

Comprehensive Study Guide: CBSE Class 10

Science - Chapter 2

Acids, Bases and Salts

Important Concepts with Detailed Explanations

1. Acids

- Definition: Substances that release H^+ ions in aqueous solution and turn blue litmus red.
- Properties:
 - Sour taste (edible acids only)
 - Conduct electricity in aqueous solution due to H^+ ions
 - React with metals to produce hydrogen gas:
$$Zn + 2HCl \rightarrow ZnCl_2 + H_2 \uparrow$$
 - React with metal carbonates/hydrogen carbonates to produce CO_2 :
$$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2 \uparrow$$
- Types:
 - *Mineral acids*: HCl , H_2SO_4 , HNO_3 (inorganic, strong)
 - *Organic acids*: Citric acid, acetic acid (from living organisms)

2. Bases

- Definition: Substances that release OH^- ions in aqueous solution and turn red litmus blue.
- Properties:
 - Bitter taste, soapy feel
 - Conduct electricity due to OH^- ions
 - React with acids to form salt and water (neutralization)
- Alkalis: Water-soluble bases (e.g., $NaOH$, KOH)

3. Indicators

Indicator	Acidic Medium	Basic Medium	Neutral
Litmus	Red	Blue	Purple

Phenolphthalein	Colorless	Pink	Colorless
Methyl Orange	Red	Yellow	Orange
Turmeric	Yellow	Red-Brown	Yellow
Red Cabbage Extract	Red/Pink	Green	Purple

4. pH Scale

- Range: 0 to 14 (logarithmic scale measuring H^+ ion concentration)
- $pH < 7$: Acidic | $pH = 7$: Neutral | $pH > 7$: Basic
- Important pH Values:
 - Gastric juice: 1.5-3.5
 - Lemon juice: ~2.5
 - Vinegar: ~3
 - Normal rainwater: 5.6 (due to dissolved CO_2 forming carbonic acid)
 - Acid rain: $pH < 5.6$
 - Pure water: 7.0
 - Blood: 7.3-7.5
 - Tooth decay begins when mouth $pH < 5.5$

5. Neutralization Reaction

- Acid + Base $\rightarrow$ Salt + Water
 $HCl + NaOH \rightarrow NaCl + H_2O$
- Applications:
 - Antacids for acidity relief
 - Soil treatment (adding lime to acidic soil)
 - Bee sting treatment (baking soda paste)

6. Salts

- Formed by replacement of H^+ ions of acid with metal/ammonium ions
- Types based on parent acid-base strength:
 - Strong acid + Strong base $\rightarrow$ Neutral salt ($pH = 7$), e.g., NaCl
 - Strong acid + Weak base $\rightarrow$ Acidic salt ($pH < 7$), e.g., NH_4Cl
 - Weak acid + Strong base $\rightarrow$ Basic salt ($pH > 7$), e.g., CH_3COONa

7. Family of Salts

- Chlorides: NaCl, KCl (from HCl)
- Sulphates: Na₂SO₄, CuSO₄ (from H₂SO₄)
- Nitrates: NaNO₃, KNO₃ (from HNO₃)
- Carbonates: Na₂CO₃, CaCO₃ (from H₂CO₃)

8. pH in Everyday Life

- Digestion: HCl in stomach (pH 1.5-3.5); excess causes acidity
- Tooth decay: Bacteria produce acids from sugar → pH < 5.5 → enamel corrosion
- Soil pH: Affects crop growth; adjusted using lime (basic) or organic matter (acidic)
- Self-defense: Bee sting (acidic) treated with baking soda; Wasp sting (basic) treated with vinegar

9. Important Salts

Salt	Chemical Formula	Preparation	Uses
Common Salt	NaCl	Sea water evaporation	Food seasoning, raw material for chemicals
Sodium Hydroxide	NaOH	Chlor-alkali process: $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{Cl}_2 + \text{H}_2$	Soap, paper, textiles
Bleaching Powder	CaOCl ₂	$\text{Cl}_2 + \text{Ca(OH)}_2 \rightarrow \text{CaOCl}_2 + \text{H}_2\text{O}$	Disinfectant, bleaching
Baking Soda	NaHCO ₃	$\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2 + \text{NH}_3 \rightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl}$	Antacid, baking
Washing Soda	Na ₂ CO ₃ ·10H ₂ O	Heating baking soda: $2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$	Water softening, cleaning
Plaster of Paris	CaSO ₄ ·½H ₂ O	Heating gypsum at 373K: $\text{CaSO}_4 \cdot 2\text{H}_2\text{O} \rightarrow \text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + 1\frac{1}{2}\text{H}_2\text{O}$	Casts, fireproofing

10. Water of Crystallisation

- Fixed number of water molecules present in crystal structure
 - Examples:
 - $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (blue vitriol) - blue crystals
 - $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ (washing soda)
 - $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (gypsum)
 - Heating effect: Crystals lose water $\rightarrow$ become anhydrous powder (e.g., blue $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} \rightarrow$ white anhydrous CuSO_4)
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Practice Questions (Based on CBSE Pattern 2021-2025)

Section A: Multiple Choice Questions (50 Questions)

Note: These questions reflect the pattern, difficulty level, and concepts tested in CBSE exams 2021-2025. Exact questions from board papers cannot be reproduced due to copyright restrictions, but these are representative practice questions.

1. Which of the following solutions has the highest concentration of H^+ ions?
 - (a) pH = 3
 - (b) pH = 5
 - (c) pH = 7
 - (d) pH = 9

Answer: (a) pH = 3

Explanation: Lower pH means higher H^+ concentration. pH is logarithmic: pH 3 has 100 times more H^+ than pH 5.

2. Phenolphthalein indicator gives pink colour in:
 - (a) Acidic solution
 - (b) Neutral solution
 - (c) Basic solution
 - (d) Both acidic and basic solutions

Answer: (c) Basic solution

Explanation: Phenolphthalein is colorless in acidic/neutral medium (pH < 8.2) and turns pink in basic medium (pH 8.2-10.0).

3. Rain is called acid rain when its pH is:
 - (a) More than 7
 - (b) Less than 7
 - (c) Less than 5.6
 - (d) Exactly 7

Answer: (c) Less than 5.6

Explanation: Normal rain has pH 5.6 due to dissolved CO_2 forming carbonic acid. Acid rain (pH < 5.6) contains additional acids from atmospheric pollutants (SO_2 , NO_x).

4. Tooth decay starts when the pH of mouth is lower than:

- (a) 7.0
- (b) 6.5
- (c) 5.5
- (d) 4.5

Answer: (c) 5.5

Explanation: Below pH 5.5, tooth enamel (calcium phosphate) starts dissolving due to acidic environment created by bacterial action on sugars.

5. Which gas is evolved when dilute HCl reacts with sodium hydrogen carbonate?

- (a) Hydrogen
- (b) Oxygen
- (c) Carbon dioxide
- (d) Chlorine

Answer: (c) Carbon dioxide

Explanation: $\text{NaHCO}_3 + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2\uparrow$. This reaction is used in fire extinguishers and baking.

