Affiliated to CBSE, New Delhi (Affiliation No. 1030642)

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CLASS X · SCIENCE (086) · CHEMISTRY · CBSE BOARD EXAMINATION 2027

CHAPTER 2

Acids, Bases and Salts

pH 7 · H^+ $NaHCO_3$

Answer Booklet · CBSE marking-scheme answers with marks for every point

Every question of the chapter booklet | Marks shown point by point | MCQ keys with reasons

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HOW TO USE THE ANSWERS

1. Answer the question in your notebook **first**. Open this booklet only to check.
2. Each answer is written the way the CBSE marking scheme sets it out: **value points**, with the **mark for each point** in orange beside it.
3. Give yourself marks point by point. Use the same **key words** in your own answers.
4. Equations must be balanced; diagrams must be labelled; numericals need formula, substitution and unit.
5. Copy every wrong answer to the My Mistakes page of your booklet.

READ THIS FIRST

Marking Guide

Model answers to every question in the chapter booklet, set out the way a CBSE examiner marks them.

HOW MARKS ARE GIVEN IN SCIENCE ANSWERS

1. **MCQ and assertion–reason (1 mark):** only the correct option scores. The reason given here is for your understanding.
2. **2 and 3 marks:** one mark (or ½) for each correct **value point**. The examiner looks for the key word – a long answer without it scores less than a short answer with it.
3. **Equations:** a correct balanced equation earns its full mark; an unbalanced one, or one with wrong formulae, usually earns ½ or nothing.
4. **Numericals:** formula, substitution and the final answer **with unit** are marked separately.
5. **Diagrams:** marks for a correct drawing and for the labels asked for. An unlabelled diagram earns little.
6. **Case study (4 marks):** 1 + 1 + 2. **Long answer (5 marks):** the split is shown beside each point.

PART A · ANSWERS

A NCERT Practice – Answers

Marking-scheme answers for every question in Part A of the chapter booklet.

Acids, bases and their reactions

A1. You are given three test tubes with distilled water, an acidic solution and a basic solution, but only red litmus paper. How will you identify each? **[3]**

Dip red litmus in each solution: the one that turns it blue is the basic solution.	1
Put a drop of this basic solution on two fresh red litmus strips; they turn blue.	1
Dip these blue strips in the other two: the solution that turns blue litmus red is acidic; the one with no change is distilled water.	1

A2. Why should curd and other sour foods not be stored in brass or copper vessels? **[2]**

Curd and sour foods contain acids.	1
These acids react with copper / brass and form harmful (poisonous) compounds that spoil the food.	1

A3. Which gas is usually given off when an acid reacts with a metal? Give an example with an equation, and describe a test for the gas. **[3]**

Hydrogen gas.	1
$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$	1
Bring a burning candle near the gas: it burns with a ‘pop’ sound.	1

A4. A calcium compound reacts with dilute hydrochloric acid with effervescence. The gas puts out a burning candle. If one product is calcium chloride, write the balanced equation. [2]

The compound is calcium carbonate; the gas is carbon dioxide. 1

$CaCO_3 + 2\,HCl \longrightarrow CaCl_2 + H_2O + CO_2$ 1

A5. Write the balanced chemical equations for the reactions of: **(i)** dilute sulphuric acid with zinc granules **(ii)** dilute hydrochloric acid with magnesium ribbon **(iii)** dilute sulphuric acid with aluminium powder **(iv)** dilute hydrochloric acid with iron filings [4]

(i) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$ 1

(ii) $Mg + 2\,HCl \longrightarrow MgCl_2 + H_2$ 1

(iii) $2\,Al + 3\,H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3\,H_2$ 1

(iv) $Fe + 2\,HCl \longrightarrow FeCl_2 + H_2$ 1

A6. Crushed egg-shells are added to a solution. A gas is given off which turns lime water milky. What kind of solution is it? Write the equation. [2]

The solution is an acid (e.g. dilute HCl); egg-shells are calcium carbonate, which gives CO_2 with acids. 1

$CaCO_3 + 2\,HCl \longrightarrow CaCl_2 + H_2O + CO_2$ 1

A7. What is a neutralisation reaction? Give two examples with equations. [3]

Reaction of an acid with a base to give a salt and water. 1

$NaOH + HCl \longrightarrow NaCl + H_2O$ 1

$Mg(OH)_2 + 2\,HCl \longrightarrow MgCl_2 + 2\,H_2O$ 1

A8. 10 mL of a sodium hydroxide solution is exactly neutralised by 8 mL of a hydrochloric acid solution. How much of the same acid will neutralise 20 mL of the same NaOH solution? [1]

