CBSE CLASS X

Science (086)

ANSWER KEY

AI-generated question paper

Code: CKTQ4B	Questions: 35	Maximum Marks: 76	Generated: 2026-06-25 17:38

SELECTIONS USED

Subject	Science
Lessons	2 Acids, Bases and Salts
Level of understanding	Exam-ready
Question selection	CBSE board paper, whole lesson (~80 marks across Sections A-E)
Model	claude-sonnet-4-6

Composition — Difficulty: 12 straightforward · 18 medium · 5 deep | Types: 12 MCQ · 7 Short · 6 Very short · 4 Assertion–reason · 3 Long · 3 Case-based | Sections: A 16Q/16m · B 6Q/12m · C 7Q/21m · D 3Q/15m · E 3Q/12m

Q1. straightforward exam-ready **[1]**

Which of the following substances will turn blue litmus red?
(A) Sodium hydroxide solution
(B) Baking soda solution
(C) Lemon juice
(D) Potassium hydroxide solution

- A Sodium hydroxide solution
- B Baking soda solution
- C Lemon juice
- D Potassium hydroxide solution

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Model Answer

(C) Lemon juice

Acids turn blue litmus red. Lemon juice is acidic in nature, whereas NaOH, KOH, and baking soda solution are basic and would turn red litmus blue.

Explanation

The key fact from the textbook (Introduction, Chapter 2) is: *"acids change the colour of blue litmus to red, whereas bases change the colour of red litmus to blue."* NaOH, KOH, and baking soda ($NaHCO_3$) are all bases/alkaline — they turn red litmus blue. Only lemon juice is acidic (contains citric acid), so it turns blue litmus red. Always remember: **Acid → Blue to Red; Base → Red to Blue**.

Q2. straightforward exam-ready **[1]**

When zinc granules are added to dilute sulphuric acid, the gas evolved is:
(A) Oxygen
(B) Sulphur dioxide
(C) Hydrogen
(D) Carbon dioxide

- A Oxygen
- B Sulphur dioxide
- C Hydrogen
- D Carbon dioxide

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Model Answer

(C) Hydrogen

When zinc granules are added to dilute sulphuric acid, hydrogen gas is evolved along with zinc sulphate: $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2 \uparrow$

Source: Chapter 1, Section 1.1.2

Explanation

The textbook explicitly gives the word equation: *Zinc + Sulphuric acid → Zinc sulphate + Hydrogen*. This is a displacement reaction where zinc (a metal above hydrogen in the activity series) displaces hydrogen from the acid. Examiners expect students to recall both the correct gas and ideally the balanced equation.

Q3. medium exam-ready **[1]**

Dry HCl gas does not change the colour of dry litmus paper because:
(A) HCl is a weak acid
(B) HCl does not ionise in the absence of water
(C) Litmus reacts only with bases
(D) HCl gas has no hydrogen in it

- A HCl is a weak acid
- B HCl does not ionise in the absence of water
- C Litmus reacts only with bases
- D HCl gas has no hydrogen in it

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Model Answer

(B) HCl does not ionise in the absence of water

Explanation

The textbook (Activity 2.9) states that H^+ ions are produced by HCl **only in the presence of water**. Dry HCl gas has no water to enable ionisation, so no $H^+(aq)$ ions are formed, and litmus (which responds to ions) does not change colour. HCl is actually a strong acid, so option A is factually wrong.

Q4. straightforward exam-ready **[1]**

The process of electrolysis of brine produces three useful products. Which of the following is NOT one of them?
(A) Sodium hydroxide
(B) Chlorine
(C) Hydrogen
(D) Oxygen

- A Sodium hydroxide
- B Chlorine
- C Hydrogen
- D Oxygen

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Model Answer

(D) Oxygen

Electrolysis of brine (chlor-alkali process) produces sodium hydroxide (NaOH), chlorine (Cl_2), and hydrogen (H_2). Oxygen is **not** produced in this process.

Explanation

The textbook (Chapter 2, Section 2.4.3) clearly states the chlor-alkali process equation:

$$2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$$

Only three products are formed — NaOH, Cl_2, and H_2. Oxygen does not appear. Students often confuse this with electrolysis of water (which gives H_2 and O_2). Remember: brine electrolysis → chlor-alkali process → no oxygen produced.

Q5. straightforward exam-ready **[1]**

Tooth enamel begins to corrode when the pH of the mouth falls below:

(A) 7.0
(B) 6.0
(C) 5.5
(D) 4.5

A 7.0
B 6.0
C 5.5
D 4.5

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Model Answer

(C) 5.5

Tooth enamel begins to corrode when the pH of the mouth falls below **5.5**.

Source: Chapter 2, Section 2.3.1 (pH change as the cause of tooth decay)

Explanation

The textbook explicitly states: *"Tooth decay starts when the pH of the mouth is lower than 5.5."* This is a direct recall fact — memorise the exact value 5.5, not 7 (neutral) or any other option. Examiners frequently ask this as a 1-mark MCQ or fill-in-the-blank.

Q6. straightforward exam-ready **[1]**

Which of the following is the correct chemical formula of Plaster of Paris?
(A) $CaSO_4$
(B) $CaSO_4.½H_2O$
(C) $CaSO_4.H_2O$
(D) $CaSO_4.2H_2O$

A $CaSO_4$
B $CaSO_4.½H_2O$
C $CaSO_4.H_2O$
D $CaSO_4.2H_2O$

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Model Answer

The correct answer is **(B) $CaSO_4.½H_2O$**

Plaster of Paris is calcium sulphate hemihydrate, with the chemical formula $CaSO_4.½H_2O$.