6. The chemical formula of bleaching powder is:

- (a) CaCl_2
- (b) Ca(OH)_2
- (c) CaOCl_2
- (d) CaCO_3

Answer: (c) CaOCl_2

Explanation: Prepared by passing chlorine gas over dry slaked lime: $\text{Ca(OH)}_2 + \text{Cl}_2 \rightarrow \text{CaOCl}_2 + \text{H}_2\text{O}$.

7. Which of the following salts does NOT contain water of crystallisation?

- (a) Blue vitriol
- (b) Gypsum
- (c) Baking soda
- (d) Washing soda

Answer: (c) Baking soda

Explanation: Baking soda (NaHCO_3) is anhydrous. Blue vitriol = $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, Gypsum = $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, Washing soda = $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$.

8. Plaster of Paris is obtained by heating gypsum at:

- (a) 373 K
- (b) 393 K
- (c) 473 K
- (d) 573 K

Answer: (a) 373 K

Explanation: $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (gypsum) $\rightarrow$ $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ (POP) + $1\frac{1}{2}\text{H}_2\text{O}$ at 373 K (100°C).

9. Which of the following is a weak acid?

- (a) HCl
- (b) H_2SO_4

- (c) HNO_3
- (d) CH_3COOH

Answer: (d) CH_3COOH

Explanation: Acetic acid partially dissociates in water, while mineral acids (HCl , H_2SO_4 , HNO_3) completely dissociate.

10. The pH of a solution increases when:

- (a) More acid is added
- (b) More base is added
- (c) Solution is diluted with water
- (d) Temperature is increased

Answer: (b) More base is added

Explanation: Adding base decreases H^+ concentration, increasing pH value.

11. Which natural indicator turns red in acidic medium and green in basic medium?

- (a) Turmeric
- (b) Litmus
- (c) Red cabbage extract
- (d) Phenolphthalein

Answer: (c) Red cabbage extract

Explanation: Red cabbage contains anthocyanin pigments that show multiple colour changes across pH range: red/pink (acidic), purple (neutral), green/yellow (basic). This makes it a crude universal indicator.

12. A solution turns blue litmus red but does not affect red litmus. The solution is:

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

Answer: (a) Acidic

Explanation: Acidic solutions turn blue litmus red. Red litmus remains red in acidic medium (no colour change), so the statement "does not affect red litmus" is consistent with acidic nature.

13. Universal indicator shows green colour for a solution. The approximate pH of solution is:

- (a) 2
- (b) 5
- (c) 7
- (d) 10

Answer: (c) 7

Explanation: Universal indicator colour chart: Red (pH 1-2), Orange/Yellow (pH 3-6), Green (pH 7), Blue (pH 8-11), Violet (pH 12-14).

14. Which of the following has the lowest pH value?

- (a) Gastric juice
- (b) Lemon juice
- (c) Vinegar

(d) Coffee

Answer: (a) Gastric juice

Explanation: Gastric juice (pH 1.5-3.5) contains concentrated HCl for digestion. Lemon juice (~2.5), vinegar (~3), coffee (~5) are less acidic.

15. If $[H^+] = 1 \times 10^{-5} \text{ M}$, the pH of solution is:

(a) 4

(b) 5

(c) 6

(d) 7

Answer: (b) 5

Explanation: $\text{pH} = -\log_{10}[H^+] = -\log_{10}(10^{-5}) = 5$. This demonstrates the logarithmic nature of pH scale.

16. Methyl orange shows orange colour in a solution. The solution is likely:

(a) Strongly acidic

(b) Weakly acidic

(c) Neutral

(d) Basic

Answer: (c) Neutral

Explanation: Methyl orange: Red (pH < 3.1), Orange (pH 3.1-4.4), Yellow (pH > 4.4). Orange at transition zone indicates near-neutral pH.

17. Which indicator is most suitable for titration of weak acid with strong base?

(a) Litmus

(b) Methyl orange

(c) Phenolphthalein

(d) Turmeric

Answer: (c) Phenolphthalein

Explanation: Weak acid-strong base titration has equivalence point in basic range (pH 8-10). Phenolphthalein changes colour at pH 8.2-10.0, making it ideal.

18. The pH of a solution decreases when:

(a) Water is added to acid

(b) Base is added to acid

(c) Acid is added to water

(d) Salt is added to water

Answer: (c) Acid is added to water

Explanation: Adding acid increases H^+ concentration, decreasing pH. Dilution of acid with water actually increases pH (makes less acidic).

19. Which soil condition requires addition of quicklime (CaO)?

(a) pH 4.5

(b) pH 7.0

(c) pH 8.5

(d) pH 10.0

Answer: (a) pH 4.5

Explanation: pH 4.5 indicates highly acidic soil. Quicklime (basic) neutralizes soil acidity: $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$; $\text{Ca(OH)}_2 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + 2\text{H}_2\text{O}$.

20. Aquatic organisms survive best in water with pH range:

- (a) 2-4
- (b) 5-6
- (c) 7-8
- (d) 10-12

Answer: (c) 7-8

Explanation: Most aquatic life requires near-neutral pH (6.5-8.5). Acid rain (pH < 5.6) kills fish and aquatic plants by disrupting metabolic processes.

21. Which statement about pH is INCORRECT?

- (a) pH 3 has 10 times more H^+ than pH 4
- (b) pH 9 has 100 times less H^+ than pH 7
- (c) pH 0 means no H^+ ions present
- (d) pH scale is logarithmic

Answer: (c) pH 0 means no H^+ ions present

Explanation: pH 0 means $[\text{H}^+] = 1 \text{ M}$ (very high concentration). Lower pH = higher H^+ concentration. pH 7 is neutral, not pH 0.

22. A solution with pH 13 has $[\text{OH}^-]$ concentration of:

- (a) 10^{-1} M
- (b) 10^{-7} M
- (c) 10^{-13} M
- (d) 10^{-14} M

Answer: (a) 10^{-1} M

Explanation: $\text{pH} + \text{pOH} = 14 \rightarrow \text{pOH} = 1 \rightarrow [\text{OH}^-] = 10^{-\text{pOH}} = 10^{-1} \text{ M}$. High $[\text{OH}^-]$ confirms strong basic nature.

23. Which household substance has pH closest to 9?

- (a) Lemon juice
- (b) Baking soda solution
- (c) Vinegar
- (d) Soft drink

Answer: (b) Baking soda solution

Explanation: Baking soda (NaHCO_3) solution is mildly basic (pH 8.3-8.6).

Lemon juice (~2.5), vinegar (~3), soft drinks (~2.5-4) are acidic.

24. The colour of phenolphthalein in sodium hydroxide solution is:

- (a) Colourless
- (b) Pink
- (c) Red
- (d) Blue

Answer: (b) Pink

Explanation: NaOH is a strong base (pH ~14). Phenolphthalein turns pink in basic medium (pH > 8.2).