Double the base needs double the acid: 2 × 8 = 16 mL. 1

Acids and bases in water

A9. Hydrochloric acid and nitric acid show acidic properties in water, but solutions of glucose and alcohol do not, though all contain hydrogen. Why? [2]

HCl and HNO_3 give H^+ ions in water; these ions are responsible for acidic properties. 1

Glucose and alcohol do not give H^+ ions in water, so they are not acidic. 1

A10. Why does an aqueous solution of an acid conduct electricity? [1]

It contains ions (H^+ / H_3O^+ and the anion), which carry the current. 1

A11. Why does distilled water not conduct electricity, whereas rain water does? [2]

Distilled water has no ions. 1

Rain water has dissolved acids (from gases such as CO_2 in air) that give ions, so it conducts. 1

A12. Why does dry HCl gas not change the colour of dry blue litmus paper? Why do acids not show acidic behaviour without water? [2]

Dry HCl gas does not form H^+ ions, so dry litmus is not affected. 1

H^+ ions are released from an acid only in the presence of water. 1

A13. While diluting an acid, why is it recommended that the acid be added to water and not water to the acid? [2]

Mixing acid and water is highly exothermic. 1

If water is added to a concentrated acid, the heat can make the mixture splash out and cause burns, and the glass may break; adding acid slowly to water spreads the heat. 1

A14. How is the concentration of ions affected when (i) an acid solution is diluted (ii) more base is dissolved in a sodium hydroxide solution? [2]

(i) The concentration of H_3O^+ ions per unit volume decreases. 1

(ii) The concentration of OH^- ions increases. 1

pH

A15. Solution A has pH 6 and solution B has pH 8. Which has more H^+ ions? Which is acidic and which is basic? [2]

A has more H^+ ions (lower pH). 1

A is acidic; B is basic. 1

A16. Do basic solutions also contain H^+ ions? If yes, why are they basic? How does H^+ concentration affect the nature of a solution? [2]

Yes; they are basic because the concentration of OH^- ions is more than that of H^+ ions. 1

The more the H^+ ions, the more acidic the solution (lower pH). 1

A17. Five solutions P, Q, R, S, T have pH 4, 1, 11, 7 and 9. Which is (i) neutral (ii) strongly alkaline (iii) strongly acidic (iv) weakly acidic (v) weakly alkaline? Arrange them in increasing order of H^+ concentration. [3]

(i) S (ii) R (iii) Q 1

(iv) P (v) T 1

R < T < S < P < Q 1

A18. Under what soil condition would a farmer treat the soil with quicklime, slaked lime or chalk? [1]

When the soil is too acidic; these bases neutralise the acidity. 1

A19. Fresh milk has pH about 6. (a) How will the pH change as it turns into curd? (b) A milkman adds a little baking soda to fresh milk. Why? Why does this milk take longer to set as curd? [3]

(a) pH falls (below 6) because lactic acid is formed. 1

(b) Baking soda makes the milk slightly alkaline, so it does not turn sour quickly. 1

The lactic acid formed first has to neutralise the baking soda, so curd takes longer to set. 1

A20. How does tooth decay start? How does using toothpaste help? [2]

Bacteria in the mouth break down sugar and food bits into acids; when the pH falls below 5.5 the enamel (calcium hydroxyapatite) is corroded. 1

Toothpastes are basic; they neutralise the extra acid. 1

Salts

A21. What is the common name of $CaOCl_2$? Name the substance that gives this compound when treated with chlorine. [2]

Bleaching powder. 1

Dry slaked lime, $Ca(OH)_2$. 1

A22. Name the sodium compound used for removing permanent hardness of water. [1]

Washing soda, $Na_2CO_3 \cdot 10\,H_2O$ (sodium carbonate). 1

A23. What happens when a solution of sodium hydrogencarbonate is heated? Write the equation. [2]

It breaks down to give sodium carbonate, water and carbon dioxide. 1

$2\,NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2$ 1

A24. Write the equation for the reaction of Plaster of Paris with water. Why should Plaster of Paris be stored in a moisture-proof container? [3]

$CaSO_4 \cdot \frac{1}{2}\,H_2O + \frac{3}{2}\,H_2O \longrightarrow CaSO_4 \cdot 2\,H_2O$ 1

It changes into gypsum, a hard solid mass. 1

Moisture would make it set (harden) in the container and become useless. 1

A25. Give two uses each of washing soda and baking soda. [2]

Washing soda: glass / soap / paper industry; removing permanent hardness of water; cleaning (any two). 1

Baking soda: baking powder; antacid; soda-acid fire extinguisher (any two). 1

A26. What is the chlor-alkali process? Write the equation and say where each product is formed. [3]

Electrolysis of brine (aqueous sodium chloride); the products are chlorine and an alkali, NaOH. 1

$2\,NaCl + 2\,H_2O \longrightarrow 2\,NaOH + Cl_2 + H_2$ 1

Chlorine at the anode; hydrogen at the cathode; NaOH solution near the cathode. 1

PART B · ANSWERS

B Exemplar Practice – Answers

Marking-scheme answers for every question in Part B of the chapter booklet.

