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 is used for whitewashing walls?

(a) Calcium oxide

(b) Calcium hydroxide

(c) Calcium carbonate

(d) Calcium chloride

Q2. Turmeric stain on white shirt turns reddish-brown when washed with soap because:

(a) Soap is acidic

(b) Soap is basic

(c) Soap is neutral

(d) Turmeric changes color naturally

Q3. Which of the following gases is produced when dilute HCl reacts with sodium carbonate?

(a) Hydrogen

(b) Oxygen

(c) Carbon dioxide

(d) Sulphur dioxide

Q4. The pH of lemon juice is approximately:

(a) 2.2

(b) 7.0

(c) 10.5

(d) 14.0

Q5. Which of the following is a use of washing soda?

(a) Making antacids

(b) Removing permanent hardness of water

(c) Making plaster for fractured bones
(d) Making baking powder

Q6. Sodium hydroxide solution is:
(a) Soapy to touch and bitter in taste
(b) Sour in taste
(c) Sweet in taste
(d) Saltish in taste

Q7. Metal compound A reacts with dilute HCl to produce effervescence. The gas evolved extinguishes a burning candle. The metal compound A is:
(a) Metal oxide
(b) Metal carbonate
(c) Metal sulphate
(d) Metal chloride

Q8. When concentrated sulphuric acid is added to water, the process is:
(a) Endothermic
(b) Exothermic
(c) Neither exothermic nor endothermic
(d) Sometimes exothermic, sometimes endothermic

Q9. Acid rain occurs when the pH of rainwater is:
(a) More than 7
(b) Equal to 7
(c) Less than 5.6
(d) Between 6 and 7

Q10. Number of water molecules in plaster of Paris is:
(a) 2
(b) 1
(c) ½
(d) 5

SECTION B - Short Answer Questions (2 marks each)

Q11. While diluting an acid, why is it recommended that acid should be added to water and not water to acid?

Q12. How is the concentration of hydroxide ions affected when excess base is dissolved in a solution of sodium hydroxide?

Q13. Name the gas evolved when dilute HCl reacts with sodium hydrogencarbonate. How will you test for this gas?

Q14. What is the common name of $Ca(ClO)_2$? Give one use of this compound.

SECTION C - Short Answer Questions (3 marks each)

Q15. A farmer has a field where the soil is acidic. Suggest two chemical compounds which he can add to neutralize the excess acid. Explain your answer with equations.

Q16. How is washing soda prepared from baking soda? Write the chemical equations involved. Give

two uses of washing soda.

Q17. What is meant by dilution? Explain why mixing concentrated acid or base with water is an exothermic process.

SECTION D - Long Answer Question (5 marks)

Q18. (a) Explain why metallic oxides are called basic oxides and non-metallic oxides are called acidic oxides. Give one example of each.
(b) Write the balanced chemical equations for:
(i) Copper oxide reacting with dilute HCl
(ii) Carbon dioxide reacting with calcium hydroxide

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

Q19. Case Study 1:
Limestone, chalk and marble are different forms of calcium carbonate ($CaCO_3$). All metal carbonates and hydrogencarbonates react with acids to give corresponding salt, carbon dioxide and water. When carbon dioxide is passed through lime water, it turns milky. On passing excess CO_2, the milky color disappears due to formation of soluble calcium hydrogencarbonate.

(a) What are the different forms of calcium carbonate? (1 mark)

(b) Write the equation for reaction of calcium carbonate with HCl. (1 mark)

(c) Why does lime water turn milky when CO_2 is passed through it? (1 mark)

(d) Why does the milkiness disappear on passing excess CO_2? Write the equation. (1 mark)

Q20. Case Study 2:
Bee sting and nettle sting contain methanoic acid which causes pain and irritation. Traditional remedies for such stings include rubbing the affected area with baking soda solution or the leaf of dock plant. These remedies work on the principle of neutralization. Plants require specific pH range for their healthy growth.

(a) Which acid is present in bee sting and nettle sting? (1 mark)

(b) Why does baking soda solution provide relief from bee sting? (1 mark)

(c) What is the nature of dock plant leaf? (1 mark)

(d) Why do plants require specific pH range for growth? (1 mark)

DETAILED ANSWER KEY - PAPER 03

SECTION A - Answers to MCQs

Ans 1. (b) Calcium hydroxide

Calcium hydroxide [$Ca(OH)_2$], also called slaked lime, is used for whitewashing walls. It reacts with CO_2 from air to form calcium carbonate ($CaCO_3$) which gives a shiny white finish:
$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

Ans 2. (b) Soap is basic

Turmeric is a natural indicator. It is yellow in acidic and neutral medium but turns reddish-brown in basic medium. Since soap is basic in nature, it turns turmeric stain reddish-brown. This demonstrates that turmeric can be used as an acid-base indicator.