25. Which indicator would you use to distinguish between pH 4 and pH 6 solutions?

- (a) Litmus
- (b) Phenolphthalein
- (c) Methyl orange
- (d) Universal indicator

Answer: (d) Universal indicator

Explanation: Litmus only distinguishes acid/base (not strength).

Phenolphthalein colourless in both ($\text{pH} < 8.2$). Methyl orange yellow in both ($\text{pH} > 4.4$). Universal indicator shows different shades (orange vs yellow-green).

Questions 26-40: Chemical Properties & Reactions

26. Which metal does NOT react with dilute hydrochloric acid to produce hydrogen gas?

- (a) Zinc
- (b) Iron
- (c) Copper
- (d) Magnesium

Answer: (c) Copper

Explanation: Copper lies below hydrogen in reactivity series, so cannot displace H_2 from acids. Zn, Fe, Mg are above hydrogen and react vigorously.

27. The gas evolved when sodium carbonate reacts with dilute sulphuric acid turns lime water milky. The gas is:

- (a) Hydrogen
- (b) Oxygen
- (c) Carbon dioxide
- (d) Sulphur dioxide

Answer: (c) Carbon dioxide

Explanation: $\text{Na}_2\text{CO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O} + \text{CO}_2\uparrow$. CO_2 turns lime water milky due to CaCO_3 formation: $\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3\downarrow + \text{H}_2\text{O}$.

28. Which reaction represents neutralization?

- (a) $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$
- (b) $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$
- (c) $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- (d) $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$

Answer: (c) $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

Explanation: Neutralization is reaction between acid and base to form salt and water only. Option (a) is metal-acid reaction; (b) is basic oxide hydration; (d) is electrolysis.

29. When copper(II) oxide reacts with dilute sulphuric acid, the colour of solution formed is:

- (a) Colourless
- (b) Blue
- (c) Green

(d) Yellow

Answer: (b) Blue

Explanation: CuO (black) + $\text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4$ (blue solution) + H_2O . Hydrated Cu^{2+} ions impart characteristic blue colour.

30. Which of the following is NOT a property of bases?

(a) Turn red litmus blue

(b) React with acids to form salt and water

(c) React with most metals to produce hydrogen gas

(d) Feel soapy to touch

Answer: (c) React with most metals to produce hydrogen gas

Explanation: Bases react only with amphoteric metals (Al, Zn, Pb) to produce H_2 , not with "most metals". Acids react with most reactive metals to produce H_2 .

31. The reaction $\text{Zn} + 2\text{NaOH} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2$ shows that zinc is:

(a) Basic

(b) Acidic

(c) Amphoteric

(d) Neutral

Answer: (c) Amphoteric

Explanation: Amphoteric substances react with both acids and bases. Zinc reacts with HCl: $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2\uparrow$ and with NaOH as shown, proving amphoteric nature.

32. Which acid is present in vinegar?

(a) Citric acid

(b) Acetic acid

(c) Lactic acid

(d) Tartaric acid

Answer: (b) Acetic acid

Explanation: Vinegar is 5-8% aqueous solution of acetic acid (CH_3COOH), produced by fermentation of ethanol.

33. The correct order of increasing acidic strength is:

(a) $\text{HCl} < \text{CH}_3\text{COOH} < \text{H}_2\text{CO}_3$

(b) $\text{CH}_3\text{COOH} < \text{H}_2\text{CO}_3 < \text{HCl}$

(c) $\text{H}_2\text{CO}_3 < \text{CH}_3\text{COOH} < \text{HCl}$

(d) $\text{HCl} < \text{H}_2\text{CO}_3 < \text{CH}_3\text{COOH}$

Answer: (c) $\text{H}_2\text{CO}_3 < \text{CH}_3\text{COOH} < \text{HCl}$

Explanation: Carbonic acid (weak, unstable) < Acetic acid (weak, partial dissociation) < Hydrochloric acid (strong, complete dissociation).

34. Which gas is responsible for acid rain formation?

(a) CO_2 only

(b) SO_2 and NO_2

(c) O_2 and N_2

(d) CH_4

Answer: (b) SO_2 and NO_2

Explanation: SO_2 forms H_2SO_4 ; NO_2 forms HNO_3 in atmosphere. CO_2 forms weak H_2CO_3 (normal rain pH 5.6), but SO_2/NO_2 from fossil fuels cause harmful acid rain (pH < 5.6).

35. The reaction between an acid and metal carbonate always produces:

- (a) Salt, water and hydrogen
- (b) Salt, water and oxygen
- (c) Salt, water and carbon dioxide
- (d) Salt and hydrogen only

Answer: (c) Salt, water and carbon dioxide

Explanation: General reaction: $\text{Metal carbonate} + \text{Acid} \rightarrow \text{Salt} + \text{Water} + \text{CO}_2\uparrow$. Example: $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2\uparrow$.

36. Which of the following oxides is amphoteric?

- (a) Na_2O
- (b) CaO
- (c) Al_2O_3
- (d) CO_2

Answer: (c) Al_2O_3

Explanation: Al_2O_3 reacts with acids: $\text{Al}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2\text{O}$ and with bases: $\text{Al}_2\text{O}_3 + 2\text{NaOH} \rightarrow 2\text{NaAlO}_2 + \text{H}_2\text{O}$, showing amphoteric character.

Na_2O , CaO are basic; CO_2 is acidic.

37. The correct observation when dilute HCl is added to sodium hydrogen carbonate is:

- (a) Brisk effervescence of colourless gas
- (b) Pungent smelling gas evolved
- (c) Brown fumes evolved
- (d) No visible change

Answer: (a) Brisk effervescence of colourless gas

Explanation: $\text{NaHCO}_3 + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2\uparrow$. CO_2 is colourless, odourless gas causing effervescence. Used in baking powder and fire extinguishers.

38. Which of the following is a strong base?

- (a) NH_4OH
- (b) NaOH
- (c) CH_3NH_2
- (d) $\text{C}_5\text{H}_5\text{N}$

Answer: (b) NaOH

Explanation: NaOH completely dissociates in water $\rightarrow$ strong base. NH_4OH (ammonium hydroxide) is weak base (partial dissociation). Others are organic weak bases.

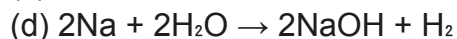
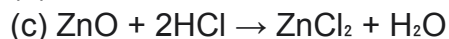
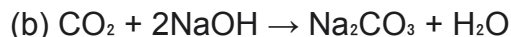
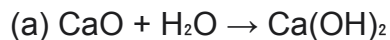
39. The pH of 0.01 M HCl solution is:

- (a) 1
- (b) 2
- (c) 3
- (d) 4

Answer: (b) 2

Explanation: $[H^+] = 0.01 \text{ M} = 10^{-2} \text{ M} \rightarrow \text{pH} = -\log(10^{-2}) = 2$. For strong acids, $[H^+]$ equals acid concentration (complete dissociation).

40. Which reaction shows that non-metallic oxides are acidic in nature?



Answer: (b) $\text{CO}_2 + 2\text{NaOH} \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$

Explanation: CO_2 (non-metal oxide) reacts with base NaOH to form salt (Na_2CO_3) and water, proving acidic nature. Option (a) shows basic oxide property.