Multiple choice

Q	Answer	Working / reason
B1	**(d)** CH_3COOH	Acetic acid gives few H^+ ions.
B2	**(d)** 10	Basic solutions have pH above 7.
B3	**(b)** Na_2CO_3	It is made from a weak acid and a strong base.
B4	**(b)** $Na_2CO_3 \cdot 10\,H_2O$	Sodium carbonate decahydrate.
B5	**(a)** It is below 7	The stomach makes HCl; gastric juice has pH about 1.2.
B6	**(b)** (i), (ii) and (iii)	CO_2 is acidic, so it cannot turn red litmus blue.
B7	**(a)** NH_4Cl	Strong acid + weak base gives an acidic salt.
B8	**(b)** $CaSO_4 \cdot 2\,H_2O$	Heating gypsum at 373 K gives Plaster of Paris.
B9	**(c)** Clove oil	Olfactory indicators change smell; onion and vanilla also do.
B10	**(b)** 5	$CuSO_4 \cdot 5\,H_2O$

Short answer

B11. What happens when dilute nitric acid is added to egg-shell? Write the equation and name a test for the gas. **[2]**

$CaCO_3 + 2\,HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2$ — 1

The gas is CO_2; it turns lime water milky. — 1

B12. An ant sting causes pain and burning. Name the acid injected and suggest a home remedy, giving the reason. **[2]**

Methanoic acid (formic acid). — 1

Rub a mild base such as baking soda solution; it neutralises the acid. — 1

B13. Equal lengths of magnesium ribbon are placed in test tube A with dilute HCl and test tube B with dilute acetic acid of the same concentration. In which tube is the fizzing more vigorous, and why? **[2]**

Tube A. — 1

HCl is a strong acid and gives more H^+ ions than acetic acid (a weak acid), so the reaction is faster. — 1

B14. Salt A, used in baking, gives salt B on heating, along with a gas C that turns lime water milky. B is used to remove permanent hardness of water. Identify A, B and C and write the equation. **[3]**

A – sodium hydrogencarbonate (baking soda); B – sodium carbonate; C – carbon dioxide. — 1½

$2\,NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2$ — 1½

B15. Blue copper sulphate crystals are heated in a dry boiling tube. What do you see? What happens when a few drops of water are added after cooling? [2]

The crystals turn white (and water drops appear on the cooler part of the tube): water of crystallisation is lost. 1

The blue colour comes back as the salt takes up water again. 1

B16. In an industrial process for making sodium hydroxide, a gas X is a by-product. X reacts with dry slaked lime to give Y, used as a bleaching agent. Identify X and Y and write the equation. [2]

X – chlorine; Y – bleaching powder ($CaOCl_2$). 1

$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$ 1

PART C · ANSWERS

C Board Pattern Practice – Answers

Marking-scheme answers for every question in Part C of the chapter booklet.

Indicators and acids in nature

Q	Answer	Working / reason
C1	**(c)** Vanilla essence	Its smell disappears in a basic solution.
C2	**(c)** Tamarind – citric acid	Tamarind has tartaric acid.
C3	**(b)** pink to colourless	Pink in base; colourless once the base is neutralised.
C4	**(a)**	Both true; R explains A.

C5. What are indicators? Name one natural and one synthetic indicator and give the colour of each in a basic solution. [2]

Substances that show by a change of colour (or smell) whether a solution is acidic or basic. 1

Natural: litmus – blue (or turmeric – reddish-brown). Synthetic: phenolphthalein – pink (or methyl orange – yellow). 1

Reactions of acids and bases

Q	Answer	Working / reason
C6	**(b)** $Na_2ZnO_2 + H_2$	Sodium zincate and hydrogen are formed.
C7	**(b)** Glucose solution	Glucose gives no ions.
C8	**(a)**	Both true; R explains A.
C9	**(a)**	Both true; R explains A.