Ans 3. (c) Carbon dioxide

When dilute HCl reacts with sodium carbonate, carbon dioxide gas is evolved:
$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2\uparrow$
This CO_2 can be tested by passing it through lime water which turns milky.

Ans 4. (a) 2.2

Lemon juice contains citric acid and is highly acidic with pH around 2.2. This is much less than 7, indicating high H^+ ion concentration. Other acidic solutions include gastric juice (pH ~1.2) and vinegar (pH ~2.4).

Ans 5. (b) Removing permanent hardness of water

Washing soda ($Na_2CO_3.10H_2O$) is used to remove permanent hardness of water by precipitating calcium and magnesium salts. It is also used in glass, soap and paper industries, and in manufacturing sodium compounds like borax.

Ans 6. (a) Soapy to touch and bitter in taste

Sodium hydroxide (NaOH) is a strong base. All bases are soapy to touch and bitter in taste. However, we should never taste or touch strong bases as they are corrosive and can cause severe burns.

Ans 7. (b) Metal carbonate

Metal carbonates react with dilute acids to produce effervescence (bubbles) due to CO_2 evolution. CO_2 extinguishes burning candle. Example: $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2\uparrow$. This is a test for carbonates.

Ans 8. (b) Exothermic

Dissolving concentrated sulphuric acid in water is a highly exothermic process that releases large amount of heat. This is why acid should always be added slowly to water with stirring, never water to acid, to prevent dangerous splashing and container breakage.

Ans 9. (c) Less than 5.6

Normal rainwater is slightly acidic (pH ~5.6) due to dissolved CO_2. When pH falls below 5.6 due to dissolved acidic gases like SO_2 and NO_2 from pollution, it is called acid rain. It is harmful for aquatic life, buildings, and plants.

Ans 10. (c) ½

Plaster of Paris has the formula $CaSO_4.½H_2O$. The ½ water molecule means two formula units of $CaSO_4$ share one molecule of water. It is obtained by heating gypsum ($CaSO_4.2H_2O$) at 373 K.

SECTION B - Answers to Short Answer Questions

Ans 11. Dilution of Acid - Safety Precaution

Acid should always be added to water and never water to acid because:

1. **Highly exothermic process:** Dissolving concentrated acid in water releases large amount of heat
2. **If water is added to acid:**
   - The small amount of water gets heated instantly to very high temperature
   - This can cause the mixture to splash out violently
   - The splashing acid can cause severe burns
   - The glass container may break due to excessive local heating
3. **If acid is added to water:**
   - Heat is absorbed by large volume of water
   - Temperature rise is gradual and controlled
   - Safe dilution occurs without splashing

Warning: Always look for the warning sign on containers of concentrated acids and bases.

Ans 12. Effect on OH^- Ion Concentration

When excess base is dissolved in a solution of sodium hydroxide:

1. More NaOH molecules are added to the solution
2. NaOH dissociates completely: $NaOH \rightarrow Na^+ + OH^-$
3. This increases the number of OH^- ions in the solution
4. The concentration of hydroxide ions (OH^-) increases
5. As OH^- concentration increases, H^+ concentration decreases
6. The pH of solution increases (becomes more basic)
7. The solution becomes more alkaline

Ans 13. Gas Evolution and Test

Gas evolved: Carbon dioxide (CO_2)

Chemical Equation:
$NaHCO_3(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + CO_2(g)$

Test for CO_2 gas:

1. Pass the evolved gas through lime water [$Ca(OH)_2$ solution]
2. If the gas is CO_2, lime water will turn milky
3. This happens due to formation of insoluble calcium carbonate:
   $Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$
   (Lime water) (White precipitate - milky)
4. On passing excess CO_2, milkiness disappears due to formation of soluble calcium hydrogencarbonate

Ans 14. Common Name and Use

Common name: $Ca(ClO)_2$ is commonly called **Bleaching powder**
Chemical name: Calcium hypochlorite (though actual composition is complex)

One important use:
Bleaching powder is used for disinfecting drinking water to make it free from germs. When added to water, it releases chlorine which kills harmful bacteria and other microorganisms.

Other uses: Bleaching cotton and linen in textile industry, bleaching wood pulp in paper factories, as an oxidizing agent in chemical industries.

