CHAPTER 2

Acids, Bases and Salts

Class 10 Science – NCERT Exemplar | Complete Study Guide

KEY TERMS / GLOSSARY

Acid	Substance that releases H^+/H_3O^+ ions in water. Sour taste, turns blue litmus red.
Base	Substance that releases OH^- ions in water. Bitter taste, turns red litmus blue.
Alkali	A BASE that is soluble in water. All alkalis are bases, but not all bases are alkalis.
Neutralisation	Reaction between acid and base to form salt and water. Exothermic.
pH Scale	Measure of H^+ concentration. 0-6 = acidic, 7 = neutral, 8-14 = basic.
Salt	Ionic compound formed when acid reacts with base. e.g. NaCl, $CuSO_4$.
Water of Crystallisation	Fixed number of water molecules in crystal lattice. e.g. $CuSO_4.5H_2O$.
Strong Acid	Completely ionises in water. e.g. HCl, H_2SO_4, HNO_3.
Weak Acid	Partially ionises in water. e.g. CH_3COOH, citric acid, formic acid.
Indicator	Substance that changes colour to show acidic/basic nature. e.g. litmus, turmeric, phenolphthalein.
Brine	Concentrated aqueous solution of common salt (NaCl). Used in chloralkali process.
Chloralkali Process	Electrolysis of brine → NaOH + Cl_2 + H_2. Industrial process.

pH Scale (0 → 14)

ACID | NEUTRAL | BASE

pH<7 | 0 1 2 3 4 5 6 7 8 9 10 11 12 13 | pH>7

SECTION A: MULTIPLE CHOICE QUESTIONS (Q1–Q30)

*✓ **Green** = Correct | ✗ **Red** = Incorrect*

Q1.

What happens when acid solution is mixed with base solution in a test tube?
(i) Temperature increases (ii) Temperature decreases (iii) Temperature same (iv) Salt formation

✗ **(a)** (i) only

✗ **(b)** (i) and (iii)

✗ **(c)** (ii) and (iii)

✓ **(d)** (i) and (iv)

✓ CORRECT ANSWER: (d) (i) and (iv)

Acid + Base → Salt + Water is a NEUTRALISATION reaction.

It is EXOTHERMIC → heat is released → temperature of solution INCREASES. So (i) is true.

Salt formation always occurs during neutralisation. So (iv) is true.

(ii) is wrong (temp rises, not falls). (iii) is wrong (temp does not stay same).

Neutralisation Reaction

Acid + Base → Salt + Water (EXOTHERMIC)

Temperature RISES → Exothermic process

Q2.

Aqueous solution turns RED litmus BLUE. Excess addition of which solution would REVERSE this change?

✗ **(a)** Baking powder — alkaline, won't reverse

✗ **(b)** Lime — alkaline Ca(OH)2, won't reverse

✗ **(c)** Ammonium hydroxide — basic, won't reverse

✓ **(d)** Hydrochloric acid

✓ CORRECT ANSWER: (d) Hydrochloric acid

Red litmus turning blue means the solution is BASIC (alkaline).

To reverse this (make it turn red again), we need to add an ACID.

HCl is an acid — it will neutralise the base and make the solution acidic again → blue litmus turns back to red.

All other options (baking powder, lime, NH4OH) are basic/alkaline and won't reverse the change.

■ EXAM TIP *Red litmus → Blue = BASIC. Blue litmus → Red = ACIDIC. To reverse acidic→basic: add base. To reverse basic→acidic: add acid.*

Q3.

During HCl gas preparation on a humid day, the gas is passed through a guard tube of $CaCl_2$. Role of $CaCl_2$?

✗ **(a)** Absorb the evolved gas

✗ **(b)** Moisten the gas

✓ **(c)** Absorb moisture from the gas

✗ **(d)** Absorb Cl^- ions from gas

✓ CORRECT ANSWER: (c) Absorb moisture from the gas

$CaCl_2$ is a drying agent (hygroscopic substance).

On a humid day, HCl gas picks up moisture from the atmosphere.

Moist HCl would dissolve in water and ionise — making it behave like hydrochloric acid.

Passing through $CaCl_2$ removes moisture, giving dry HCl gas.

Dry HCl is a covalent compound and does NOT ionise → used to show HCl is covalent.

Q4.

Which salt does NOT contain water of crystallisation?

✗ (a) Blue vitriol — CuSO4.5H2O (5 water molecules)

✓ (b) Baking soda — NaHCO3 (no water of crystallisation)

✗ (c) Washing soda — Na2CO3.10H2O (10 water molecules)

✗ (d) Gypsum — CaSO4.2H2O (2 water molecules)

✓ CORRECT ANSWER: (b) Baking soda

Baking soda = Sodium hydrogencarbonate ($NaHCO_3$) — no water of crystallisation.

Blue vitriol: $CuSO_4.5H_2O$ (5 molecules), Washing soda: $Na_2CO_3.10H_2O$ (10 molecules).

Gypsum: $CaSO_4.2H_2O$ (2 molecules). All except baking soda have water of crystallisation.

Salt	Common Name	Formula	Water of Cryst.
Blue vitriol	Copper sulphate	CuSO4.5H2O	5 molecules
Washing soda	Sodium carbonate	Na2CO3.10H2O	10 molecules
Gypsum	Calcium sulphate	CaSO4.2H2O	2 molecules
Plaster of Paris	Calcium sulphate hemihydrate	CaSO4.½H2O	½ molecule
Baking soda	Sodium hydrogencarbonate	NaHCO3	NONE

Q5.