C10. In the laboratory preparation of HCl gas, the gas is passed through a guard tube containing calcium chloride. Why? What happens to (i) dry (ii) moist blue litmus paper held in this gas? [2]

Calcium chloride absorbs moisture and dries the gas. 1

(i) No change, as no H^+ ions form without water; (ii) turns red, as H^+ ions form in water. 1

C11. Marble chips react with dilute HCl, and the gas formed is passed through lime water (i) for a short time (ii) for a long time. Write what you see in each case, with equations. [3]

$CaCO_3 + 2\,HCl \longrightarrow CaCl_2 + H_2O + CO_2$ 1

(i) Lime water turns milky: $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$ 1

(ii) Milkiness disappears, as soluble calcium hydrogencarbonate forms: $CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2$ 1

C12. Black copper(II) oxide is added to dilute hydrochloric acid and stirred. (a) What colour change is seen? (b) Write the equation. (c) What does this show about metal oxides? [3]

(a) The solution turns blue-green (copper(II) chloride forms). 1

(b) $CuO + 2\,HCl \longrightarrow CuCl_2 + H_2O$ 1

(c) Metal oxides are basic: they react with acids to give salt and water. 1

pH and its importance

Q	Answer	Working / reason
C13	**(a)** NH_4Cl < KNO_3 < Na_2CO_3	Acidic (< 7), neutral (7), basic (> 7).
C14	**(c)** 5.5	Acid below pH 5.5 corrodes enamel.
C15	**(a)**	Both true; R explains A.

C16. Three solutions P, Q and R have pH 6, 8 and 9.5. (i) Which is acidic? (ii) Which has the most H^+ ions? (iii) Which is the most basic? (iv) Arrange them in increasing order of H^+ ion concentration. [2]

(i) P (ii) P 1

(iii) R (iv) R < Q < P 1

C17. Explain: (a) a bee sting is treated with baking soda; (b) a farmer adds quicklime to a field; (c) fish in a lake die after acid rain. [3]

(a) The sting injects methanoic acid; baking soda, a mild base, neutralises it. 1

(b) The soil is too acidic; quicklime (a base) neutralises the extra acid so crops can grow. 1

(c) Acid rain (pH below 5.6) lowers the pH of the lake; aquatic life can survive only in a narrow pH range. 1

Salts from common salt

Q	Answer	Working / reason
C18	**(a)** Cl_2 and NaOH	Chlorine at the anode; hydrogen and NaOH at the cathode.
C19	**(c)** Gypsum	$CaSO_4 \cdot 2\,H_2O$

C20	**(b)** a mild edible acid such as tartaric acid	The acid reacts with baking soda to give CO_2.
C21	**(a)**	Both true; R explains A.

C22. Write balanced equations for the preparation of (i) bleaching powder (ii) baking soda (iii) Plaster of Paris. **[3]**

(i) $Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$ — 1

(ii) $NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$ — 1

(iii) $CaSO_4 \cdot 2\,H_2O \xrightarrow{373\,K} CaSO_4 \cdot \frac{1}{2}\,H_2O + \frac{3}{2}\,H_2O$ — 1

C23. Why is the electrolysis of brine called the chlor-alkali process? Write the equation and give one use of each product. **[3]**

Its products are chlorine (chlor) and sodium hydroxide (alkali). — 1

$2\,NaCl + 2\,H_2O \longrightarrow 2\,NaOH + Cl_2 + H_2$ — 1

NaOH – soaps, paper, degreasing metals; Cl_2 – water treatment, PVC, bleaching powder; H_2 – fuel, margarine, ammonia (one each). — 1

C24. How is washing soda obtained from common salt? Write the equations for each step. **[3]**

$NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$ — 1

$2\,NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2$ — 1

Recrystallisation: $Na_2CO_3 + 10\,H_2O \longrightarrow Na_2CO_3 \cdot 10\,H_2O$ — 1

C25. Give the chemical name and formula of Plaster of Paris and write the equation for its preparation. **[2]**

Calcium sulphate hemihydrate, $CaSO_4 \cdot \frac{1}{2}\,H_2O$. — 1

$CaSO_4 \cdot 2\,H_2O \xrightarrow{373\,K} CaSO_4 \cdot \frac{1}{2}\,H_2O + \frac{3}{2}\,H_2O$ — 1

C26. A cake made with baking soda alone tastes bitter, but one made with baking powder does not. Explain why baking powder makes the cake soft and spongy and why the bitterness goes. **[2]**

On heating (or with water), baking powder gives CO_2, which makes the cake rise – soft and spongy. — 1

Baking soda alone leaves sodium carbonate, which is bitter; the tartaric acid in baking powder reacts with it, so no bitter taste remains. — 1