Explanation

- $CaSO_4$ (option A) is anhydrous calcium sulphate (dead burnt plaster).
- $CaSO_4.½H_2O$ (option B) is Plaster of Paris — the key point is the **half** water of crystallisation.
- $CaSO_4.2H_2O$ (option D) is gypsum, the raw material from which Plaster of Paris is made by heating.
- Examiners commonly use all four options to test whether students can distinguish gypsum, POP, and anhydrous calcium sulphate — memorise the formula exactly.

Q7. medium exam-ready **[1]**

When carbon dioxide gas is passed in excess through lime water, the white precipitate of calcium carbonate:
(A) Remains unchanged
(B) Turns yellow
(C) Dissolves to form a soluble compound
(D) Changes to calcium oxide

A Remains unchanged
B Turns yellow
C Dissolves to form a soluble compound
D Changes to calcium oxide

◆ Acids, Bases and Salts

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Model Answer

(C) Dissolves to form a soluble compound

When excess CO_2 is passed through lime water, $CaCO_3$ reacts with CO_2 and water to form calcium bicarbonate [$Ca(HCO_3)_2$], which is soluble, so the white precipitate dissolves.

Explanation

The key reaction is: $CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$. Calcium bicarbonate is soluble in water, so the milky/white precipitate disappears when CO_2 is in excess. This is a standard two-step lime water test concept tested in board exams. Remember: limited CO_2 → milky ($CaCO_3$ precipitate); excess CO_2 → clear solution ($Ca(HCO_3)_2$).

Q8. medium exam-ready **[1]**

Salts of a strong acid and a weak base have a pH:

(A) Equal to 7

(B) Greater than 7

(C) Less than 7

(D) Equal to 14

- A Equal to 7
- B Greater than 7
- C Less than 7
- D Equal to 14

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Model Answer

(C) Less than 7

Salts of a strong acid and a weak base are acidic in nature, with pH value less than 7.

Source: More About Salts, Section 2.4.2

Explanation

The textbook directly states: "salts of a strong acid and weak base are acidic with pH value less than 7." Examples include ammonium chloride (strong acid HCl + weak base NH_4OH) and zinc sulphate. Examiners expect students to recall this rule for all three combinations: strong acid + strong base → pH 7; strong acid + weak base → pH < 7; weak acid + strong base → pH > 7.

Q9. straightforward exam-ready **[1]**

Baking powder used in cooking is a mixture of baking soda and:
(A) Washing soda
(B) A mild edible acid such as tartaric acid
(C) Common salt
(D) Slaked lime

- A Washing soda
- B A mild edible acid such as tartaric acid
- C Common salt
- D Slaked lime

◆ **Acids, Bases and Salts**

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Model Answer

(B) A mild edible acid such as tartaric acid

Baking powder is a mixture of baking soda ($NaHCO_3$) and a mild edible acid such as tartaric acid.

Explanation

The textbook explicitly states under *Uses of Baking Soda*: "baking powder is a mixture of baking soda (sodium hydrogencarbonate) and a mild edible acid such as tartaric acid." The acid reacts with $NaHCO_3$ on heating/mixing with water to release CO_2, making bread/cake soft and spongy. Do not confuse baking powder with washing soda or baking soda alone.

Source: Chapter 2, Section 2.4.3 (Uses of Baking Soda)

Q10. straightforward exam-ready **[1]**

Among the following, which is an olfactory indicator?
(A) Litmus
(B) Phenolphthalein
(C) Onion
(D) Methyl orange

- A Litmus
- B Phenolphthalein
- C Onion
- D Methyl orange

◆ **Acids, Bases and Salts**

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Model Answer

(C) Onion

Onion is an olfactory indicator because its odour changes in acidic or basic media, unlike litmus, phenolphthalein, and methyl orange, which are colour-change indicators.

Explanation

Olfactory indicators are substances whose **smell** (not colour) changes in acidic or basic solutions. The textbook (Activity 2.2) uses onion, vanilla, and clove oil as examples. Litmus, methyl orange, and phenolphthalein are visual (colour-change) indicators. Examiners expect you to know the definition and one example.

Q11. straightforward exam-ready **[1]**

A base that is soluble in water is specifically called:
(A) A salt
(B) An acid
(C) An alkali
(D) An indicator

A A salt
B An acid
C An alkali
D An indicator

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Model Answer

(C) An alkali

A base that is soluble in water is called an **alkali**. For example, NaOH and KOH dissolve in water and are alkalis.

Source: Chapter 2, Section 2.2

Explanation

The textbook explicitly states: *"Bases which are soluble in water are called alkalis."* Examiners expect students to recall this precise definition. Do not confuse base (broader term) with alkali (only water-soluble bases).

Q12. medium exam-ready **[1]**

Reaction of zinc with sodium hydroxide solution produces hydrogen gas and:
(A) Zinc chloride
(B) Zinc oxide
(C) Sodium zincate
(D) Zinc sulphate

A Zinc chloride
B Zinc oxide
C Sodium zincate
D Zinc sulphate

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Model Answer

(C) Sodium zincate

Zinc reacts with NaOH solution to form sodium zincate (Na_2ZnO_2) and hydrogen gas.

Explanation

Zinc is an amphoteric metal — it reacts with both acids and bases. With NaOH, it forms sodium zincate (Na_2ZnO_2), not a chloride or sulphate (those require different acids). This reaction is a standard example of an amphoteric metal reacting with a base. Remember: $Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2\uparrow$.

Q13. medium exam-ready **[1]**

Assertion (A): When an aqueous solution of an acid is diluted, its pH value increases.
Reason (R): Dilution decreases the concentration of H_3O^+ ions per unit volume of the solution.

A Both A and R are true and R is the correct explanation of A.
B Both A and R are true but R is not the correct explanation of A.
C A is true but R is false.
D A is false but R is true.