Questions 41-50: Salts & Everyday Applications

41. Bleaching powder is chemically:

(a) Calcium chloride

(b) Calcium hypochlorite

(c) Calcium oxychloride

(d) Calcium carbonate

Answer: (c) Calcium oxychloride

Explanation: Formula CaOCl_2 (calcium oxychloride). Contains both OCl^- (hypochlorite) and Cl^- ions. Common name "bleaching powder" refers to CaOCl_2 .

42. The chemical name of baking soda is:

(a) Sodium carbonate

(b) Sodium bicarbonate

(c) Sodium sulphate

(d) Sodium chloride

Answer: (b) Sodium bicarbonate

Explanation: NaHCO_3 = Sodium hydrogen carbonate = Sodium bicarbonate. Used in baking (releases CO_2 on heating/acid addition) and as antacid.

43. Washing soda is obtained by heating baking soda at:

(a) 373 K

(b) 393 K

(c) 473 K

(d) 573 K

Answer: (a) 373 K

Explanation: $2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$ at 373 K (100°C). Anhydrous Na_2CO_3 is then crystallized as $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ (washing soda) from solution.

44. Which salt has water of crystallisation?

(a) NaCl

(b) KNO_3

(c) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

(d) NH_4Cl

Answer: (c) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

Explanation: Hydrated copper sulphate contains 5 water molecules per formula unit. NaCl , KNO_3 , NH_4Cl are typically anhydrous salts.

45. Plaster of Paris hardens when mixed with water due to formation of:

(a) CaSO_4

(b) $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$

(c) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

(d) $\text{Ca}(\text{OH})_2$

Answer: (c) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

Explanation: $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ (POP) + $1\frac{1}{2}\text{H}_2\text{O} \rightarrow \text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (gypsum). The rehydration forms interlocking gypsum crystals, creating hard mass.

46. Which salt solution will have $\text{pH} > 7$?

(a) NaCl

(b) NH_4Cl

(c) CH_3COONa

(d) KCl

Answer: (c) CH_3COONa

Explanation: CH_3COONa from weak acid (CH_3COOH) + strong base (NaOH) undergoes hydrolysis: $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COOH} + \text{OH}^-$, producing OH^- ions $\rightarrow$ basic solution ($\text{pH} > 7$).

47. The main component of egg shells is:

(a) CaSO_4

(b) CaCO_3

(c) $\text{Ca}(\text{OH})_2$

(d) CaO

Answer: (b) CaCO_3

Explanation: Egg shells contain ~95% calcium carbonate. Reacts with vinegar (acetic acid) to produce CO_2 : $\text{CaCO}_3 + 2\text{CH}_3\text{COOH} \rightarrow (\text{CH}_3\text{COO})_2\text{Ca} + \text{H}_2\text{O} + \text{CO}_2\uparrow$.

48. Which salt is used for softening hard water?

(a) NaHCO_3

(b) Na_2CO_3

(c) NaCl

(d) CaOCl_2

Answer: (b) Na_2CO_3

Explanation: Washing soda (Na_2CO_3) removes $\text{Ca}^{2+}/\text{Mg}^{2+}$ ions causing hardness: $\text{Ca}^{2+} + \text{CO}_3^{2-} \rightarrow \text{CaCO}_3\downarrow$. Precipitated carbonates are removed by filtration.

49. The reaction $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{Cl}_2 + \text{H}_2$ is called:

(a) Haber process

(b) Chlor-alkali process

(c) Solvay process

(d) Contact process

Answer: (b) Chlor-alkali process

Explanation: Electrolysis of brine (concentrated NaCl solution) produces three important chemicals: NaOH (alkali), Cl₂ and H₂ (chlor for chlorine).

50. Which statement about Plaster of Paris is FALSE?

(a) Formula is CaSO₄·½H₂O

(b) Prepared by heating gypsum at 373 K

(c) Used for making casts for fractured bones

(d) Should be stored in moist container

Answer: (d) Should be stored in moist container

Explanation: POP absorbs moisture from air and hardens prematurely. Must be stored in air-tight, dry containers. Options (a), (b), (c) are correct properties.

Section B: Short Answer Questions (20 Questions)

Q1. Why does an aqueous solution of an acid conduct electricity?

Answer: Acids dissociate in water to produce H⁺ ions (and corresponding anions).

These ions act as charge carriers, enabling electrical conduction.

Concept: Acid dissociation and conductivity (NCERT Topic: Chemical properties of acids)

Q2. What happens when copper oxide reacts with dilute hydrochloric acid? Write the balanced equation.

Answer: Black copper oxide dissolves to form blue-green copper chloride solution and water.



Concept: Metal oxide + Acid → Salt + Water (NCERT Topic: Reaction of metallic oxides with acids)

Q3. Why does dry HCl gas not change the colour of dry litmus paper?

Answer: HCl shows acidic character only in aqueous solution where it dissociates to produce H⁺ ions. Dry HCl gas cannot dissociate without water, so no H⁺ ions are produced to change litmus colour.

Concept: Acidic character requires aqueous medium (NCERT Page 25 discussion)

Q4. Equal lengths of magnesium ribbons are taken in test tubes A and B.

Hydrochloric acid is added to test tube A, while acetic acid is added to test tube B. In which test tube will the fizzing occur more vigorously and why?

Answer: Test tube A (with HCl). HCl is a strong acid that completely dissociates, producing higher H^+ concentration than weak acetic acid (partial dissociation). Higher H^+ concentration leads to faster reaction rate with Mg:



Concept: Strong vs. weak acids (NCERT Topic: Strength of acids)

Q5. Fresh milk has a pH of 6. How do you think the pH will change as it turns into curd? Explain.

Answer: pH will decrease (become more acidic). Lactobacillus bacteria convert lactose sugar in milk to lactic acid during curdling, increasing H^+ concentration.

Concept: pH in daily life - curdling of milk (NCERT Page 31)

Q6. What is water of crystallisation? Give two examples.

Answer: Fixed number of water molecules chemically bound in crystal structure of salts.

Examples:

- Copper sulphate pentahydrate: $CuSO_4 \cdot 5H_2O$ (blue crystals)
- Washing soda: $Na_2CO_3 \cdot 10H_2O$

Concept: Hydrated salts (NCERT Topic: Family of salts)

Q7. Why is sodium hydrogen carbonate used as an antacid?

Answer: It is a mild base that neutralizes excess stomach acid (HCl) without causing irritation:



CO_2 gas produced may cause burping, providing relief.

Concept: Neutralization in daily life (NCERT Page 30)

Q8. What happens when plaster of Paris is mixed with water? Write the equation.

Answer: It forms a hard solid mass (gypsum) within 5-10 minutes:



This setting property makes it useful for casts and moulds.

Concept: Plaster of Paris (NCERT Page 34)

Q9. Name the gas evolved when zinc reacts with sodium hydroxide solution. Write the equation.

Answer: Hydrogen gas



Concept: Reaction of metals with bases (NCERT Page 22 Activity 2.5)

Q10. Why does distilled water not conduct electricity whereas rain water does?