Long answer

C27. (a) Write one balanced equation each for the reaction of an acid with (i) a metal (ii) a metal carbonate (iii) a metal hydrogencarbonate (iv) a base. (b) How will you test the gas formed in (i)? **[5]**

(i) $Zn + 2\,HCl \longrightarrow ZnCl_2 + H_2$ — 1

(ii) $Na_2CO_3 + 2\,HCl \longrightarrow 2\,NaCl + H_2O + CO_2$ — 1

(iii) $NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$ — 1

(iv) $NaOH + HCl \longrightarrow NaCl + H_2O$ — 1

(b) A burning splinter near the gas: it burns with a ‘pop’ sound – hydrogen. — 1

C28. (a) Give the chemical name and formula of washing soda and of baking soda. (b) Write the equation for the action of heat on baking soda. (c) Give two uses of each. **[5]**

(a) Washing soda: sodium carbonate decahydrate, $Na_2CO_3 \cdot 10\,H_2O$. — 1

Baking soda: sodium hydrogencarbonate, $NaHCO_3$. — 1

(b) $2\,NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2$ — 1

(c) Washing soda: glass, soap and paper industries; removing permanent hardness of water; cleaning. — 1

Baking soda: baking powder; antacid; soda-acid fire extinguisher. — 1

C29. (a) What does the pH scale measure? What do pH 7, below 7 and above 7 show? (b) Solution X has pH 2 and Y has pH 5. Which is the stronger acid? (c) How do pH changes cause tooth decay and indigestion, and how are they treated? **[5]**

(a) The concentration of H^+ ions, on a scale of 0 to 14. — 1

pH 7 – neutral; below 7 – acidic; above 7 – basic. — 1

(b) X; lower pH means more H^+ ions. — 1

(c) Tooth decay: bacteria make acids from sugar; below pH 5.5 enamel is corroded; basic toothpaste neutralises the acid. — 1

Indigestion: too much HCl in the stomach; an antacid such as milk of magnesia (a mild base) neutralises it. — 1

PART D · ANSWERS

D Case-Based Questions – Answers

Marking-scheme answers for every question in Part D of the chapter booklet.

D1. Case Study · The Salt Factory [4]

(i) Name the gas collected at the anode. **[1]**

Chlorine (Cl_2). 1

(ii) Name the white powder and write its formula. **[1]**

Bleaching powder, $CaOCl_2$. 1

(iii) Write the balanced equation for the electrolysis of the salt solution. **[2]**

Correct reactants and products: sodium chloride and water give sodium hydroxide, chlorine and hydrogen. 1

$2\,NaCl + 2\,H_2O \longrightarrow 2\,NaOH + Cl_2 + H_2$ 1

OR

(iii) Write the equation for making the white powder, and give two of its uses. **[2]**

$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$ 1

Disinfecting drinking water; bleaching cotton, linen or wood pulp (any two uses). 1

D2. Case Study · Kitchen Chemistry [4]

(i) Why did the stain turn reddish-brown with soap? **[1]**

Turmeric in the curry is an indicator; soap is basic, so it turns turmeric reddish-brown. 1

(ii) Why did it become yellow again after rinsing? **[1]**

Rinsing washes away the soap, so the cloth is no longer basic and turmeric is yellow again. 1

(iii) What happens to baking soda on heating? Write the equation and say how it makes the pakoras fluffy. **[2]**

$2\,NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2$ 1

The CO_2 gas forms bubbles that make the batter rise, so the pakoras become light and fluffy. 1

OR

(iii) Name the acid present in lemon. Why was the pickle not stored in a copper pot? **[2]**

Citric acid. 1

The acid in the pickle reacts with copper and forms harmful compounds that spoil the food. 1

D3. Case Study · The Antacid [4]

(i) Name the acid made in our stomach. **[1]**

Hydrochloric acid (HCl). 1

(ii) Is milk of magnesia acidic or basic? Give its approximate pH. **[1]**

Basic (a mild base); pH about 10. 1

(iii) Write the equation for the reaction of milk of magnesia with the stomach acid, and name the type of reaction. **[2]**

$Mg(OH)_2 + 2\,HCl \longrightarrow MgCl_2 + 2\,H_2O$ — 1

Neutralisation. — 1

OR

(iii) How do sweets cause tooth decay, and how does brushing with toothpaste help? **[2]**

Bacteria break down sugar into acids; when the pH falls below 5.5, tooth enamel is corroded. — 1

Toothpaste is basic, so it neutralises the extra acid. — 1