Sodium carbonate (Na_2CO_3) is a BASIC salt because it is a salt of:

✗ (a) Strong acid + strong base

✗ (b) Weak acid + weak base

✗ (c) Strong acid + weak base

✓ (d) Weak acid + strong base

✓ CORRECT ANSWER: (d) Weak acid + strong base

Na_2CO_3 is formed from: H_2CO_3 (weak acid) + NaOH (strong base).

When a salt is from weak acid + strong base → solution is BASIC (pH > 7).

Rule: Weak acid + strong base → basic salt. Strong acid + weak base → acidic salt. Both strong → neutral salt.

Salt Type	Example	Solution pH
Weak acid + Strong base	Na2CO3, Na2SO3	Basic (pH>7)
Strong acid + Weak base	NH4Cl, ZnSO4	Acidic (pH<7)
Strong acid + Strong base	NaCl, KNO3	Neutral (pH=7)

Weak acid + Weak base	CH3COONH4	Nearly neutral

Q6.

Calcium phosphate is present in tooth enamel. Its nature is:

✓ (a) Basic

✗ (b) Acidic

✗ (c) Neutral

✗ (d) Amphoteric

✓ CORRECT ANSWER: (a) Basic

Calcium phosphate [$Ca_3(PO_4)_2$] is a salt of:

H_3PO_4 (weak acid) + $Ca(OH)_2$ (strong base) → BASIC salt.

This is why tooth enamel has a basic nature and why acidic foods (cola, citrus) can damage teeth.

Tooth decay begins when pH in mouth falls below 5.5 — acid attacks the basic enamel.

■ **EXAM TIP** *Tooth decay: acid produced by bacteria from sugar dissolves Ca3(PO4)2 enamel. Toothpaste is basic — it neutralises the acid. Antacids work on same principle.*

Q7.

Soil + water solution turns pH paper yellowish-orange. Which would change it to greenish-blue?

✗ (a) Lemon juice — acidic, would keep/increase acidity

✗ (b) Vinegar — acidic

✗ (c) Common salt — neutral, won't change to basic

✓ (d) An antacid

✓ CORRECT ANSWER: (d) An antacid

Yellowish-orange on pH paper = acidic (pH around 4-5). The soil is acidic.

Greenish-blue on pH paper = basic (pH around 8-9).

To change from acidic → basic, we need to add a BASE.

An antacid is basic in nature (e.g. $Mg(OH)_2$, $NaHCO_3$). It will neutralise the acidity and raise pH to basic level.

Lemon juice, vinegar = acidic; common salt = neutral. None would raise pH to basic.

Q8.

Correct increasing order of acidic strength?

✓ (a) Water < Acetic acid < Hydrochloric acid

✗ (b) Water < Hydrochloric acid < Acetic acid

✗ (c) Acetic acid < Water < Hydrochloric acid

✗ (d) Hydrochloric acid < Water < Acetic acid

✓ CORRECT ANSWER: (a) Water < Acetic acid < HCl

Water (H_2O) is neutral → least acidic of the three.

Acetic acid (CH_3COOH) is a WEAK acid → partially ionises → moderately acidic.

Hydrochloric acid (HCl) is a STRONG acid → completely ionises → most acidic.

More H^+ ions = stronger acid. HCl gives most H^+.

■ **COMMON MISTAKE** *Students confuse 'concentrated' with 'strong'. Strong/weak refers to DEGREE OF IONISATION, not concentration.*

Q9.

Concentrated acid spills on student's hand. What should be done?

✗ **(a)** Wash with saline — insufficient treatment

✓ **(b)** Wash with plenty of water, apply NaHCO3 paste

✗ **(c)** Apply NaOH solution — strong base, also harmful

✗ **(d)** Neutralise with strong alkali — dangerous, exothermic

✓ CORRECT ANSWER: (b)

Step 1: Immediately wash with PLENTY of cold water to dilute and remove the acid.

Step 2: Apply paste of sodium hydrogencarbonate ($NaHCO_3$) — baking soda.

$NaHCO_3$ is a mild base — it neutralises the acid gently without causing further harm.

NaOH (option c) is a strong base — its neutralisation is highly exothermic and would cause burns.

Strong alkali (option d) = dangerous. Saline (option a) = insufficient.

■ **EXAM TIP** *First aid for acid burns: Water first, then mild base (baking soda). NEVER apply strong alkali like NaOH — the heat of neutralisation would cause more damage.*

Q10.

$NaHCO_3$ + acetic acid → gas evolved. Which statements are TRUE about the gas?
(i) Turns lime water milky (ii) Extinguishes burning splinter
(iii) Dissolves in NaOH solution (iv) Has pungent odour

✗ **(a)** (i) and (ii)

✓ **(b)** (i), (ii) and (iii)

✗ **(c)** (ii), (iii) and (iv)

✗ **(d)** (i) and (iv)

✓ CORRECT ANSWER: (b) (i), (ii) and (iii)

Gas evolved = CO_2 (carbon dioxide). Reaction: $NaHCO_3 + CH_3COOH \rightarrow CH_3COONa + H_2O + CO_2$

(i) ✓ CO_2 turns lime water milky: $Ca(OH)_2 + CO_2 \rightarrow CaCO_3\downarrow + H_2O$

(ii) ✓ CO_2 does not support combustion → extinguishes burning splinter.

(iii) ✓ CO_2 dissolves in NaOH: $CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

(iv) ✗ CO_2 is ODOURLESS. Pungent odour is a property of SO_2 or NH_3, NOT CO_2.

Q11.