SECTION C - Answers to Short Answer Questions

Ans 15. Neutralizing Acidic Soil

Two chemical compounds to neutralize acidic soil:

1. Slaked lime [Calcium hydroxide - $Ca(OH)_2$]:
• It is a base that neutralizes acids in soil
• Reaction: $Ca(OH)_2 + 2H^+ \rightarrow Ca^{2+} + 2H_2O$
• Being a strong base, it effectively raises soil pH
• Easily available and economical

2. Quick lime (Calcium oxide - CaO):
• Reacts with water to form $Ca(OH)_2$: $CaO + H_2O \rightarrow Ca(OH)_2$
• Then $Ca(OH)_2$ neutralizes soil acidity
• Overall reaction: $CaO + 2H^+ \rightarrow Ca^{2+} + H_2O$

Alternative - Chalk (Calcium carbonate - $CaCO_3$):
• Reacts with acid to neutralize it
• $CaCO_3 + 2H^+ \rightarrow Ca^{2+} + H_2O + CO_2\uparrow$
• Milder than CaO or $Ca(OH)_2$
• Safer to use in large quantities

Process called: This treatment of soil is called liming. It is essential because most plants require pH between 6-7 for optimal growth. Acidic soil (pH < 6) hampers nutrient availability and plant growth.

Ans 16. Preparation of Washing Soda

Preparation from Baking Soda:

Step 1: Baking soda (sodium hydrogencarbonate) is heated:
$2NaHCO_3(s) \xrightarrow{Heat} Na_2CO_3(s) + H_2O(l) + CO_2(g)$
(Sodium hydrogencarbonate) → (Sodium carbonate) + Water + Carbon dioxide

Step 2: Sodium carbonate is dissolved in water and recrystallized:
$Na_2CO_3(s) + 10H_2O(l) \rightarrow Na_2CO_3.10H_2O(s)$
(Sodium carbonate) → (Washing soda)

The $10H_2O$ represents water of crystallization.

Two Uses of Washing Soda:

1. **Removing permanent hardness of water:**

- Reacts with calcium and magnesium salts in hard water
- Precipitates them as insoluble carbonates
- Makes water soft for washing and other purposes

2. Manufacturing glass:
- Important raw material in glass industry
- Used in making soda-lime glass
- Also used in soap and paper industries

Ans 17. Dilution and Exothermic Nature

What is Dilution:
Dilution is the process of decreasing the concentration of ions (H_3O^+ or OH^-) per unit volume by adding more water to an acid or base solution. When an acid or base is diluted:
- The number of H_3O^+ ions (in acid) or OH^- ions (in base) remains same
- But they are distributed in larger volume of water
- Therefore, concentration (ions per unit volume) decreases
- The acid becomes less acidic and base becomes less basic

Why Mixing is Exothermic:
Mixing concentrated acid or base with water is a highly exothermic process because:

1. **Ion-dipole interaction:**
   - Acid or base molecules interact strongly with water molecules
   - When H^+ ions from acid (or OH^- from base) get hydrated, strong bonds form
   - Example: $H^+ + H_2O \rightarrow H_3O^+$ (hydronium ion formation)

2. **Energy release:**
   - The process of hydration releases large amount of energy
   - This energy is released as heat
   - The heat generated can be so much that water may boil

3. **Breaking of molecular structure:**
   - Concentrated acids/bases have organized molecular structure
   - Adding water breaks this structure
   - This breaking and new bond formation releases heat

Safety Note: Due to this exothermic nature, concentrated acid must always be added slowly to water with constant stirring, never water to acid.

SECTION D - Answer to Long Answer Question

Ans 18. Metallic and Non-metallic Oxides

(a) Why Metallic Oxides are Basic and Non-metallic Oxides are Acidic:

Metallic Oxides - Basic Oxides:
Metallic oxides are called basic oxides because they react with acids to give salt and water, similar to how bases react with acids:

Metal oxide + Acid → Salt + Water

Example: Copper oxide (CuO)
• CuO is a metallic oxide
• It reacts with acids like a base:
$CuO + 2HCl \rightarrow CuCl_2 + H_2O$
$CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$
• This behavior is characteristic of bases
• Hence, metallic oxides are basic in nature
• Other examples: Na_2O, MgO, Al_2O_3, ZnO, Fe_2O_3

Non-metallic Oxides - Acidic Oxides:
Non-metallic oxides are called acidic oxides because they react with bases to give salt and water, similar to how acids react with bases:

Non-metal oxide + Base → Salt + Water

Example: Carbon dioxide (CO_2)
• CO_2 is a non-metallic oxide
• It reacts with bases like an acid:
$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$
$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$
• This behavior is characteristic of acids
• Hence, non-metallic oxides are acidic in nature
• Other examples: SO_2, SO_3, NO_2, P_4O_{10}

(b) Balanced Chemical Equations:

(i) Copper oxide reacting with dilute HCl:
$CuO(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$
(Black copper oxide) + (Hydrochloric acid) → (Blue-green copper chloride solution) + Water

Observation: Black copper oxide dissolves in HCl to form blue-green solution of copper(II) chloride. This demonstrates that metallic oxides react with acids like bases do.

