Sodium carbonate)

(b) Water of Crystallization:

Water of crystallization is the fixed number of water molecules present in one formula unit of a salt in its crystalline form. These water molecules are an integral part of the crystal structure.

Example:

Copper sulphate crystals ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) contain 5 molecules of water of crystallization per formula unit. Features:

- Blue color of crystals is due to this water
- When heated, water is removed and crystals turn white
- On adding water again, blue color reappears
- Chemical equation: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} \xrightarrow{\text{Heat}} \text{CuSO}_4 + 5\text{H}_2\text{O}$

Other examples:

- Gypsum: $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (2 water molecules)
- Washing soda: $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ (10 water molecules)
- Plaster of Paris: $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ ($\frac{1}{2}$ water molecule)

(c) Alkali:

An alkali is a base that dissolves in water to produce hydroxide (OH^-) ions. In other words, all alkalis are bases, but not all bases are alkalis.

Example:

Sodium hydroxide (NaOH) is an alkali because:

- It is a base (contains OH⁻)
- It dissolves readily in water
- $\text{NaOH(s)} \rightarrow \text{Na}^{\text{(aq)}} + \text{OH}^{\text{(aq)}}$
- It produces OH⁻ ions in solution

Other examples of alkalis:

- Potassium hydroxide (KOH)
- Calcium hydroxide [Ca(OH)₂] - sparingly soluble
- Ammonium hydroxide (NH₄OH)

Non-alkali base example:

Copper hydroxide [Cu(OH)₂] is a base but not an alkali because it does not dissolve in water.

SECTION D - Answer to Long Answer Question**Ans 18.** pH and Its Applications**(a) What is pH and Its Usefulness:****Definition of pH:**

- pH is a scale for measuring the concentration of hydrogen ions (H⁺) in a solution
- The 'p' stands for 'potenz' (German word meaning power)
- pH scale ranges from 0 to 14
- It indicates whether a solution is acidic, basic, or neutral
- pH 7 = Neutral (pure water)
- pH < 7 = Acidic (higher H⁺ concentration)
- pH > 7 = Basic/Alkaline (lower H⁺ concentration)
- Lower the pH value, higher the H⁺ ion concentration

Usefulness in Daily Life:**1. In Agriculture:**

- Plants require specific pH range (usually 6-7) for optimal growth
- Farmers test soil pH and add lime (if acidic) or compost (if alkaline)
- Wrong pH affects nutrient availability and crop yield

2. In Digestive System:

- Stomach produces HCl (pH 1-3) for digestion
- Excess acid causes acidity (heartburn)
- Antacids (mild bases) neutralize excess acid
- Our body maintains blood pH at 7.4 for proper functioning

3. In Oral Care:

- Tooth enamel corrodes when mouth pH < 5.5
- Bacteria produce acids from food sugars
- Toothpastes are basic to neutralize these acids
- Prevents tooth decay

4. In Bee/Ant Stings:

- Bee sting contains acid (lowers pH of skin)

- Baking soda (base) neutralizes the acid
- Provides relief from pain

(b) Solutions A and B Analysis:

Given:

- Solution A: pH = 3
- Solution B: pH = 10

Which gives pink color with phenolphthalein:

Solution B (pH 10) will give pink color with phenolphthalein because:

- Phenolphthalein is colorless in acidic medium
- It turns pink in basic medium
- Solution B is basic (pH > 7)
- Solution A is acidic (pH < 7), so it will remain colorless

Which is more acidic:

Solution A (pH 3) is more acidic because:

- pH 3 < 7, hence acidic
- pH 10 > 7, hence basic (not acidic at all)
- Lower the pH, more acidic the solution
- Solution A has higher H⁺ ion concentration than solution B

(c) pH Change from Milk to Curd:

pH of fresh milk: 6 (slightly acidic to neutral)

Change when it turns to curd:

When fresh milk turns into curd, the pH **decreases** (becomes more acidic).

Explanation:

1. Bacterial action:

- Lactobacillus bacteria present in milk become active
- They multiply and ferment lactose (milk sugar)

2. Lactic acid formation:

- Lactose is converted to lactic acid by bacteria
- $C_{12}H_{22}O_{11}$ (Lactose) \rightarrow $4C_3H_6O_3$ (Lactic acid)

3. pH decrease:

- Lactic acid is produced and accumulates
- This increases H⁺ ion concentration
- pH drops from 6 to about 4.5-5.0
- The solution becomes more acidic

4. Curd formation:

- The acidic environment causes milk proteins to coagulate
- This gives curd its thick, semi-solid texture
- The sour taste of curd is due to lactic acid