Answer: Distilled water has no ions. Rain water contains dissolved atmospheric gases (CO_2 , SO_2 , NO_2) that form acids and produce ions (H^+ , HCO_3^- , etc.), enabling conduction.

Concept: Conductivity of solutions (NCERT Topic: Chemical properties)

Q1. Why should curd and sour substances not be kept in brass or copper vessels?

Answer: Curd and sour substances contain acids (lactic acid in curd). Acids react with brass/copper to form toxic metal salts that contaminate food and cause food poisoning.



Concept: Reaction of acids with metals; food safety

Q2. Write balanced chemical equations for:

(a) Reaction of zinc with sodium hydroxide

(b) Reaction of sodium hydrogen carbonate with hydrochloric acid

Answer:



Concept: Amphoteric metals; acid-carbonate reactions

Q3. What is the common name of CaOCl_2 ? How is it prepared? Give one use.

Answer: Common name: Bleaching powder

Preparation: $\text{Ca(OH)}_2 + \text{Cl}_2 \rightarrow \text{CaOCl}_2 + \text{H}_2\text{O}$ (Chlorine passed over dry slaked lime)

Use: Disinfecting drinking water / bleaching cotton/linen in textile industry

Concept: Important salts from common salt

Q4. A white powder 'X' is used in kitchens for making crispy pakoras. On heating, it gives sodium carbonate, carbon dioxide and water vapour. Identify 'X' and write the reaction.

Answer: 'X' is baking soda (sodium hydrogen carbonate, NaHCO_3)

Reaction: $2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2 \uparrow$ (on heating)

CO_2 makes pakoras crispy by creating bubbles in batter.

Concept: Baking soda properties and uses

Q5. What happens when:

(a) Blue crystals of copper sulphate are heated strongly?

(b) Water is added to the product obtained in (a)?

Answer:

(a) Blue $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ loses water of crystallisation $\rightarrow$ white anhydrous CuSO_4 powder

$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} \rightarrow \text{CuSO}_4 + 5\text{H}_2\text{O}$ (on strong heating)

(b) White powder turns blue again as it regains water of crystallisation

$\text{CuSO}_4 + 5\text{H}_2\text{O} \rightarrow \text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

Concept: Water of crystallisation; reversible reactions

Q6. Why does an aqueous solution of sodium chloride conduct electricity whereas solid sodium chloride does not?

Answer: Solid NaCl has ions held in fixed positions in crystal lattice $\rightarrow$ no mobile charge carriers. In aqueous solution, NaCl dissociates into mobile Na^+ and Cl^- ions that carry electric current.

Concept: Conductivity of ionic compounds

Q7. Equal amounts of sodium hydroxide solution and hydrochloric acid of same concentration are mixed.

(a) What is the pH of resulting solution?

(b) Name the type of reaction.

Answer:

(a) pH = 7 (neutral)

(b) Neutralization reaction

Explanation: NaOH (strong base) + HCl (strong acid) $\rightarrow$ NaCl (neutral salt) + H_2O .

Equal moles completely neutralize each other.

Concept: Neutralization; pH of salt solutions

Q8. Why is pH of our stomach maintained around 1.5-3.5? What happens if excess acid is produced? How is it treated?

Answer: Low pH due to HCl secretion aids protein digestion and kills bacteria.

Excess acid causes acidity/indigestion (burning sensation). Treated with antacids (mild bases like $\text{Mg}(\text{OH})_2$, NaHCO_3) that neutralize excess acid:



Concept: pH in daily life - digestion

Q9. Distinguish between strong and weak acids with examples.

Answer:

Strong Acid	Weak Acid
Completely dissociates in water	Partially dissociates in water
High $[\text{H}^+]$ at same concentration	Low $[\text{H}^+]$ at same concentration
Good conductor of electricity	Poor conductor
Examples: HCl , H_2SO_4 , HNO_3	Examples: CH_3COOH , H_2CO_3 , citric acid

Concept: Acid strength and dissociation

Q10. Why does dry HCl gas not show acidic properties?

Answer: Acidic properties require presence of H^+ ions. Dry HCl exists as covalent molecules (no ions). In aqueous solution, HCl ionizes: $HCl + H_2O \rightarrow H_3O^+ + Cl^-$, producing hydronium ions that show acidic character.

Concept: Acidic character requires aqueous medium

Q11. What is water of crystallisation? Give two examples with chemical formulas.

Answer: Fixed number of water molecules chemically bound in crystal lattice of salts.

Examples:

- Blue vitriol: $CuSO_4 \cdot 5H_2O$ (5 water molecules)
- Washing soda: $Na_2CO_3 \cdot 10H_2O$ (10 water molecules)

Concept: Hydrated salts

Q12. Why is sodium hydrogen carbonate used in fire extinguishers?

Answer: In soda-acid fire extinguishers, $NaHCO_3$ solution reacts with sulphuric acid:



CO_2 gas forms blanket over fire, cutting off oxygen supply and extinguishing fire.

Concept: Applications of salts

Q13. What happens when chlorine gas is passed through dry slaked lime? Write equation and give one use of product.

Answer: Bleaching powder is formed:



Use: Disinfecting drinking water / bleaching textiles

Concept: Preparation of bleaching powder

Q14. Why does distilled water not conduct electricity but rain water does?

Answer: Distilled water has no ions (pure H_2O molecules only). Rain water dissolves atmospheric CO_2 , SO_2 , NO_2 forming acids that dissociate into ions:



These ions enable electrical conduction.

Concept: Conductivity and ionization

Q15. A metal compound 'A' reacts with dilute hydrochloric acid to produce effervescence. The gas evolved extinguishes a burning candle. Write a balanced equation if one of the compounds formed is calcium chloride.

Answer: Gas that extinguishes candle is $\text{CO}_2 \rightarrow$ compound 'A' is calcium carbonate



Concept: Acid-carbonate reactions; gas identification

Q16. Why should Plaster of Paris be stored in moisture-proof containers?

Answer: POP ($\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$) absorbs moisture from air and undergoes hydration to form hard gypsum:



This premature setting makes it unusable for intended purposes (casts, moulds).

Concept: Properties of POP

Q17. What is the effect of pH change on aquatic life?

Answer: Aquatic organisms survive best in pH 6.5-8.5. Acid rain (pH < 5.6) lowers water pH causing:

- Death of fish and aquatic plants
- Leaching of toxic metals (Al, Hg) from soil into water
- Disruption of reproductive cycles

Concept: Environmental impact of pH

Q18. How does toothpaste prevent tooth decay?

Answer: Tooth decay starts when mouth pH < 5.5 (enamel dissolves). Toothpastes are mildly basic (pH ~8-9) that:

- Neutralize acids produced by bacterial action on sugars
- Maintain mouth pH above 5.5
- Fluoride in toothpaste forms acid-resistant fluorapatite layer on enamel

Concept: pH in daily life - dental health

Q19. Why is sodium carbonate considered a basic salt?