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Model Answer

Option A is correct. Both A and R are true and R is the correct explanation of A.

On dilution, concentration of H_3O^+ ions per unit volume decreases, so pH increases (higher pH = lower H^+ concentration).

Explanation

- The textbook states: "Mixing an acid or base with water results in decrease in the concentration of ions (H_3O^+/OH^-) per unit volume" — this confirms R is true.
- The pH scale states: "Higher the hydronium ion concentration, lower is the pH value" — so decreasing H_3O^+ concentration directly causes pH to rise, confirming A is true AND that R correctly explains A.
- Choose **A**, not B, because R is the direct/causal explanation of A.

Q14. medium exam-ready **[1]**

Assertion (A): Metallic oxides are called basic oxides.
Reason (R): Metallic oxides react with acids to form a salt and water, similar to the reaction of a base with an acid.

A Both A and R are true and R is the correct explanation of A.
B Both A and R are true but R is not the correct explanation of A.
C A is true but R is false.
D A is false but R is true.

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Model Answer

Option A is correct.

Both A and R are true and R is the correct explanation of A. Metallic oxides are called basic oxides because they react with acids to form salt and water, just like a base does, which justifies their basic nature.

Explanation

The textbook (Chapter 3) states that "metals combine with oxygen to form basic oxides." The reason correctly explains *why* they are called basic — their acid-neutralising behaviour mirrors that of bases. Since R directly and logically explains A, option A is the right choice. Avoid choosing B here; R is not merely a coincidental true statement — it is the actual basis for the assertion.

Q15. medium exam-ready **[1]**

Assertion (A): Plaster of Paris should always be stored in a moisture-proof container.
Reason (R): Plaster of Paris reacts with water to form gypsum ($CaSO_4.2H_2O$), losing its ability to set.

A Both A and R are true and R is the correct explanation of A.
B Both A and R are true but R is not the correct explanation of A.
C A is true but R is false.
D A is false but R is true.

◆ Acids, Bases and Salts

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Model Answer

Option A — Both A and R are true and R is the correct explanation of A.

Plaster of Paris ($CaSO_4 \cdot \frac{1}{2}H_2O$) reacts with water to form gypsum ($CaSO_4 \cdot 2H_2O$), losing its setting property, so moisture-proof storage is essential.

Explanation

The Assertion is correct — moisture ruins PoP by triggering premature setting. The Reason correctly explains *why*: the reaction with water converts PoP back to gypsum, so it can no longer set when needed. Since R directly and correctly explains A, option **A** is the right choice. Note: the source passages provided do not cover PoP, but this is standard Class 10 Science (Chapter 2 — Acids, Bases and Salts) factual knowledge expected in the exam.

Q16. deep exam-ready **[1]**

Assertion (A): Non-metallic oxides are acidic in nature.
Reason (R): Carbon dioxide reacts with sodium hydroxide (a base) to produce a salt and water, behaving like an acid.

A Both A and R are true and R is the correct explanation of A.
B Both A and R are true but R is not the correct explanation of A.
C A is true but R is false.
D A is false but R is true.

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Model Answer

Answer: A

Both A and R are true and R is the correct explanation of A. Non-metallic oxides are acidic; CO_2 reacts with NaOH to form Na_2CO_3 (salt) and water, confirming its acidic nature.

Source: What you have learnt, Chapter 3

Explanation

- The textbook states: *"Non-metals form oxides which are either acidic or neutral"* — so Assertion A is **true**.
- CO_2 (a non-metallic oxide) reacting with NaOH (a base) to give a salt and water is a classic example of acidic behaviour — so Reason R is **true**.
- R directly explains *why* non-metallic oxides are called acidic (they react with bases like acids do), making R the **correct explanation** of A.
- Choose **Option A**.

Q17. medium exam-ready **[2]**

Glucose and alcohol both contain hydrogen atoms but are not considered acids. What experimental evidence would you use to justify this, and what does it tell us about the nature of H^+ ions in acids?

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Model Answer

Experimental evidence (Activity 2.8): When glucose and alcohol solutions are tested for electrical conductivity using a bulb-and-battery setup, the bulb does **not** glow, showing these solutions produce **no ions**. Acids like HCl make the bulb glow, proving they produce ions in solution.

Nature of H^+ ions: This tells us that mere presence of hydrogen is not enough for acidity. Acids specifically produce **H^+(aq) / H_3O^+ ions** in water, which are responsible for acidic properties. Glucose and alcohol do not ionise, so they are not acids.

Source: Chapter 2, Section 2.2 (Activity 2.8)

Explanation

- **1 mark** for the experimental evidence (conductivity test — bulb glows with acids, not with glucose/alcohol).
- **1 mark** for the conclusion about H^+ ions (acids release H^+(aq)/H_3O^+; not all H-containing compounds do).
- Examiners want you to name the specific activity/observation, not just state it vaguely.
- Key phrase: "acids produce H^+(aq) ions in solution" — must appear in your answer.

Q18. medium exam-ready **[2]**

A farmer finds that the crop yield in his field is poor and suspects soil acidity is the problem. Name two substances he could add to the soil to improve it and explain the chemical basis of their action.

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Model Answer

Two substances the farmer can add are **quicklime (CaO)** or **slaked lime [Ca(OH)2]**.

Chemical basis: Acidic soil has excess H^+ ions (low pH). Lime being basic produces OH^- ions, which neutralise H^+ ions:

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

This raises the soil pH to a suitable level for crop growth.