Summary: Fresh milk (pH 6) \rightarrow Curd (pH 4.5-5.0)

Direction: pH decreases (becomes more acidic)

SECTION E - Answers to Case Study Based Questions

Ans 19. Case Study 1 - Washing Soda

(a) Chemical formula of washing soda:

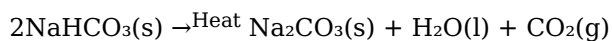
$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ (Sodium carbonate decahydrate)

Where:

- Na_2CO_3 = Sodium carbonate
- $10\text{H}_2\text{O}$ = Ten molecules of water of crystallization

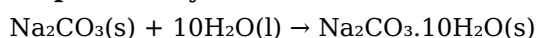
(b) Preparation from baking soda:

Step 1 - Heating baking soda:



(Sodium hydrogencarbonate) → (Sodium carbonate) + Water + Carbon dioxide

Step 2 - Recrystallization:



(Sodium carbonate) + (Water) → (Washing soda crystals)

The sodium carbonate obtained from heating is dissolved in water and then recrystallized to obtain washing soda crystals with 10 water molecules.

(c) Why used for removing hardness of water:

Washing soda removes permanent hardness of water because:

1. Permanent hardness is caused by dissolved calcium and magnesium chlorides and sulphates
2. Na_2CO_3 reacts with these salts to form insoluble carbonates:
$$\text{Na}_2\text{CO}_3 + \text{CaCl}_2 \rightarrow \text{CaCO}_3 \downarrow + 2\text{NaCl}$$
$$\text{Na}_2\text{CO}_3 + \text{MgSO}_4 \rightarrow \text{MgCO}_3 \downarrow + \text{Na}_2\text{SO}_4$$
3. Calcium carbonate and magnesium carbonate are insoluble
4. They precipitate out and can be removed by filtration
5. The water becomes soft (free from Ca^{2+} and Mg^{2+} ions)
6. Soft water is better for washing and other uses

(d) Two industrial uses:

1. Glass industry:

- Essential raw material for manufacturing glass
- Used in making soda-lime glass (common glass)
- Mixed with sand (SiO_2) and calcium carbonate (CaCO_3)

2. Soap and paper industry:

- Used in the manufacture of soap
- Important chemical in paper manufacturing
- Also used in textile industry for processing

Ans 20. Case Study 2 - Electrical Conductivity

(a) Why acidic solutions conduct electricity:

Acidic solutions conduct electricity because:

1. When acids dissolve in water, they dissociate into ions
2. For example: $\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$



3. These ions (H^+ and anions) are charged particles
4. When electric current is passed through the solution:
 - H^+ ions (cations) move towards cathode (negative electrode)
 - Anions (Cl^- , SO_4^{2-} , etc.) move towards anode (positive electrode)
5. This movement of ions constitutes electric current
6. The bulb glows, indicating current flow
7. More ions = Better conductivity = Brighter glow

(b) Acid with brightest glow and reason:

The bulb will glow most brightly with **H_2SO_4 (Sulphuric acid)**

Reason:

1. H_2SO_4 is a strong acid - ionizes completely
2. Each molecule gives 2 H^+ ions:

$$H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$$
3. Therefore, it produces maximum number of ions
4. More ions = Better conductivity
5. HCl and HNO_3 also ionize completely but give only 1 H^+ per molecule
6. So H_2SO_4 has highest ion concentration among the given acids
7. Hence brightest glow

(c) Acid with dim glow and reason:

The bulb will glow dimly with **CH_3COOH (Acetic acid)**

Reason:

1. CH_3COOH is a weak acid
2. It does not ionize completely in water
3. Partial ionization: $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$
 (Only small fraction ionizes)
4. Produces fewer H^+ ions compared to strong acids
5. Fewer ions = Poor conductivity
6. Hence bulb glows dimly
7. While HCl , H_2SO_4 , HNO_3 ionize completely (100%),
 CH_3COOH ionizes only about 1-2% at same concentration

(d) Will glucose solution conduct electricity:

No, glucose solution will NOT conduct electricity.

Reason:

1. Glucose ($C_6H_{12}O_6$) is not an acid or ionic compound
2. When glucose dissolves in water, it does NOT ionize
3. It exists as complete neutral molecules in solution
4. No ions are formed: $C_6H_{12}O_6(s) \rightarrow C_6H_{12}O_6(aq)$
5. Without ions, there are no charge carriers
6. Therefore, electric current cannot flow
7. The bulb will NOT glow with glucose solution
8. This proves that merely containing hydrogen is not enough to be acidic
9. Only ionizable hydrogen that can be released as H^+ ions makes a substance acidic

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