(ii) Carbon dioxide reacting with calcium hydroxide:
$CO_2(g) + Ca(OH)_2(aq) \rightarrow CaCO_3(s) + H_2O(l)$
(Carbon dioxide) + (Lime water) → (Calcium carbonate - white precipitate) + Water

Observation: CO_2 gas turns lime water milky due to formation of insoluble calcium carbonate. This is used as a test for CO_2. This demonstrates that non-metallic oxides react with bases like acids do.

SECTION E - Answers to Case Study Based Questions

Ans 19. Case Study 1 - Calcium Carbonate Forms

(a) Different forms of calcium carbonate:
Calcium carbonate ($CaCO_3$) exists in three main natural forms:

1. **Limestone** - Sedimentary rock form
2. **Chalk** - Soft, porous form
3. **Marble** - Metamorphic rock form (hardest and most crystalline)

All three have the same chemical composition ($CaCO_3$) but different physical properties.

(b) Reaction of calcium carbonate with HCl:
$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$
(Calcium carbonate) + (Hydrochloric acid) → (Calcium chloride) + Water + (Carbon dioxide)

This reaction is common to all metal carbonates and is used to test for the presence of carbonate ions.

(c) Why lime water turns milky:
Lime water turns milky when CO_2 is passed through it because:

1. CO_2 reacts with calcium hydroxide in lime water
2. Reaction: $Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$
3. Calcium carbonate ($CaCO_3$) formed is insoluble in water
4. It forms a white precipitate suspended in water
5. This white suspension makes the solution appear milky
6. This is used as a confirmatory test for CO_2 gas

(d) Disappearance of milkiness:
When excess CO_2 is passed through milky lime water, the milkiness disappears because:

Chemical Equation:
$CaCO_3(s) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2(aq)$
(Calcium carbonate - insoluble) → (Calcium hydrogencarbonate - soluble)

Explanation:

- The white precipitate $CaCO_3$ reacts with excess CO_2 and water
- Forms calcium hydrogencarbonate [$Ca(HCO_3)_2$]
- $Ca(HCO_3)_2$ is soluble in water
- As the insoluble precipitate dissolves, milkiness disappears
- Solution becomes clear again

Ans 20. Case Study 2 - Neutralization in Nature

(a) Acid in bee sting and nettle sting:
Methanoic acid (also called formic acid, HCOOH) is present in both bee sting and nettle sting. When the stinging hair of nettle plant or the sting of a bee pierces the skin, this acid is injected, causing burning pain and irritation.

(b) Why baking soda provides relief:
Baking soda (sodium hydrogencarbonate - $NaHCO_3$) provides relief from bee sting because:

1. Baking soda is a mild base (alkaline substance)
2. Methanoic acid from the sting is acidic
3. When baking soda is applied, neutralization reaction occurs:
   $HCOOH + NaHCO_3 \rightarrow HCOONa + H_2O + CO_2$
   (Acid from sting) + (Baking soda - base) → (Salt) + Water + Carbon dioxide
4. The acid is neutralized and converted to harmless salt and water
5. This reduces the acidic effect and provides relief from pain
6. The principle used is: **Base neutralizes acid**

(c) Nature of dock plant leaf:
The dock plant leaf is **basic (alkaline) in nature**. That's why it provides relief when rubbed on nettle sting - it neutralizes the methanoic acid from the sting. This is a natural example of neutralization. Dock plants often grow near nettle plants in nature, providing a natural remedy.

(d) Why plants require specific pH range:
Plants require specific pH range for healthy growth because:

1. **Nutrient availability:** Different nutrients are available to plants at different pH levels. If pH is too high or too low, essential nutrients become unavailable
2. **Enzyme activity:** Plant enzymes work best at specific pH. Wrong pH affects metabolic activities
3. **Microbial activity:** Beneficial soil microorganisms that help in nitrogen fixation and decomposition thrive at specific pH
4. **Root growth:** Extreme pH can damage root cells and inhibit root growth
5. **Toxic elements:** At very low pH (highly acidic), toxic elements like aluminum become soluble and can harm plants
6. **Optimal range:** Most plants grow best in slightly acidic to neutral soil (pH 6-7), though some plants like azaleas prefer more acidic soil

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