Source: Chapter 2, Section 2.2

Explanation

- The examiner expects you to name **two basic substances** used to treat acidic soil — quicklime and slaked lime are the standard answers.
- The key concept is **neutralisation**: acid + base → salt + water. Showing the ionic equation ($H^+ + OH^- \rightarrow H_2O$) demonstrates the chemical basis clearly.
- Do not write baking soda here — it is used for acidity in the stomach, not typically for soil in CBSE context. Lime-based answers score full marks.
- 1 mark for naming two substances; 1 mark for the chemical explanation.

Q19. straightforward exam-ready **[2]**

State what is meant by 'water of crystallisation'. Give one example of a salt that contains water of crystallisation, stating its chemical formula, and describe what you would observe on strongly heating a few crystals of this salt.

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Model Answer

Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt.

Example: Copper sulphate — $CuSO_4 \cdot 5H_2O$

Observation on strong heating: The blue crystals turn white (as water of crystallisation is removed), and water droplets appear on the cooler parts of the boiling tube.

Explanation

The examiner expects: (1) a correct definition, (2) a named example with correct formula, and (3) two observations — colour change (blue → white) and water droplets. Copper sulphate is the textbook example used in Activity 2.15. Washing soda ($Na_2CO_3 \cdot 10H_2O$) is also acceptable as an example. Don't forget the formula — it earns a mark by itself.

Source: Chapter 2, Section 2.4.4

Q20. medium exam-ready **[2]**

A bee sting causes an acidic reaction on the skin. What type of substance should be applied to relieve the pain, and why? Name the substance traditionally found in the leaves of the dock plant that serves this purpose.

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Model Answer

A **base (alkali)** should be applied to relieve the pain, because bee sting is acidic in nature. A base neutralises the acid, providing relief. This is a neutralisation reaction.

The substance traditionally found in the leaves of the **dock plant** is **baking soda (sodium hydrogencarbonate)**.

(Note: The dock plant leaves naturally contain an alkaline/basic substance that neutralises the acid of the bee sting.)

Source: Chapter 2, Introduction / Acids, Bases and Salts

Explanation

- The key concept here is **neutralisation** — an acid is neutralised by a base.
- Examiners expect you to identify: (1) the type of substance = base/alkali, (2) the reason = neutralisation, and (3) the name = baking soda / sodium hydrogencarbonate from dock plant leaves.
- The dock plant connection is a classic NCERT example from this chapter; remember it as a real-life application of neutralisation.
- Do not write "acid" as the remedy — that is a common mistake since bee sting is already acidic.

Q21. straightforward exam-ready **[2]**

What is acid rain? State the pH value below which rain is classified as acid rain and explain one harmful effect it has on aquatic ecosystems.

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Model Answer

Acid rain is rain water having pH less than **5.6**, caused by the presence of acidic pollutants like SO_2 and NO_2 dissolved in rainwater.

Harmful effect on aquatic ecosystems: When acid rain flows into rivers, it lowers the pH of river water, making survival of aquatic life difficult.

Source: Chapter 2, Section 2.3.1 — Importance of pH in Everyday Life

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Explanation

- The examiner expects the **exact pH value of 5.6** — writing "less than 7" will not fetch marks.
- One clearly stated harmful effect is enough for a 2-mark answer; do not over-explain.
- The phrase "survival of aquatic life becomes difficult" directly mirrors the textbook language — using it shows the examiner you know the source material.

Q22. medium exam-ready **[2]**

Sodium hydrogencarbonate ($NaHCO_3$) is used as an antacid and also as an ingredient in baking powder. Write the equation for its decomposition on heating and explain why it makes bread soft and spongy.

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Model Answer

Decomposition reaction on heating:

$$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + H_2O + CO_2 \uparrow$$

Why bread becomes soft and spongy:
When baking powder is heated or mixed with water, $NaHCO_3$ reacts with the edible acid (e.g., tartaric acid) present and releases CO_2 gas. This CO_2 gets trapped in the dough, causing it to rise and making the bread soft and spongy.

Source: Chapter 2, Section 2.4.3 — Baking soda

Explanation

- The equation must be **balanced** and include the heat arrow (Δ); missing it loses marks.
- The key point examiners look for: CO_2 is the gas responsible for making bread spongy — state this explicitly.
- Note the two scenarios given in the textbook: $NaHCO_3$ decomposes on **heating alone**, but in baking powder it also reacts with an **acid** to release CO_2. Since the question asks about baking powder use, mentioning the acid reaction is ideal.
- Do not confuse the decomposition equation (2 mol $NaHCO_3$) with the single-mol acid reaction equation.

Q23. medium exam-ready **[3]**

Equal concentrations of hydrochloric acid (HCl) and acetic acid (CH_3COOH) are taken. Which of the two is a stronger acid? Explain your answer and state how their pH values would compare at the same concentration.

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Model Answer

HCl (hydrochloric acid) is the stronger acid.

HCl is a mineral acid that is **completely ionised** in water, producing a large number of H^+ ions. Acetic acid (CH_3COOH), being a carboxylic acid, is a **weak acid** — it only partially ionises in water, producing fewer H^+ ions at the same concentration.

Since acid strength depends on the number of H^+ ions produced, HCl is stronger than CH_3COOH at equal concentrations.

Comparison of pH: At the same concentration, HCl produces more H^+ ions, so it has a **lower pH** than acetic acid. Acetic acid, being partially ionised, produces fewer H^+ ions and therefore has a **higher pH** than HCl.

Source: Chapter 2, Section 2.3; Chapter 4, Section 4.4.2

Explanation

- The key phrase from the textbook is: *"unlike mineral acids like HCl, which are completely ionised, carboxylic acids are weak acids."* Quote or paraphrase this directly — examiners look for it.
- Connect acid strength to H^+ ion concentration (more H^+ = stronger acid = lower pH). This links Chapter 2 (pH scale) with Chapter 4 (acetic acid properties).
- Don't just state which is stronger — **explain why** (ionisation) and **compare pH** as the question asks both. All three points carry marks.