Answer: Na_2CO_3 is formed from strong base (NaOH) and weak acid (H_2CO_3). In water, CO_3^{2-} undergoes hydrolysis:



Production of OH^- ions makes solution basic (pH ~11).

Concept: Salt hydrolysis; pH of salt solutions

Q20. What happens when:

(a) Zinc granules are added to copper sulphate solution?

(b) Copper turnings are added to zinc sulphate solution?

Answer:

(a) Zinc displaces copper (Zn more reactive):



(b) No reaction (Cu less reactive than Zn; cannot displace Zn from solution)

Concept: Reactivity series; displacement reactions

Section C: Long Answer Questions (20 Questions)

Q1. (a) What are indicators? Name three natural indicators.

(b) How does the colour of litmus, phenolphthalein and methyl orange change in acidic and basic media?

(c) Why is universal indicator preferred over litmus paper for measuring pH?

Answer:

(a) Indicators are substances that show different colours in acidic and basic solutions, helping identify nature of solution.

Natural indicators: Turmeric, red cabbage extract, hydrangea flowers.

(b) Colour changes:

Indicator	Acidic Medium	Basic Medium

Litmus	Red	Blue
Phenolphthalein	Colorless	Pink
Methyl Orange	Red	Yellow

(c) Universal indicator is a mixture of several indicators that shows different colours across entire pH range (0-14), allowing approximate pH measurement. Litmus only distinguishes acid/base (not strength) with just two colours.

Concept: Indicators and pH measurement (NCERT Pages 18-20)

Q2. Explain the chlor-alkali process with diagram. Mention three uses of each product formed.

Answer:

Process: Electrolysis of concentrated aqueous NaCl (brine) solution:

1
2
3

Products and Uses:

1. Sodium hydroxide (NaOH):
 - Soap and detergent manufacturing
 - Paper production
 - Petroleum refining
2. Chlorine (Cl₂):
 - Water disinfection
 - PVC production
 - Bleaching powder preparation
3. Hydrogen (H₂):
 - Hydrogenation of oils (vanaspati)
 - Fuel for rockets
 - Ammonia synthesis (Haber process)

Concept: Important chemicals from common salt (NCERT Pages 32-33)

Q3. (a) What is water of crystallisation? Explain with an activity.

(b) What happens when hydrated copper sulphate crystals are heated? Write observations and equation.

(c) Why is washing soda used for softening hard water?

Answer:

(a) Fixed number of water molecules chemically bound in crystal lattice.

Activity: Heat blue $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ crystals in test tube. Water droplets appear on cooler parts; crystals turn white (anhydrous CuSO_4). Add water $\rightarrow$ blue colour restored.

(b) Observations:

- Blue crystals turn white
 - Water droplets condense on cooler parts of test tube
- Equation: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} \rightarrow \text{CuSO}_4 + 5\text{H}_2\text{O}$ (on heating)

(c) Hard water contains $\text{Ca}^{2+}/\text{Mg}^{2+}$ ions that form insoluble scum with soap. Washing soda (Na_2CO_3) reacts with these ions to form insoluble carbonates that precipitate out:



Softened water then lathers well with soap.

Concept: Hydrated salts and water treatment (NCERT Pages 33-34)

Q4. (a) Define pH. How is it related to H^+ ion concentration?

(b) The pH values of five solutions A, B, C, D and E are 2, 4, 7, 10 and 13 respectively. Arrange them in increasing order of H^+ ion concentration.

(c) Explain how pH change causes tooth decay and how it can be prevented.

Answer:

(a) $\text{pH} = -\log_{10}[\text{H}^+]$. It measures acidity/basicity on scale 0-14. Lower pH = higher $[\text{H}^+]$. Each pH unit represents 10-fold change in $[\text{H}^+]$.

(b) Increasing H^+ concentration means decreasing pH:

E (pH 13) < D (pH 10) < C (pH 7) < B (pH 4) < A (pH 2)

(c) Bacteria in mouth degrade sugar $\rightarrow$ produce acids $\rightarrow$ pH drops below 5.5 $\rightarrow$ enamel ($\text{Ca}_3(\text{PO}_4)_2$) dissolves $\rightarrow$ cavities form.

Q1. (a) What are olfactory indicators? Give two examples.

(b) How can you identify acidic, basic and neutral solutions using turmeric paper?

(c) Why are synthetic indicators preferred over natural indicators in laboratories?

Answer:

(a) Olfactory indicators are substances whose odour changes in acidic/basic media.

Examples: Onion extract (odour disappears in base), Vanilla essence (odour disappears in base)

(b) Turmeric paper test:

- Acidic solution: Yellow colour retained
- Basic solution: Yellow → Red-brown colour
- Neutral solution: Yellow colour retained

Limitation: Cannot distinguish between acidic and neutral solutions

(c) Synthetic indicators preferred because:

- Sharp, distinct colour changes at specific pH
- Not affected by colour of solution being tested
- Available in precise pH ranges (e.g., phenolphthalein 8.2-10.0)
- Long shelf life; not prone to microbial degradation
- Natural indicators often have gradual colour changes and limited pH range

Concept: Types of indicators; practical applications

Q2. Explain the chlor-alkali process with labelled diagram. Write chemical equation.

Mention three important uses of each product formed.

Answer:

Process: Electrolysis of concentrated aqueous sodium chloride (brine) solution using diaphragm cell.

1
2
3
4
5
6

Products and Uses:

Product	Uses
Sodium hydroxide (NaOH)	1. Soap/detergent manufacturing 2. Paper pulping 3. Petroleum refining (removing acids)
Chlorine (Cl ₂)	1. Water disinfection 2. PVC production 3. Bleaching powder preparation
Hydrogen (H ₂)	1. Vegetable oil hydrogenation (vanaspati) 2. Ammonia synthesis (Haber process) 3. Rocket fuel

Significance: Single process yields three commercially important chemicals from common salt.

Concept: Industrial preparation of chemicals from NaCl

Q3. (a) What is water of crystallisation? Explain with activity.

(b) What happens when hydrated copper sulphate crystals are heated? Write observations and equation.

(c) Why is washing soda used for softening hard water? Explain with chemical equation.

Answer:

(a) Definition: Fixed number of water molecules chemically bound in crystal lattice of salts. These water molecules give crystals their shape and colour.

Activity to demonstrate:

1. Take few blue crystals of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in dry test tube
2. Heat gently over burner
3. Observations:
 - Blue crystals turn white

- Water droplets appear on cooler parts of test tube
- 4. Add few drops of water to white powder
- 5. Observation: White powder turns blue again

Conclusion: Water was part of crystal structure (water of crystallisation)

(b) Heating copper sulphate:

Observations:

- Blue crystals → white powder
- Water droplets condense on upper cooler parts of test tube
- On adding water to white powder, blue colour restored

Equation: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} \rightarrow \text{CuSO}_4 + 5\text{H}_2\text{O}$ (on heating)

(c) Softening hard water:

Hard water contains $\text{Ca}^{2+}/\text{Mg}^{2+}$ ions that form insoluble scum with soap, wasting soap.