Common salt (NaCl) can be used as raw material for making:

- ✗ **(a)** (i) and (ii)
- ✗ **(b)** (i), (ii) and (iv)
- ✓ **(c)** (i) and (iii)
- ✗ **(d)** (i), (iii) and (iv)

Product	Process	Derived from NaCl?
Washing soda ($Na_2CO_3.10H_2O$)	Solvay process from NaCl	✓ YES
Baking soda ($NaHCO_3$)	$NaCl + NH_3 + CO_2 + H_2O$	✓ YES
Bleaching powder	$Cl_2 + Ca(OH)_2$ (Cl_2 from NaCl electrolysis)	Indirectly via Cl_2
Slaked lime ($Ca(OH)_2$)	$CaO + H_2O$ — from limestone, NOT NaCl	✗ NO

✓ CORRECT ANSWER: (c) (i) and (iii) — washing soda and baking soda

Directly from NaCl: washing soda (via Solvay process) and baking soda.

Slaked lime is made from limestone ($CaCO_3$), not from NaCl.

Q12.

One constituent of baking powder is $NaHCO_3$. The other is:

- ✗ **(a)** Hydrochloric acid — strong acid, too reactive
- ✓ **(b)** Tartaric acid
- ✗ **(c)** Acetic acid — pungent smell, not suitable
- ✗ **(d)** Sulphuric acid — strong acid, harmful

✓ CORRECT ANSWER: (b) Tartaric acid

Baking powder = $NaHCO_3$ (baking soda) + tartaric acid (a mild organic acid).

On heating: $NaHCO_3$ + tartaric acid → CO_2 (makes cake rise/fluffy) + water + sodium tartrate.

Tartaric acid neutralises Na_2CO_3 formed during heating, preventing bitter taste.

If only baking soda is used: $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$ — Na_2CO_3 makes cake taste bitter/soapy.

Q13.

To protect against tooth decay, we brush regularly. Toothpaste nature is:

- ✗ **(a)** Acidic — would damage enamel
- ✗ **(b)** Neutral — would not neutralise acids
- ✓ **(c)** Basic
- ✗ **(d)** Corrosive — would be harmful

✓ CORRECT ANSWER: (c) Basic

Bacteria in mouth break down food sugars → produce acids → $pH < 5.5$ → tooth decay.

Toothpaste is basic (alkaline) — it neutralises the acids produced by bacteria.

Toothpaste typically contains $CaCO_3$, NaF, basic compounds — pH around 7-10.

Q14.

Correct statements about pH of aqueous acid/base solutions?
(i) Higher pH = stronger acid   (ii) Higher pH = weaker acid
(iii) Lower pH = stronger base   (iv) Lower pH = weaker base

✗ **(a)** (i) and (iii)

✗ **(b)** (ii) and (iii)

✗ **(c)** (i) and (iv)

✓ **(d)** (ii) and (iv)

✓ CORRECT ANSWER: (d) (ii) and (iv)

(ii) ✓ Higher pH = weaker acid: Stronger acids have LOWER pH (more H^+). Higher pH → fewer H^+ → weaker acid.

(iv) ✓ Lower pH = weaker base: Stronger bases have HIGHER pH. Lower pH → weaker base.

(i) ✗ Wrong: Higher pH = MORE alkaline, not more acidic.

(iii) ✗ Wrong: Lower pH = more acidic = WEAKER base, not stronger.

■ COMMON MISTAKE *pH 1 is MORE acidic than pH 3. pH 13 is MORE basic than pH 9. Many students confuse the direction. Remember: pH↑ = more basic.*

Q15.

pH of gastric juices released during digestion is:

✓ **(a)** Less than 7

✗ **(b)** More than 7

✗ **(c)** Equal to 7

✗ **(d)** Equal to 0

✓ CORRECT ANSWER: (a) Less than 7

Gastric juices contain hydrochloric acid (HCl) produced by the stomach lining.

HCl is a strong acid → pH is approximately 1.5–3.5 (strongly acidic, less than 7).

This acidic environment activates pepsin enzyme and kills harmful bacteria in food.

Excess acid → acidity/heartburn → treated by antacids (basic compounds) to neutralise.

Q16.

When a small amount of acid is added to water, which phenomena occur?
(i) Ionisation   (ii) Neutralisation   (iii) Dilution   (iv) Salt formation

✗ **(a)** (i) and (ii)

✓ **(b)** (i) and (iii)

✗ **(c)** (ii) and (iii)

✗ **(d)** (ii) and (iv)

✓ CORRECT ANSWER: (b) (i) and (iii)

(i) ✓ Ionisation: Acid molecules split into H^+ and anions in water. e.g. $HCl \rightarrow H^+ + Cl^-$

(iii) ✓ Dilution: Adding to water dilutes the acid (lowers concentration).

(ii) ✗ Neutralisation: Needs both acid AND base together. Just acid + water is not neutralisation.

(iv) ✗ Salt formation: Needs acid + base/metal/carbonate. Not from acid + water alone.

Q17.

Which indicator can be used by a VISUALLY IMPAIRED student?

✗ **(a)** Litmus — colour change, needs sight

✗ **(b)** Turmeric — colour change, needs sight

✓ **(c)** Vanilla essence

✗ **(d)** Petunia leaves — colour change, needs sight

✓ CORRECT ANSWER: (c) Vanilla essence

Olfactory indicators change SMELL rather than colour — detectable without sight.

Vanilla essence: sweet smell in neutral/acidic conditions; smell disappears in basic conditions.

Other olfactory indicators: clove oil, onion juice.

Litmus, turmeric, petunia leaves all rely on visual colour change — not useful for visually impaired.