Q24. straightforward exam-ready **[3]**

Describe how bleaching powder is manufactured from chlorine. Write the balanced chemical equation for this reaction and list any two uses of bleaching powder.

◆ Acids, Bases and Salts

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Model Answer

Manufacture of Bleaching Powder:

Bleaching powder is manufactured by passing chlorine gas over dry slaked lime [$Ca(OH)_2$] at about 40°C.

Balanced Chemical Equation:

$$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$$

(Calcium hydroxide + Chlorine → Bleaching powder + Water)

Two Uses of Bleaching Powder:

1. It is used as a disinfectant and for sterilising drinking water.
2. It is used for bleaching cotton and linen in the textile industry.

Explanation

This question tests knowledge from the Acids, Bases and Salts chapter. Examiners expect: (1) a one-line description of the manufacturing process mentioning both reactants and the temperature condition, (2) the correctly written and balanced equation with formula $CaOCl_2$ for bleaching powder, and (3) any two distinct uses. Avoid vague answers — be specific (e.g., "drinking water" not just "water").

Q25. straightforward exam-ready **[3]**

What happens when sodium carbonate (Na_2CO_3) reacts with dilute hydrochloric acid? Write the balanced equation and describe a test you would perform to identify the gas produced.

◆ Acids, Bases and Salts

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Model Answer

When sodium carbonate reacts with dilute hydrochloric acid, it produces sodium chloride, water, and carbon dioxide gas. Effervescence (brisk bubbling) is observed.

Balanced equation:

$$Na_2CO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

Test for the gas produced (CO_2):
Pass the gas through lime water [$Ca(OH)_2$ solution]. The lime water turns **milky**, confirming the gas is carbon dioxide.

$$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$$

The white precipitate of $CaCO_3$ causes the milkiness.

Source: Chapter 2, Section 2.1.3 — How do Metal Carbonates and Metal Hydrogencarbonates React with Acids?

Explanation

- **Mark distribution (3 marks):** 1 mark for stating the products/observation, 1 mark for the balanced equation, 1 mark for the lime water test with its equation or description.
- Always include **state symbols** (s, aq, l, g) in balanced equations — examiners reward this.
- The lime water test is the **standard test for CO_2** at this level; mentioning the white precipitate of $CaCO_3$ completes the answer.
- Do not confuse Na_2CO_3 (sodium carbonate / washing soda) with $NaHCO_3$ (baking soda) — both react with HCl to give CO_2, but the equations differ in stoichiometry.

Q26. medium exam-ready **[3]**

Our stomach produces hydrochloric acid to help in digestion. (a) What happens during indigestion? (b) What type of substances are used as antacids? (c) Why is magnesium hydroxide preferred over sodium hydroxide as an antacid?

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Model Answer

(a) During indigestion, the stomach produces **excess hydrochloric acid**, which causes discomfort, pain, and a burning sensation.

(b) Antacids are mild **bases (alkaline substances)** that neutralise the excess acid in the stomach. For example, sodium hydrogencarbonate (baking soda) and magnesium hydroxide.

(c) Magnesium hydroxide [$Mg(OH)_2$] is preferred over sodium hydroxide ($NaOH$) because $NaOH$ is a **strong base** and is highly corrosive, which could harm the stomach lining. $Mg(OH)_2$ is a **mild, non-corrosive base** and is safe for ingestion.

Source: Chapter 2, Section 2.4.3 (Baking soda)

Explanation

- **(a)** Simply state that excess HCl is produced — this is the root cause of indigestion.
- **(b)** The keyword is "base/alkaline" — antacids neutralise the acid by a neutralisation reaction (Base + Acid → Salt + Water).
- **(c)** This is the most important part: the distinction is **mild base vs. strong/corrosive base**. Examiners expect you to use the word "corrosive" for $NaOH$. $Mg(OH)_2$ is mentioned in Activity 2.1 as a base, and the text explains $NaHCO_3$ is "mild non-corrosive" — apply the same logic to $Mg(OH)_2$ vs. $NaOH$.

Q27. medium exam-ready **[3]**

Write the balanced chemical equation for the chlor-alkali process. Name the electrode at which (i) chlorine is produced and (ii) hydrogen is produced. State one industrial use of the sodium hydroxide produced.

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Model Answer

Balanced chemical equation for the chlor-alkali process:

$$2\mathrm{NaCl(aq)} + 2\mathrm{H_2O(l)} \xrightarrow{\text{electricity}} 2\mathrm{NaOH(aq)} + \mathrm{Cl_2(g)} + \mathrm{H_2(g)}$$

(i) Chlorine is produced at the **anode** (positive electrode).

(ii) Hydrogen is produced at the **cathode** (negative electrode).

Industrial use of NaOH: Sodium hydroxide is used in the manufacture of soaps and detergents (also used in paper making and de-greasing metals).

Explanation

- The equation must be balanced and include state symbols — examiners check this.
- "Chlor-alkali" refers to the electrolysis of brine (NaCl solution) producing chlorine (Cl_2), alkali (NaOH), and hydrogen (H_2) — remember all three products.
- Anode = oxidation → Cl^- loses electrons → Cl_2 formed. Cathode = reduction → H^+ gains electrons → H_2 formed. This anode/cathode distinction is a common 1-mark trap.
- Any one valid industrial use of NaOH earns the mark (soaps, paper, textiles, de-greasing).

Q28. deep exam-ready **[3]**

Fresh milk has a pH of about 6. As the milk turns to curd, does the pH increase or decrease? Explain why. A milkman adds a small amount of baking soda to fresh milk — how does this affect the time taken for the milk to set into curd and why?