Washing soda (Na_2CO_3) reacts with these ions:



Insoluble carbonates precipitate out. Filtered water is soft and lathers well with soap.

Concept: Hydrated salts; water treatment applications

Q4. (a) Define pH. How is it mathematically related to hydrogen ion concentration?

(b) Five solutions A, B, C, D, E have pH values 2, 4, 7, 10, 13 respectively. Arrange them in:

(i) Increasing order of H^+ ion concentration

(ii) Increasing order of OH^- ion concentration

(c) Explain how change in pH causes tooth decay and how it can be prevented.

Answer:

(a) pH definition: Negative logarithm (base 10) of hydrogen ion concentration:

$$\text{pH} = -\log_{10}[\text{H}^+] \text{ where } [\text{H}^+] \text{ is in mol/L}$$

Relationship:

- $\text{pH} \downarrow \rightarrow [\text{H}^+] \uparrow$ (inverse relationship)
- Each unit decrease in pH means 10-fold increase in $[\text{H}^+]$

Example: pH 3 has 10 times more H^+ than pH 4; 100 times more than pH 5

(b) (i) Increasing H^+ concentration = decreasing pH:

E (13) < D (10) < C (7) < B (4) < A (2)

(ii) Increasing OH^- concentration = increasing pH (since $\text{pH} + \text{pOH} = 14$):

A (2) < B (4) < C (7) < D (10) < E (13)

(c) Tooth decay mechanism:

- Bacteria in mouth act on sugar/food particles $\rightarrow$ produce acids (mainly lactic acid)
- Acid production lowers mouth pH below 5.5
- Tooth enamel (hydroxyapatite, $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$) starts dissolving:
$$\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2 + 8\text{H}^+ \rightarrow 10\text{Ca}^{2+} + 6\text{HPO}_4^{2-} + 2\text{H}_2\text{O}$$
- Enamel erosion $\rightarrow$ cavities formation

Prevention:

1. Brushing with basic toothpaste (neutralizes acids, maintains $\text{pH} > 5.5$)
2. Reducing sugar intake (less substrate for acid-producing bacteria)
3. Using fluoride toothpaste (forms fluorapatite $\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$ which is acid-resistant)
4. Rinsing mouth after meals (removes food particles)

Concept: pH scale; logarithmic calculations; pH in daily life

Q5. (a) What are the chemical names and formulas of:

(i) Baking soda

(ii) Washing soda

(iii) Bleaching powder

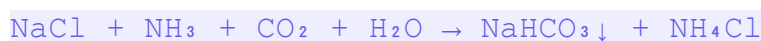
- (b) How is baking soda prepared industrially? Write equation.
- (c) Explain two uses each of baking soda and washing soda with relevant chemical equations.

Answer:

(a)

- (i) Baking soda: Sodium hydrogen carbonate, NaHCO_3
- (ii) Washing soda: Sodium carbonate decahydrate, $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
- (iii) Bleaching powder: Calcium oxychloride, CaOCl_2
- (b) Industrial preparation (Solvay process):

Ammonia and carbon dioxide passed through concentrated NaCl solution:



Sodium hydrogen carbonate precipitates due to low solubility. Filtered and dried.

(c) Uses with equations:

Baking soda (NaHCO_3):

1. Antacid: Neutralizes excess stomach acid



2. Baking: Releases CO_2 on heating/acid addition, making bread/cakes rise



Washing soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$):

1. Water softening: Removes $\text{Ca}^{2+}/\text{Mg}^{2+}$ ions causing hardness



2. Cleaning agent: Hydrolysis produces OH^- ions that saponify grease/oil



OH^- converts grease (ester) to soap (sodium salt of fatty acid) which is water-soluble

Concept: Important salts; industrial preparation; applications

Q6. (a) What is neutralization reaction? Give two examples from daily life.

(b) A metal carbonate 'X' on reacting with an acid gives a gas which when passed through lime water turns it milky. Identify 'X' and the gas. Write all chemical equations involved.

(c) Why is an antacid tablet taken when you suffer from acidity?

Answer:

(a) Neutralization: Reaction between acid and base to form salt and water only.



Daily life examples:

1. Antacid for acidity: $\text{Mg}(\text{OH})_2$ (milk of magnesia) neutralizes excess stomach

HCl



2. Soil treatment: Acidic soil ($\text{pH} < 6$) treated with slaked lime $[\text{Ca}(\text{OH})_2]$



(b) Identification:

- Gas turning lime water milky $\rightarrow \text{CO}_2$
- Metal carbonate producing CO_2 with acid $\rightarrow$ Any carbonate (e.g., CaCO_3 , Na_2CO_3)

Taking calcium carbonate as 'X':

Equations:



(c) Antacid action:

- Stomach normally has pH 1.5-3.5 due to HCl for digestion

- Excess HCl production → acidity (burning sensation in stomach/food pipe)
- Antacids contain mild bases ($\text{Mg}(\text{OH})_2$, $\text{Al}(\text{OH})_3$, NaHCO_3) that neutralize excess acid:



- Neutralization reduces acidity, providing relief without damaging stomach lining (strong bases like NaOH would be harmful)

Concept: Neutralization; gas tests; daily life applications

Q7. (a) What is Plaster of Paris? How is it prepared from gypsum? Write equation.

(b) Why is it called Plaster of Paris?

(c) List three uses of Plaster of Paris with explanation of chemical principle involved in each use.

Answer:

(a) Definition: Calcium sulphate hemihydrate, $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$

Preparation: Gypsum heated at 373 K (100°C):



Temperature control critical:

- Below 373 K: Incomplete dehydration
- Above 393 K: Forms anhydrous CaSO_4 (dead burnt plaster) which doesn't set with water

(b) Origin of name: Large deposits of gypsum found near Paris (Montmartre hills).

Historically used for construction in Paris → "Plaster of Paris"

(c) Uses with chemical principles:

1. Orthopaedic casts for fractured bones:

- POP powder mixed with water → applied as paste around fracture
- Chemical setting: $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + 1\frac{1}{2}\text{H}_2\text{O} \rightarrow \text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
- Forms hard, porous gypsum mass that immobilizes bone for healing
- Porous nature allows skin to breathe

2. Making decorative ceiling designs/moulds:

- POP paste poured into mould → sets to exact shape
- Rehydration forms interlocking gypsum crystals creating rigid structure
- Lightweight yet strong after setting

3. Fireproofing material:

- POP contains water of crystallisation ($\frac{1}{2}$ H₂O per CaSO₄)
- On heating during fire, water released as steam:



- Steam absorbs heat and forms protective layer, slowing fire spread

Concept: Plaster of Paris preparation, properties and applications

Q8. (a) Differentiate between acidic salts, basic salts and neutral salts with examples.

(b) Predict the pH of aqueous solutions of:

(i) NaCl

(ii) NH₄Cl

(iii) CH₃COONa

(iv) Na₂CO₃

with justification.

(c) Why does an aqueous solution of ammonium chloride give acidic reaction?