■ ***NOTE:*** *Olfactory indicators are smell-based indicators. Examples: vanilla, clove oil, onion. Vanilla loses its characteristic smell in basic solution.*

Q18.

Which substance will NOT give CO_2 on treatment with dilute acid?

✗ **(a)** Marble — CaCO3 + 2HCl → CaCl2 + H2O + CO2

✗ **(b)** Limestone — same as marble (CaCO3)

✗ **(c)** Baking soda — NaHCO3 + HCl → NaCl + H2O + CO2

✓ **(d)** Lime — CaO + 2HCl → CaCl2 + H2O (no CO2)

✓ CORRECT ANSWER: (d) Lime (CaO)

Lime = Calcium oxide (CaO) — a basic oxide, NOT a carbonate.

$CaO + 2HCl \rightarrow CaCl_2 + H_2O$ — NO CO_2 produced.

Marble, limestone (both $CaCO_3$) and baking soda ($NaHCO_3$) all contain carbonate/bicarbonate → produce CO_2 with acid.

Q19.

Which of the following is acidic in nature?

✓ **(a)** Lime juice — contains citric acid, pH ~2-3

✗ **(b)** Human blood — slightly basic, pH 7.35–7.45

✗ (c)	Lime water — Ca(OH)2, basic, pH ~12
✗ (d)	Antacid — basic, used to treat acidity

✓ CORRECT ANSWER: (a) Lime juice

Lime juice contains citric acid — pH about 2–3, strongly acidic.

Human blood has pH 7.35–7.45 (slightly basic). Even small changes cause problems.

Lime water = $Ca(OH)_2$ solution — basic (pH ~12).

Antacids contain basic compounds like $Mg(OH)_2$, $NaHCO_3$ — basic in nature.

Q20.

Bulb + Switch + 6V battery + Dilute NaOH solution electrolyte. Which statements are correct?
(i) Bulb won't glow — electrolyte not acidic (ii) Bulb will glow — NaOH is strong base, furnishes ions
(iii) Bulb won't glow — circuit incomplete (iv) Bulb won't glow — depends on type of electrolyte

✗ (a)	(i) and (iii)
✗ (b)	(ii) and (iv)
✓ (c)	(ii) only
✗ (d)	(iv) only

✓ CORRECT ANSWER: (c) (ii) only

NaOH is a STRONG BASE — it completely dissociates in water: $NaOH \rightarrow Na^+ + OH^-$.

These freely moving ions conduct electricity → bulb will GLOW.

(i) ✗ Wrong: Electrical conductivity depends on ions, not on being acidic.

(iii) ✗ Wrong: The circuit is complete — NaOH solution conducts electricity.

(iv) ✗ Partially correct but misleading: Strong electrolyte (NaOH) DOES conduct electricity.

■ **EXAM TIP** *Electrical conductivity in solutions depends on FREE IONS, not acidic/basic nature. Strong acids AND strong bases both conduct well. Weak acids/bases conduct poorly.*

Q21.

Which is used for dissolution of gold?

✗ (a)	Hydrochloric acid — cannot dissolve gold
✗ (b)	Sulphuric acid — cannot dissolve gold
✗ (c)	Nitric acid — cannot dissolve gold alone
✓ (d)	Aqua regia

✓ CORRECT ANSWER: (d) Aqua regia

Aqua regia = 3 parts conc. HCl + 1 part conc. HNO_3 (Latin: 'royal water').

It is the ONLY acid mixture that can dissolve gold (Au) and platinum (Pt).

Neither HCl nor HNO_3 alone can dissolve gold.

Gold dissolves: $Au + 3HCl + HNO_3 \rightarrow AuCl_3 + NOCl + 2H_2O$

The name 'royal water' — because it can dissolve the 'royal metals' (gold and platinum).

Q22.

Which is NOT a mineral acid?

✗ (a) Hydrochloric acid — mineral acid

✓ (b) Citric acid — organic acid from citrus fruits

✗ (c) Sulphuric acid — mineral acid

✗ (d) Nitric acid — mineral acid

✓ CORRECT ANSWER: (b) Citric acid

Mineral acids (inorganic acids): HCl, H_2SO_4, HNO_3, H_3PO_4 — derived from minerals.

Organic acids: citric acid, acetic acid, lactic acid, formic acid — derived from living organisms.

Citric acid is found in citrus fruits (lemon, orange) — it is an organic acid.

Q23.

Which among the following is NOT a base?

✗ (a) NaOH — sodium hydroxide, a strong base

✗ (b) KOH — potassium hydroxide, a strong base

✗ (c) NH4OH — ammonium hydroxide, a weak base

✓ (d) C2H5OH — ethanol, an alcohol, not a base

✓ CORRECT ANSWER: (d) C2H5OH (Ethanol)

Ethanol (C_2H_5OH) is an ALCOHOL — it has an -OH group but does NOT release OH^- ions in water.

A base must release OH^- ions in water (Arrhenius definition).

NaOH, KOH, NH_4OH all release OH^- ions → they are bases.

Ethanol -OH is covalent and does not ionise in water — it is neutral.

Q24.

Which statement is NOT correct?

✗ (a) Metal carbonates + acid → salt + water + CO2 — CORRECT

✓ (b) ALL metal oxides + water → salt + acid — NOT CORRECT

✗ (c) Some metals + acids → salt + H2 — CORRECT

✗ (d) Some non-metal oxides + water → acid — CORRECT

✓ CORRECT ANSWER: (b) [The incorrect statement]

Statement (b) says: 'All metal oxides react with water to give SALT and ACID' — this is WRONG.