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Model Answer

pH change as milk turns to curd: The pH **decreases** (becomes more acidic). During the formation of curd, bacteria act on milk and produce **lactic acid**. This increases the H^+ ion concentration, lowering the pH below 6.

Effect of baking soda added by the milkman:

(a) Baking soda is alkaline, so it raises the pH of fresh milk from 6 to slightly alkaline. This makes the milk last longer before turning sour.

(b) Since lactic acid is produced during curd formation, the added baking soda **neutralises** this acid. The milk therefore takes a **longer time** to set as curd, because the acid produced must first neutralise the baking soda before the pH can drop enough for curdling to occur.

Source: Chapter 2 — Acids, Bases and Salts; Section 2.3.1 and Exercise Q.11–12

Explanation

- Examiners expect students to name **lactic acid** as the cause of pH decrease — this is a key fact from the chapter.
- For the baking soda part, the core idea is **neutralisation**: baking soda (basic) neutralises the lactic acid produced, delaying the pH drop needed for curdling. Mentioning this mechanism earns full marks.
- Table 2.3 confirms lactic acid is present in sour milk/curd, supporting the answer.
- Don't just say "pH increases/decreases" — always explain *why* using ion concentration or chemical reasoning.

Q29. deep exam-ready **[3]**

Two solutions X and Y are tested with universal indicator. Solution X shows a pH of 2 and solution Y shows a pH of 12. (a) Identify the nature of each solution. (b) Which solution has a higher concentration of OH^- ions? (c) If equal volumes of X and Y are mixed, predict whether the resulting solution will be acidic, basic or neutral, giving a reason.

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Model Answer

(a) Solution X (pH = 2) is **strongly acidic** in nature. Solution Y (pH = 12) is **strongly basic (alkaline)** in nature. Values less than 7 indicate acidic solutions and values greater than 7 indicate basic solutions.

(b) Solution Y (pH = 12) has a higher concentration of OH^- ions. As pH value increases from 7 to 14, it represents an increase in OH^- ion concentration.

(c) The resulting solution will be **acidic**. Solution X (pH = 2) is a strong acid with very high H^+ concentration, while Solution Y (pH = 12) is a strong base. Since equal volumes are mixed but the acid's H^+ concentration (10^{-2} M) exceeds the base's OH^- concentration (10^{-2} M) — actually they are equal — the solution will be **neutral** (pH ≈ 7), as H^+ and OH^- ions neutralise each other: $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$.

Source: Chapter 2, Section 2.3

Explanation

- pH 2 and pH 12 are **equidistant** from 7 — pH 2 means $[H^+] = 10^{-2}$ M and pH 12 means $[OH^-] = 10^{-2}$ M. Equal volumes → equal moles of H^+ and OH^- → **neutral** solution. Examiners expect students to reason through the neutralisation, not just guess "acidic."
- For part (b), remember: higher pH above 7 = more OH^- ions.
- Use the phrase "neutralisation reaction" and the ionic equation $H^+ + OH^- \rightarrow H_2O$ for full marks on part (c).

Q30. deep exam-ready **[5]**

(a) With a suitable example, explain what is meant by a neutralisation reaction. Write the ionic equation that represents all such reactions between a strong acid and a strong base.
(b) A metal oxide X reacts with dilute sulphuric acid to form a blue-green solution. Identify X and write the balanced chemical equation for the reaction. What class of oxide does X belong to, and why?
(c) Write the balanced chemical equation for the reaction of zinc with sodium hydroxide. How does this reaction differ from the general reaction of a metal with an acid?

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Model Answer

(a) A neutralisation reaction is when an acid reacts with a base to form salt and water, with the evolution of heat. Example: $NaOH + HCl \rightarrow NaCl + H_2O$.

The ionic equation for all strong acid–strong base neutralisation reactions is:

$$\mathrm{H^+}(aq) + \mathrm{OH^-}(aq) \rightarrow \mathrm{H_2O}(l)$$

(b) The blue-green solution indicates formation of copper sulphate, so metal oxide X is **copper(II) oxide (CuO)**.

$$\mathrm{CuO}(s) + \mathrm{H_2SO_4}(aq) \rightarrow \mathrm{CuSO_4}(aq) + \mathrm{H_2O}(l)$$

CuO is a **basic oxide** because it reacts with an acid (H_2SO_4) to form salt and water only, showing no acidic character.

(c) Zinc reacts with sodium hydroxide as follows:

$$\mathrm{Zn}(s) + 2\mathrm{NaOH}(aq) \rightarrow \mathrm{Na_2ZnO_2}(aq) + \mathrm{H_2}(g)$$

Difference: When a metal reacts with an acid, hydrogen gas is displaced and a salt of the acid is formed. Here, zinc reacts with a **base** (NaOH) and still produces hydrogen gas, forming sodium zincate. This shows zinc is an **amphoteric** metal — it can react with both acids and bases, unlike most metals which react only with acids.

Explanation

- **(a)** Examiners expect the word "salt and water" and the net ionic equation $H^+ + OH^- \rightarrow H_2O$. Avoid writing full ionic equations with spectator ions.
- **(b)** "Blue-green" is the key clue for Cu^{2+} ions in solution → $CuSO_4$ → CuO was the reactant. Basic oxide reacts with acids (not bases) to give salt + water only.
- **(c)** The reaction of Zn with NaOH is a standard NCERT example showing amphoteric behaviour. The key contrast to emphasise: metals normally react with acids to give H_2, but Zn also reacts with a *base* to give H_2 — this is the difference examiners look for.

Q31. medium exam-ready **[5]**

(a) What is the pH scale? Explain how pH is related to the concentration of H^+(aq) ions in a solution. How does the pH of a solution change when it is diluted?
(b) Explain why our body is sensitive to pH changes. Give two specific examples from everyday life where pH plays a critical role in living systems or health.
(c) A universal indicator turns orange (pH ≈ 4) in one solution and violet (pH ≈ 11) in another. Compare the concentrations of H^+ and OH^- ions in these two solutions.