Answer:

(a) Classification of salts:

Type	Formed from	pH in water	Example	Reason
Neutral salt	Strong acid + Strong base	pH = 7	NaCl (HCl + NaOH)	No hydrolysis; ions don't react with water

Acidic salt	Strong acid + Weak base	pH < 7	NH ₄ Cl (HCl + NH ₄ OH)	Cation hydrolysis: $\text{NH}_4^+ + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4\text{OH} + \text{H}^+$
Basic salt	Weak acid + Strong base	pH > 7	CH ₃ COONa (CH ₃ COOH + NaOH)	Anion hydrolysis: $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COOH} + \text{OH}^-$

(b) pH prediction:

(i) NaCl: pH = 7 (neutral)

From strong acid (HCl) + strong base (NaOH); no hydrolysis

(ii) NH₄Cl: pH < 7 (acidic)

From strong acid (HCl) + weak base (NH₄OH); NH₄⁺ hydrolysis produces H⁺

(iii) CH₃COONa: pH > 7 (basic)

From weak acid (CH₃COOH) + strong base (NaOH); CH₃COO⁻ hydrolysis produces OH⁻

(iv) Na₂CO₃: pH > 7 (basic, ~11)

From weak acid (H₂CO₃) + strong base (NaOH); CO₃²⁻ hydrolysis:



(c) Acidic nature of NH₄Cl solution:

NH₄Cl dissociates: $\text{NH}_4\text{Cl} \rightarrow \text{NH}_4^+ + \text{Cl}^-$

- Cl⁻ from strong acid HCl → does not hydrolyze
- NH₄⁺ from weak base NH₄OH → undergoes hydrolysis:



- H^+ ions produced $\rightarrow$ solution becomes acidic (pH $\sim$ 4.5-6.0)

Note: This is why NH_4Cl used in dry cells (acidic medium required for Zn- MnO_2 reaction)

Concept: Salt hydrolysis; pH prediction based on parent acid-base strength

Q9. (a) What are the products formed when electricity is passed through brine? Write balanced equation.

(b) How is bleaching powder prepared from one of these products? Write equation.

(c) Explain three important uses of bleaching powder with chemical equations where applicable.

Answer:

(a) Chlor-alkali process:



Products: Sodium hydroxide, Chlorine gas, Hydrogen gas

(b) Bleaching powder preparation:

Chlorine gas passed over dry slaked lime $[\text{Ca}(\text{OH})_2]$:



Conditions:

- Slaked lime must be dry (moisture causes side reactions)
- Temperature maintained below 40°C (higher temperature forms calcium chlorate)

(c) Uses of bleaching powder:

1. Bleaching cotton/linen in textile industry:

- In presence of dilute acid (or CO_2 from air), releases chlorine:



- Cl_2 reacts with water to form nascent oxygen:



- Nascent oxygen oxidizes coloured substances to colourless compounds

2. Disinfecting drinking water:

- Releases chlorine which kills bacteria/viruses:

$$\text{CaOCl}_2 + \text{CO}_2 (\text{air}) \rightarrow \text{CaCO}_3 + \text{Cl}_2$$
- $\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{HOCl}$ (hypochlorous acid)
- HOCl decomposes: $\text{HOCl} \rightarrow \text{HCl} + [\text{O}]$ (nascent oxygen kills microbes)

3. Oxidizing agent in chemical industry:

- Used in production of chloroform:

$$\text{CH}_3\text{CHO} + 3\text{CaOCl}_2 \rightarrow \text{CCl}_3\text{CHO} + 3\text{Ca}(\text{OH})_2$$
- Further reaction: $\text{CCl}_3\text{CHO} + \text{Ca}(\text{OH})_2 \rightarrow \text{CHCl}_3$ (chloroform) + HCOOCa

Concept: Chlor-alkali process; bleaching powder preparation and applications

Q10. (a) What is acid rain? How is it formed?

(b) What are the harmful effects of acid rain?

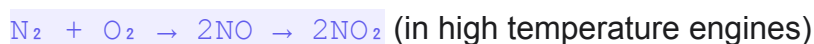
(c) Suggest three measures to prevent acid rain.

Answer:

(a) Definition: Rain water with pH less than 5.6

Formation mechanism:

1. Fossil fuel combustion in industries/vehicles releases SO_2 and NO_2 :



2. These gases dissolve in atmospheric water vapour:



3. Normal rain has pH 5.6 due to dissolved CO_2 forming weak carbonic acid:



Acid rain has additional strong acids (H_2SO_4 , HNO_3) $\rightarrow$ pH drops to 4-4.5 or lower

(b) Harmful effects:

Environmental:

- Lowers pH of lakes/ivers $\rightarrow$ kills fish and aquatic plants (optimal pH 6.5-8.5)
- Leaches toxic metals (Al, Hg) from soil into water bodies
- Damages forests by leaching essential nutrients (Ca, Mg) from soil

Structural:

- Corrodes buildings/statues made of marble/limestone:



- Rusts metal bridges, railway tracks, vehicles

Human health:

- Respiratory problems (asthma, bronchitis) from inhaling acid aerosols
- Contaminated drinking water with leached toxic metals

(c) Prevention measures:

- Use of scrubbers in industries:
 - Flue gas desulphurization units remove SO_2 before emission:
$$\text{CaCO}_3 + \text{SO}_2 \rightarrow \text{CaSO}_3 + \text{CO}_2$$
 - Catalytic converters in vehicles reduce NO_x emissions
- Switch to cleaner energy sources:
 - Solar, wind, hydroelectric power instead of coal-fired plants
 - Use of low-sulphur fuels in industries/vehicles
- Afforestation:
 - Trees absorb CO_2 , SO_2 , NO_2 from atmosphere

- Helps maintain ecological balance and reduces acid rain precursors

Concept: Environmental chemistry; acid rain causes and prevention

- Brushing with basic toothpaste neutralizes acids
- Reducing sugar intake
- Using fluoride toothpaste (forms acid-resistant fluorapatite)

Concept: pH scale and daily life applications (NCERT Pages 28-31)

Important Notes for Students

1. NCERT Reference Guide (General Topics - Not Page Numbers):
 - Acids/Bases definitions & properties: Early chapter sections
 - Indicators & pH scale: Middle sections with activities
 - Salts & neutralization: Following pH discussion
 - Important chemicals from NaCl: Final sections (chlor-alkali, bleaching powder, baking soda, washing soda, POP)
 2. Exam Tips:
 - Memorize 5-6 important chemical equations (reactions of acids/bases, salt preparations)
 - Practice pH calculations (logarithmic relationship)
 - Understand difference between strong/weak acids & bases
 - Learn uses of all important salts (2-3 uses each)
 - Focus on application-based questions (tooth decay, soil treatment, antacids)
 3. Common Mistakes to Avoid:
 - Confusing baking soda (NaHCO_3) with washing soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$)
 - Writing wrong formula for bleaching powder (CaOCl_2 , not CaCl_2)
 - Forgetting water molecules in hydrated salts
 - Incorrect pH range for indicators (phenolphthalein: 8.2-10.0, not 7-14)
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