Metal oxides are BASIC oxides. They react with water to give BASE, not salt+acid.

e.g. $CaO + H_2O \rightarrow Ca(OH)_2$ (a base/alkali), NOT a salt+acid.

Non-metal oxides + water → acid (statement d is correct). e.g. $CO_2 + H_2O \rightarrow H_2CO_3$.

Q25.

Match Column A (chemical) with Column B (application):
A=Bleaching powder, B=Baking soda, C=Washing soda, D=Sodium chloride
(i) Preparation of glass (ii) Production of H2 and Cl2 (iii) Decolourisation (iv) Antacid

✗ **(a)** A-(ii), B-(i), C-(iv), D-(iii)

✗ **(b)** A-(iii), B-(ii), C-(iv), D-(i)

✓ **(c)** A-(iii), B-(iv), C-(i), D-(ii)

✗ **(d)** A-(ii), B-(iv), C-(i), D-(iii)

Chemical	Application	Reason
Bleaching powder [CaOCl2]	(iii) Decolourisation	Releases Cl2 which bleaches coloured substances
Baking soda [NaHCO3]	(iv) Antacid	Basic nature — neutralises excess stomach acid
Washing soda [Na2CO3.10H2O]	(i) Preparation of glass	Na2CO3 is a key ingredient in glass manufacturing
Sodium chloride [NaCl]	(ii) Production of H2 and Cl2	Electrolysis of brine (NaCl solution) = chloralkali process

Q26.

Equal volumes of HCl and NaOH (same concentration) mixed. pH paper colour?

✗ **(a)** Red — would mean acidic (excess acid)

✗ **(b)** Yellow — would mean weakly acidic

✓ **(c)** Yellowish green — neutral pH ≈ 7

✗ **(d)** Blue — would mean basic (excess base)

✓ CORRECT ANSWER: (c) Yellowish green

$HCl + NaOH \rightarrow NaCl + H_2O$ (complete neutralisation)

Equal volumes of equal concentration → EXACT neutralisation → pH = 7 (neutral).

Yellowish-green on pH paper corresponds to neutral pH ≈ 7.

NaCl is a salt of strong acid + strong base → neutral in water.

Q27.

Which is(are) true when HCl(g) is passed through water?
(i) Does not ionise (covalent compound) (ii) Ionises
(iii) Gives H^+ and OH^- (iv) Forms H_3O^+ by $H^+ + H_2O$

✗ **(a)** (i) only

✗ **(b)** (iii) only

✓ **(c)** (ii) and (iv)

✗ **(d)** (iii) and (iv)

✓ CORRECT ANSWER: (c) (ii) and (iv)

(ii) ✓ HCl ionises in water: $HCl(g) + H_2O \rightarrow H_3O^+ + Cl^-$

(iv) ✓ H_3O^+ formed: H^+ ion combines with water molecule → hydronium ion (H_3O^+).

(i) ✗ Wrong: Dry HCl is covalent and does NOT ionise. But in water it does ionise completely.

(iii) ✗ Wrong: HCl gives H^+ and Cl^- in water — NOT OH^- ions. Only bases give OH^-.

■ ***NOTE:*** *H+ ions never exist freely in water — they always attach to a water molecule to form hydronium ion H3O+. Both representations (H+ and H3O+) are used.*

Q28.

Which statement is TRUE for acids?

✗ (a)	Bitter and change red litmus to blue — this is for BASES
✗ (b)	Sour and change red litmus to blue — BASES change red to blue
✓ (c)	Sour and change blue litmus to red
✗ (d)	Bitter and change blue litmus to red — bitter is for bases

✓ CORRECT ANSWER: (c) Sour and change blue litmus to red

Acids taste SOUR (e.g. lemon = citric acid, vinegar = acetic acid).

Acids turn BLUE litmus to RED.

Bases taste BITTER and turn RED litmus to BLUE.

Q29.

Which are present in dilute aqueous HCl?

✓ (a)	H3O+ + Cl-
✗ (b)	H3O+ + OH- — OH- is for bases
✗ (c)	Cl- + OH- — no OH- in acids
✗ (d)	Unionised HCl — HCl fully ionises in water

✓ CORRECT ANSWER: (a) H3O+ + Cl-

HCl(aq) → H^+(aq) + Cl^-(aq) [complete ionisation — strong acid]

H^+ combines with water: $H^+ + H_2O \rightarrow H_3O^+$ (hydronium ion)

So dilute HCl contains: H_3O^+ and Cl^- ions.

HCl is a strong acid — completely ionises — no unionised HCl molecules remain.

OH^- ions are produced by bases, not acids.

Q30.

Correct equation for chloralkali process:

✗ (a)	2NaCl(l) + 2H2O(l) → ... — NaCl is aqueous, not liquid
✗ (b)	2NaCl(aq) + 2H2O(aq) → ... — H2O(aq) is wrong (water is liquid)
✗ (c)	... Cl2(aq) + H2(aq) — both are gases, not aqueous
✓ (d)	2NaCl(aq) + 2H2O(l) → 2NaOH(aq) + Cl2(g) + H2(g)

✓ CORRECT ANSWER: (d)

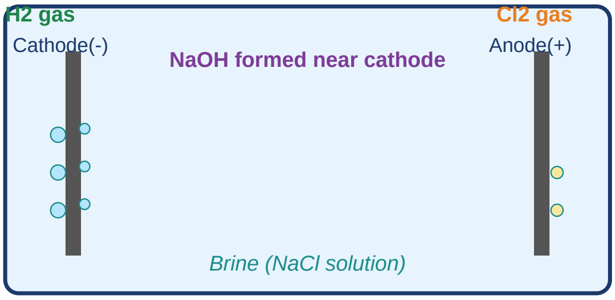
Correct equation: $2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

NaCl is dissolved in water → (aq). Water is liquid → (l).