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Model Answer

(a) The pH scale is a scale from 0 to 14 used to measure the concentration of H^+(aq) ions in a solution. Higher the H^+ ion concentration, **lower** the pH value. A neutral solution has pH = 7; values below 7 indicate acidic solutions, and above 7 indicate basic solutions. On dilution, the concentration of H^+ (or OH^-) ions per unit volume **decreases**, so the pH of an acid moves closer to 7 (increases), and that of a base also moves closer to 7 (decreases).

(b) Our body works within the pH range of 7.0 to 7.8; living organisms can survive only in a narrow pH range. Even a small change disturbs metabolic activities.

- **Digestion:** The stomach produces HCl for digestion. Excess acid (indigestion) causes pain; antacids (mild bases) neutralise it.
- **Tooth decay:** Bacteria degrade food, producing acids. When mouth pH falls below 5.5, tooth enamel (calcium hydroxyapatite) gets corroded, causing decay.

(c) Solution with pH ≈ 4 (orange) is **acidic** — high H^+ concentration, low OH^- concentration. Solution with pH ≈ 11 (violet) is **strongly alkaline** — very low H^+ concentration, high OH^- concentration. Thus, the first solution has much greater H^+ concentration than the second, while the second has much greater OH^- concentration than the first.

Source: Chapter 2, Sections 2.3 and 2.3.1

Explanation

- **(a):** Examiners want the definition, the inverse relationship (higher H^+ → lower pH), the neutral/acid/base ranges, and the effect of dilution (pH shifts toward 7). Don't just memorise the range — explain the direction of shift on dilution.
- **(b):** Two specific examples with the mechanism (excess acid → antacid neutralises; pH < 5.5 → enamel corrodes) earn full marks. Just naming examples without explanation loses marks.
- **(c):** This is a comparison question — clearly state which solution has more H^+ and which has more OH^-. No calculation is needed; reasoning from pH values (below 7 = acidic, above 7 = basic) is sufficient.

Q32. medium exam-ready **[5]**

(a) Common salt (sodium chloride) is described as a raw material for several important chemicals. Starting from brine, describe the preparation of sodium hydroxide, naming the process and writing the balanced equation.
(b) How is washing soda prepared from sodium carbonate? Write the equation. State two industrial or domestic uses of washing soda.
(c) Gypsum on heating at 373 K gives Plaster of Paris. Write the balanced equation. When Plaster of Paris is mixed with water, it sets into a hard mass — explain what happens chemically and state one practical use of this property.

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Model Answer

(a) Sodium Hydroxide — Chlor-Alkali Process:

When electricity is passed through brine (aqueous NaCl), it decomposes. This is called the **chlor-alkali process**.

$$2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$$

Cl_2 is released at the anode; H_2 at the cathode; NaOH forms near the cathode.

(b) Washing Soda:

Sodium carbonate is recrystallised with water to give washing soda ($Na_2CO_3 \cdot 10H_2O$):

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

Uses: (i) Used in glass, soap, and paper industries. (ii) Used as a domestic cleaning agent and to remove permanent hardness of water.

(c) Plaster of Paris:

$$CaSO_4.2H_2O \xrightarrow{373\text{ K}} CaSO_4.\tfrac{1}{2}H_2O + 1\tfrac{1}{2}H_2O$$

When mixed with water, Plaster of Paris rehydrates and converts back to gypsum ($CaSO_4 \cdot 2H_2O$), forming a hard solid mass:

$$CaSO_4.\tfrac{1}{2}H_2O + 1\tfrac{1}{2}H_2O \rightarrow CaSO_4.2H_2O$$

Practical use: Used by doctors to set fractured bones in the correct position.

Source: Chapter 2, Section 2.4.3 and 2.4.4

Explanation

- **(a)** Examiners expect the process name ("chlor-alkali"), the balanced equation, and mention of products at each electrode — all three earn marks.
- **(b)** The key point is that Na_2CO_3 is *recrystallised* (not just mixed) with water. Write the equation and give two distinct uses from the textbook list.
- **(c)** Two equations are needed: formation of Plaster of Paris from gypsum, and its setting with water. The chemical explanation (rehydration → gypsum) and one use (bone-setting/fractured bones) are expected. Don't forget the temperature (373 K) in the heating equation.

Q33. medium exam-ready **[4]**

Read the following and answer the questions:

Rahul and Priya are performing an experiment in the school laboratory. They dissolve different substances — hydrochloric acid, sulphuric acid, glucose solution, and alcohol — in water and connect each solution to a simple electrical circuit containing a bulb. They observe that the bulb glows brightly for hydrochloric acid and sulphuric acid solutions, but does not glow at all for glucose and alcohol solutions. Their teacher then explains that when an acid is dissolved in water, something special happens at the ionic level that allows electricity to flow.

(i) Why does the bulb glow when HCl or H_2SO_4 solution is used but not with glucose or alcohol? (1 mark)
(ii) Write the equation showing what happens when HCl dissolves in water. What is the ion formed called? (1 mark)
(iii) NaOH solution conducts electricity but NaOH in its solid state does not. Explain why, and state what type of ion is responsible for the basic nature of NaOH solution. (1 mark)
(iv) Both glucose and alcohol contain hydrogen atoms. Why are they not classified as acids? (1 mark)

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Model Answer

(i) HCl and H_2SO_4 dissolve in water to produce ions (H^+ and respective anions), which carry electric current, making the bulb glow. Glucose and alcohol do not ionise in water; they produce no ions, so no current flows and the bulb does not glow.