NaOH formed in solution → (aq). Cl_2 and H_2 escape as gases → (g).

Cl_2 released at anode; H_2 at cathode; NaOH near cathode.

Chloralkali Process (Electrolysis of Brine)



SECTION B: SHORT ANSWER QUESTIONS (Q31–Q42)

Q31.

Match acids with their natural source:

Acid	Source	Formula
Lactic acid	(iv) Curd	$CH_3CH(OH)COOH$
Acetic acid	(iii) Vinegar	CH_3COOH
Citric acid	(ii) Lemon	$C_6H_8O_7$
Oxalic acid	(i) Tomato	$(COOH)_2$

Q32.

Match chemicals with formulae:

Chemical	Formula	Key Fact
Plaster of Paris	(ii) $CaSO_4.½H_2O$	½ water molecule; used in casts/moulds
Gypsum	(iii) $CaSO_4.2H_2O$	2 water molecules; raw material for POP
Bleaching Powder	(iv) $CaOCl_2$	Calcium oxychloride; bleaching agent
Slaked Lime	(i) $Ca(OH)_2$	Used in whitewash, water treatment

Q33.

Action of the following on litmus paper:

Substance	Action on Litmus	Reason
Dry HCl gas	**No change**	Dry HCl is covalent — no ions in absence of water → no acidic effect
Moistened NH_3 gas	**Turns red → blue**	$NH_3 + H_2O \rightarrow NH_4OH \rightarrow NH_4^+ + OH^-$ → basic
Lemon juice	**Turns blue → red**	Contains citric acid — acidic nature
Carbonated soft drink	**Turns blue → red**	Contains CO_2 dissolved → H_2CO_3 (carbonic acid) — acidic
Curd	**Turns blue → red**	Contains lactic acid — acidic
Soap solution	**Turns red → blue**	Soap is basic (sodium/potassium salt of fatty acid) — alkaline

■ ***NOTE:*** *Dry HCl has NO EFFECT on litmus because HCl is covalent — it only ionises when water is present. This proves acids need water to show acidic properties.*

Q34.

Name the acid in ant sting, its formula, and relief method:

✓ **Answer 34**

Acid in ant sting = **Methanoic acid (Formic acid)**. Formula: HCOOH.

Ants inject formic acid when they sting — it causes pain/burning sensation.

Relief method: Apply a mild BASE to neutralise the acid.

Apply baking soda ($NaHCO_3$) paste or calamine solution ($ZnCO_3$) on the sting.

$HCOOH + NaHCO_3 \rightarrow HCOONa + H_2O + CO_2$

Q35.

What happens when nitric acid is added to egg shell?

✓ Answer 35

Egg shell contains calcium carbonate ($CaCO_3$).

$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$

The egg shell DISSOLVES — bubbles of CO_2 gas are produced.

CO_2 turns lime water milky — confirmatory test.

This is why carbonated drinks (acids) damage tooth enamel (also $CaCO_3$/Ca phosphate).

Q36.

Two colourless solutions: one acid, one base. Litmus not available. How to distinguish?

✓ Answer 36

Use natural/olfactory indicators instead of litmus:

Method 1 — Turmeric paper: Turmeric stays yellow with acid; turns red/pink with base.

Method 2 — Red cabbage juice: Turns red/pink in acid; turns green/yellow in base.

Method 3 — China rose (Hibiscus) extract: Turns pink/red in acid; green in base.

Method 4 — Phenolphthalein: Colourless in acid; pink/red in base.

Method 5 — pH paper: If available, use universal indicator paper to check pH.

Method 6 — Smell test (Olfactory): Vanilla/clove loses smell in base solution.

Q37.

Distinguish between baking powder and washing soda by heating:

✓ Answer 37

Baking powder ($NaHCO_3$ + tartaric acid): On heating → produces CO_2 gas.

$2NaHCO_3 \rightarrow (Heat) \rightarrow Na_2CO_3 + H_2O + CO_2\uparrow$

CO_2 turns lime water milky — POSITIVE TEST for baking powder.

Washing soda ($Na_2CO_3.10H_2O$): On heating → loses water of crystallisation → white anhydrous Na_2CO_3.

$Na_2CO_3.10H_2O \rightarrow (Heat) \rightarrow Na_2CO_3 + 10H_2O$

Washing soda does NOT produce CO_2 on heating — lime water does NOT turn milky.

Conclusion: The one that turns lime water milky = baking powder. The one that doesn't = washing soda.

Q38.

Salt A (used in bakery) → heat → Salt B (used for removing hardness) + Gas C (turns lime water milky). Identify A, B, C:

✓ Answer 38

A = $NaHCO_3$ (Sodium hydrogencarbonate / Baking soda) — used in bakery products.

Reaction: $2NaHCO_3(s) \rightarrow (Heat) \rightarrow Na_2CO_3(s) + H_2O(l) + CO_2(g)$

B = Na_2CO_3 (Sodium carbonate / Washing soda) — used to remove permanent hardness of water.

C = CO_2 (Carbon dioxide) — turns lime water milky: $Ca(OH)_2 + CO_2 \rightarrow CaCO_3\downarrow + H_2O$.

Q39.

Industrial manufacture of NaOH → byproduct gas X reacts with lime water → compound Y (bleaching agent). Identify X and Y:

✓ Answer 39

NaOH is manufactured by electrolysis of brine (chloralkali process).