(ii)

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

The ion formed (H_3O^+) is called the **hydronium ion**.

(iii) In solid state, NaOH ions are held in a fixed crystal lattice and cannot move, so it does not conduct electricity. When dissolved in water, it dissociates into free Na^+ and OH^- ions that move freely. The **hydroxide ion (OH^-)** is responsible for the basic nature of NaOH solution.

(iv) Glucose and alcohol do contain hydrogen, but they do not release H^+ (hydrogen) ions when dissolved in water. Only compounds that produce $H^+(aq)$ ions in solution are classified as acids. Since glucose and alcohol produce no ions at all, they are not acids.

Source: Chapter 2, Section 2.2 and 2.2.1

Explanation

- **(i)** The key concept is **ionisation** — examiners want the word "ions" linked to conductivity.
- **(ii)** Write the equation correctly and name H_3O^+ as "hydronium ion" — both parts carry marks.
- **(iii)** Two points needed: why solid doesn't conduct (no free ions) + OH^- causes basic nature.
- **(iv)** The distinction is not the *presence* of hydrogen but whether $H^+(aq)$ ions are *released* in water — this is the core idea examiners test here.

Q34. medium exam-ready **[4]**

Read the following and answer the questions:

During a science fair, students set up a display about the importance of pH in daily life. One student brings a chart showing: tooth enamel corroding below pH 5.5; the human body maintaining a pH of 7.0–7.8 for metabolic activity; acid rain having a pH below 5.6; and a stomach producing HCl to aid digestion. Another student points out that toothpastes are basic, and explains why we use them. A third student adds that farmers sometimes treat acidic soil with quicklime.

(i) Why does tooth decay begin only when pH of the mouth drops below 5.5 and not before? (1 mark)
(ii) How do toothpastes help in preventing tooth decay? (1 mark)
(iii) What is the source of the acid that lowers pH in the mouth after eating? (1 mark)
(iv) Write a balanced chemical equation showing how quicklime (CaO) could help neutralise excess acid (HCl) in soil. (1 mark)

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Model Answer

(i) Tooth enamel is made of calcium hydroxyapatite, which does not dissolve in water. It is corroded only when the pH in the mouth falls below 5.5. Above this pH, the acid is not strong enough to corrode the enamel, so decay does not begin.

(ii) Toothpastes are generally basic in nature. They neutralise the excess acid produced in the mouth by bacteria, raising the pH above 5.5, thereby preventing the corrosion of tooth enamel and stopping tooth decay.

(iii) Bacteria present in the mouth degrade sugar and food particles left in the mouth after eating and produce acids. These acids lower the pH of the mouth.

(iv) Quicklime reacts with HCl as follows:

$$CaO + 2HCl \rightarrow CaCl_2 + H_2O$$

Source: Chapter 2, Section 2.3.1 (pH change as the cause of tooth decay); Chapter 5 (Dental caries box)

Explanation

- **(i)** The key fact is that enamel (calcium hydroxyapatite) is stable above pH 5.5 — state this explicitly.
- **(ii)** Always mention: toothpastes are **basic**, they **neutralise** the acid — both points needed for the mark.
- **(iii)** The source of acid is **bacterial degradation of sugar/food particles** — don't just say "bacteria" without mentioning what they break down.
- **(iv)** Write the fully **balanced** equation; note it is **2HCl** (not 1). $CaO + 2HCl \rightarrow CaCl_2 + H_2O$. Examiners check balancing.

Q35. deep exam-ready **[4]**

Read the following and answer the questions:

A chemistry teacher demonstrates two reactions to the class. In the first, she adds dilute HCl to a test tube containing sodium carbonate powder and passes the gas produced through lime water — the lime water first turns milky. She then passes excess gas and the milkiness disappears. In the second demonstration, she places copper oxide powder into a beaker and slowly adds dilute HCl with stirring, and the contents gradually turn blue-green.

(i) Name the gas produced in the first reaction and write the balanced equation for its reaction with lime water to produce the white precipitate. (1 mark)
(ii) Why does the milky white precipitate disappear when excess gas is passed? Write the equation for this reaction. (1 mark)
(iii) In the second reaction, what causes the blue-green colour of the solution? Write the balanced equation for the reaction. (1 mark)
(iv) Based on the second reaction, explain why copper oxide is classified as a basic oxide. (1 mark)

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Model Answer

(i) The gas produced is **carbon dioxide (CO_2)**.

$$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$$

The white precipitate is calcium carbonate ($CaCO_3$), which makes lime water milky.

(ii) When excess CO_2 is passed, the insoluble $CaCO_3$ reacts with water and excess CO_2 to form soluble calcium hydrogencarbonate, causing the milkiness to disappear.

$$CaCO_3(s) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2(aq)$$

(iii) The blue-green colour is due to the formation of **copper(II) chloride ($CuCl_2$)**. Balanced equation:

$$CuO(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$$

(iv) Copper oxide reacts with hydrochloric acid (an acid) to produce a salt and water — this is similar to the reaction of a base with an acid. Since metallic oxides react with acids to give salt and water, they are classified as **basic oxides**.

Source: Chapter 2, Sections 2.1.3 and 2.1.5

Explanation

- **(i)** The reaction of Na_2CO_3 with HCl releases CO_2; always write the lime water equation with state symbols.
- **(ii)** Examinees often forget the reason — stress that $Ca(HCO_3)_2$ is *soluble*, which is why milkiness disappears.
- **(iii)** "Blue-green" is the key observation cue; always name the compound responsible ($CuCl_2$) and balance the equation.
- **(iv)** The definition-based justification is essential: link "metal oxide + acid → salt + water" directly to the definition of a basic oxide. One sentence of reasoning scores the mark.

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