Byproduct gas X = Cl_2 (Chlorine gas) — released at anode during electrolysis.

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

Compound Y = $CaOCl_2$ (Bleaching powder / Calcium oxychloride).

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

Bleaching powder is used to bleach cotton, paper, and to disinfect drinking water.

Q40.

Fill in the missing data in the salt table:

Name	Formula	Base	Acid
Ammonium chloride	NH4Cl	NH4OH	**HCl**
Copper sulphate	**CuSO4**	**Cu(OH)2**	H2SO4
Sodium chloride	NaCl	NaOH	**HCl**
Magnesium nitrate	Mg(NO3)2	**Mg(OH)2**	HNO3
Potassium sulphate	K2SO4	**KOH**	**H2SO4**
Calcium nitrate	Ca(NO3)2	Ca(OH)2	**HNO3**

■ ***NOTE:*** *Bold entries are the filled-in answers. Pattern: Salt = Metal from base + Anion from acid.*

Q41.

What are strong and weak acids? Classify the given acids:

✓ Answer 41 — Definitions

Strong acid: An acid that COMPLETELY ionises in water to give H^+ ions. High concentration of H^+, low pH.

Weak acid: An acid that PARTIALLY ionises in water — equilibrium established. Low H^+ concentration, higher pH than strong acid of same molarity.

Strong Acids	Weak Acids
Hydrochloric acid (HCl)	Citric acid
Nitric acid (HNO3)	Acetic acid (CH3COOH)
Sulphuric acid (H2SO4)	Formic acid (HCOOH)

Q42.

Zinc + dilute strong acid → gas used in oil hydrogenation. Name gas, write equation, test:

✓ Answer 42

Gas evolved = Hydrogen (H_2)

Chemical equation: $Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$

Or: $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

Test for H_2 gas: Bring a burning candle/splinter near the gas — it burns with a 'pop' (squeaky pop) sound. This is the confirmatory test for hydrogen.

Use in hydrogenation: H_2 gas is used to convert vegetable oils (unsaturated) → vegetable ghee/margarine (saturated) using Ni catalyst.

SECTION C: LONG ANSWER QUESTIONS (Q43–Q48)

Q43.

H_2 preparation setup (Fig 2.3): Zn granules + dilute H_2SO_4. What changes if:

Change	What happens
(a) Zinc dust instead of granules	Reaction is FASTER. Zinc dust has much larger surface area → more contact with acid → H2 produced rapidly. More gas bubbles observed.
(b) Dilute HCl instead of H2SO4	Gas is still produced. Reaction: Zn + 2HCl → ZnCl2 + H2. Almost same rate of H2 production. ZnCl2 is soluble.
(c) Copper turnings instead of Zn	NO reaction. Cu is BELOW hydrogen in the activity series → cannot displace H from H2SO4. No gas produced.
(d) NaOH instead of H2SO4 (heated)	H2 gas is still produced! Zn is amphoteric: Zn + 2NaOH → Na2ZnO2 (sodium zincate) + H2. Heating is needed to speed this reaction.

Q44.

Baking soda used instead of baking powder in cake:

✓ Answer 44(a) — Effect on taste

Cake will taste BITTER/SOAPY and unpleasant.

Reason: $2NaHCO_3$ → (Heat) → $Na_2CO_3 + H_2O + CO_2$

Na_2CO_3 (sodium carbonate) is formed — it has a bitter, soapy taste.

In baking powder, tartaric acid neutralises Na_2CO_3 → prevents bitter taste.

✓ Answer 44(b) — Converting baking soda to baking powder

Add an appropriate amount of tartaric acid to baking soda.

Baking powder = $NaHCO_3$ + tartaric acid (in correct proportion).

✓ Answer 44(c) — Role of tartaric acid

Tartaric acid neutralises the Na_2CO_3 formed during heating.

Na_2CO_3 + tartaric acid → sodium tartrate + $CO_2 + H_2O$

This prevents the cake from tasting bitter/soapy.

So tartaric acid serves as an acidic component to neutralise the basic Na_2CO_3.

Q45.

Metal carbonate X + acid → gas → through solution Y → carbonate back. Gas G (at anode, electrolysis of brine) + dry Y → compound Z (disinfectant). Identify X, Y, G, Z:

✓ Answer 45

X = $CaCO_3$ (Calcium carbonate) — metal carbonate that reacts with acid to give CO_2.

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

Y = $Ca(OH)_2$ (Lime water / Calcium hydroxide) — CO_2 passed through it gives $CaCO_3$ (carbonate back).

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3\downarrow + H_2O$

G = Cl_2 (Chlorine gas) — produced at anode during electrolysis of brine.

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

Z = $CaOCl_2$ (Bleaching powder) — $Cl_2 + Ca(OH)_2 \rightarrow CaOCl_2 + H_2O$.

Bleaching powder (Z) is used to disinfect drinking water.

Q46.

Dry pellet of base B absorbs moisture, turns sticky. Also a byproduct of chloralkali process. Identify B. Reaction with acidic oxide:

✓ Answer 46

B = NaOH (Sodium hydroxide / Caustic soda).

NaOH is hygroscopic (absorbs moisture from air) → turns sticky.

NaOH is a byproduct of chloralkali process (electrolysis of brine).

Reaction with acidic oxide: Base + acidic oxide → salt + water.

Example: $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

Another: $2NaOH + SO_2 \rightarrow Na_2SO_3 + H_2O$

Type of reaction: Acid-Base (neutralisation) reaction.

Q47.

Group 2 sulphate salt: white, soft, mouldable. Left open → becomes hard. Identify and explain:

✓ Answer 47 — Plaster of Paris

Salt = Plaster of Paris (POP) = Calcium sulphate hemihydrate: $CaSO_4.½H_2O$

Group 2 element = Calcium (Ca). POP is soft and can be moulded when mixed with water.

Why it becomes hard (sets) in open:

POP absorbs moisture from the atmosphere and reacts:

$CaSO_4.½H_2O + 1½H_2O \rightarrow CaSO_4.2H_2O$ (Gypsum)

Gypsum is a hard, solid mass — it cannot be re-moulded.

This is why POP-based casts/moulds must be used quickly before they absorb moisture and set.

Q48.

Compound X: + Zn → A + H_2(g), + HCl → B + H_2O, + CH_3COOH → C + H_2O. Identify X, A, B, C:

✓ Answer 48 — Compound X = NaOH (Sodium hydroxide)

X reacts with Zn (metal), HCl (acid), and CH3COOH (acid) → a STRONG BASE.

X = NaOH (Sodium hydroxide)

Reaction 1: X + Zn → A + H2

$Zn + 2NaOH \rightarrow Na_2ZnO_2(aq) + H_2(g)$

A = Na_2ZnO_2 = Sodium zincate

Reaction 2: X + HCl → B + H2O

$NaOH + HCl \rightarrow NaCl + H_2O$

B = NaCl = Sodium chloride

Reaction 3: X + CH3COOH → C + H2O

$NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$

C = CH_3COONa = Sodium acetate (sodium ethanoate)

MCQ ANSWER KEY SUMMARY GRID

Q	Ans	Q	Ans	Q	Ans
1	**(d)**	2	**(d)**	3	**(c)**
4	**(b)**	5	**(d)**	6	**(a)**
7	**(d)**	8	**(a)**	9	**(b)**
10	**(b)**	11	**(c)**	12	**(b)**
13	**(c)**	14	**(d)**	15	**(a)**
16	**(b)**	17	**(c)**	18	**(d)**
19	**(a)**	20	**(c)**	21	**(d)**
22	**(b)**	23	**(d)**	24	**(b)**
25	**(c)**	26	**(c)**	27	**(c)**
28	**(c)**	29	**(a)**	30	**(d)**

EXAM TIPS AND COMMON MISTAKES

■ **EXAM TIP** *Acid+Base neutralisation is ALWAYS exothermic (temperature rises). Memorise: Neutralisation = Exothermic.*

■ **COMMON MISTAKE** *Confusing neutralisation with endothermic — students sometimes say temperature decreases.*

■ **EXAM TIP** *pH scale: 0-6 = acidic (lower pH = stronger acid); 7 = neutral; 8-14 = basic (higher pH = stronger base).*

■ **COMMON MISTAKE** *Thinking pH 2 is less acidic than pH 6. Lower pH = MORE acidic.*

■ **EXAM TIP** *Strong acids: HCl, H2SO4, HNO3 (completely ionise). Weak acids: acetic, citric, formic (partial ionisation).*

■ **COMMON MISTAKE** *Confusing strong with concentrated. Dilute HCl is STILL a strong acid.*

■ **EXAM TIP** *Dry HCl gas does NOT affect litmus. Moist HCl turns blue litmus red. Proves water is needed for acidic property.*

■ **COMMON MISTAKE** *Students say dry HCl is an acid — it IS acidic only in presence of water.*

■ **EXAM TIP** *Water of crystallisation: Blue vitriol=5H2O, Washing soda=10H2O, Gypsum=2H2O, POP=½H2O. Baking soda has NONE.*

■ **COMMON MISTAKE** *Mixing up the number of water molecules in different salts.*

■ **EXAM TIP** *Baking powder = Baking soda + Tartaric acid. If only baking soda is used, Na_2CO_3 forms → bitter cake.*

■ **COMMON MISTAKE** *Treating baking soda and baking powder as interchangeable in chemistry questions.*

QUICK REVISION TABLE

Concept	Key Point	Example
Acid	Releases H^+/H_3O^+ in water; sour; blue→red litmus	HCl, H_2SO_4, CH_3COOH
Base	Releases OH^- in water; bitter; red→blue litmus	NaOH, $Ca(OH)_2$, NH_4OH
Neutralisation	Acid + Base → Salt + Water (exothermic)	NaOH+HCl→NaCl+H_2O
Strong acid	100% ionises; low pH	HCl, H_2SO_4, HNO_3
Weak acid	Partial ionisation; higher pH	CH_3COOH, citric, formic
Baking soda	$NaHCO_3$ — antacid, CO_2 source in baking	$2NaHCO_3 \rightarrow Na_2CO_3+H_2O+CO_2$
Washing soda	$Na_2CO_3.10H_2O$ — removes hardness of water	Solvay process from NaCl
Plaster of Paris	$CaSO_4.½H_2O$ — sets hard by absorbing water	→ Gypsum ($CaSO_4.2H_2O$)
Bleaching powder	$CaOCl_2$ — bleaches/disinfects; from $Cl_2+Ca(OH)_2$	Used in water treatment
Chloralkali	Electrolysis of brine → NaOH+Cl_2+H_2	$2NaCl+2H_2O \rightarrow 2NaOH+Cl_2+H_2$
Aqua regia	3HCl:1HNO_3 — dissolves gold/platinum	"Royal water"
Olfactory indicator	Smell-based indicator for visually impaired	Vanilla, clove oil, onion
pH<7	Acidic solution	Gastric juice pH ~2
pH=7	Neutral solution	Pure water, NaCl solution
pH>7	Basic solution	Blood pH ~7.4, NaOH