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CHAPTER 1

Chemical Reactions

and Equations | Class 10 Science – NCERT Exemplar



KEY TERMS / GLOSSARY

Chemical Reaction	A process where reactants transform into products with different properties.
Reactant	Substance that is consumed in a chemical reaction.
Product	New substance formed as a result of a chemical reaction.
Oxidation	Loss of hydrogen OR gain of oxygen by a substance.
Reduction	Gain of hydrogen OR loss of oxygen by a substance.
Exothermic	Reaction that releases heat energy to surroundings (temperature rises).
Endothermic	Reaction that absorbs heat energy from surroundings (temperature falls).
Precipitation	Formation of an insoluble solid (precipitate) during a reaction in solution.
Corrosion	Slow eating away of metals by surrounding substances (moisture, acids, gases).
Rancidity	Oxidation of fats/oils in food causing bad smell and taste.

SECTION A: MULTIPLE CHOICE QUESTIONS

Each question has four options. Select the **MOST CORRECT** answer. ✓ **Green** = Correct answer | ✗ **Red** = Incorrect options

Q1.

Which of the following is **NOT** a physical change?

- ✗ (a) Boiling of water to give water vapour
- ✗ (b) Melting of ice to give water
- ✗ (c) Dissolution of salt in water
- ✓ (d) Combustion of Liquefied Petroleum Gas (LPG)

✓ **CORRECT ANSWER: (d) Combustion of LPG**

Physical changes are reversible and do **NOT** produce new substances. Boiling, melting, and dissolving are all physical changes — no new substance is formed.

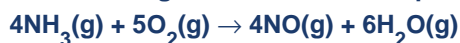
Combustion (burning) of LPG is a **chemical change** — it produces new substances (CO₂ and H₂O) and releases energy. The process is irreversible.

Reaction: $C_4H_{10} + 13/2 O_2 \rightarrow 4CO_2 + 5H_2O + \text{Heat}$ (LPG ~ butane)

■ **EXAM TIP** Key distinction: Physical change = same substance, different state/shape. Chemical change = NEW substance formed. Burning always = chemical change.

Q2.

The following reaction is an example of which type(s)?



(i) displacement reaction (ii) combination reaction (iii) redox reaction (iv) neutralisation reaction

✗ (a) (i) and (iv)

✗ (b) (ii) and (iii)

✓ (c) (i) and (iii)

✗ (d) (iii) and (iv)

✓ **CORRECT ANSWER: (c) (i) and (iii)**

Displacement: Oxygen displaces hydrogen from ammonia (NH₃). Hydrogen goes to water.

Redox: N in NH₃ is oxidised (goes from -3 to +2 in NO). O₂ is reduced.

It is NOT combination (two substances do not simply add up to one).

It is NOT neutralisation (no acid-base reaction; no salt or water as the ONLY products).

■ **EXAM TIP** A reaction can belong to MULTIPLE types simultaneously. Always check all criteria: oxidation state changes → redox; one element replaces another → displacement.

Q3.

Which statements about the reaction below are correct?



(i) Iron metal is getting oxidised (ii) Water is getting reduced (iii) Water is acting as reducing agent (iv) Water is acting as oxidising agent

✗ (a) (i), (ii) and (iii)

✗ (b) (iii) and (iv)

✓ (c) (i), (ii) and (iv)

✗ (d) (ii) and (iv)

✓ **CORRECT ANSWER: (c) (i), (ii) and (iv)**

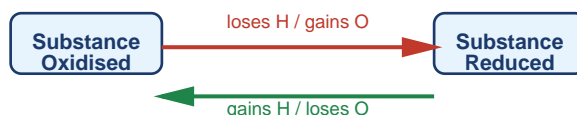
(i) ✓ **Iron is oxidised:** Fe gains oxygen → Fe₃O₄. Oxidation = gain of O (or loss of H).

(ii) ✓ **Water is reduced:** H₂O loses oxygen (the O goes to Fe). Reduction = loss of O.

(iv) ✓ **Water is the oxidising agent:** It oxidises iron, so it itself gets reduced → it IS the oxidising agent.

(iii) ✗ **WRONG:** Water is NOT the reducing agent. A reducing agent itself gets oxidised. Here, IRON is the reducing agent (it gets oxidised).

Oxidation & Reduction in Redox



Oxidising Agent = gets reduced (accepts electrons)
Reducing Agent = gets oxidised (donates electrons)
Both happen simultaneously in a REDOX reaction

EXAM TIP

Memory trick: Oxidising Agent = gets Reduced (OIL RIG: Oxidation Is Loss, Reduction Is Gain of electrons). The substance that gets reduced = the oxidising agent.

Q4.

Which of the following are exothermic processes?

- (i) Reaction of water with quick lime (ii) Dilution of an acid
(iii) Evaporation of water (iv) Sublimation of camphor crystals

✓ (a) (i) and (ii)

✗ (b) (ii) and (iii)

✗ (c) (i) and (iv)

✗ (d) (iii) and (iv)

✓ CORRECT ANSWER: (a) (i) and (ii)

(i) ✓ **CaO + H₂O → Ca(OH)₂ + Heat:** Quick lime reacting with water releases large amounts of heat. Highly exothermic.

(ii) ✓ **Acid dilution:** Adding acid to water releases heat. Always exothermic (remember: always add acid to water, not vice versa).

(iii) ✗ **Evaporation:** Requires heat energy → ENDOTHERMIC.

(iv) ✗ **Sublimation of camphor:** Requires heat to change solid → gas → ENDOTHERMIC.

Q5.

Beakers A (NaOH), B (anhydrous CuSO₄) and C (NaCl) each had 25 mL water. Temperature rose in A and B; fell in C. Which statement(s) are correct?

- (i) A and B: exothermic (ii) A and B: endothermic (iii) C: exothermic (iv) C: endothermic

✗ (a) (i) only

✗ (b) (ii) only

✓ (c) (i) and (iv)

✗ (d) (ii) and (iii)

✓ CORRECT ANSWER: (c) (i) and (iv)

Temperature RISE in A and B → heat is being released → EXOTHERMIC. So (i) is correct.

Temperature FALL in C → heat is being absorbed → ENDOTHERMIC. So (iv) is correct.

Dissolving NaOH and CuSO₄ are exothermic. Dissolving NaCl is endothermic.

Q6.

Dilute FeSO_4 was added to acidified KMnO_4 (light purple). The purple colour fades and disappears. Which explanation is correct?

- ✓ (a) KMnO_4 is an oxidising agent; it oxidises FeSO_4
- ✗ (b) FeSO_4 acts as an oxidising agent and oxidises KMnO_4
- ✗ (c) Colour disappears due to dilution only; no reaction occurs
- ✗ (d) KMnO_4 decomposes in presence of FeSO_4 to a colourless compound

✓ CORRECT ANSWER: (a)

KMnO_4 is a powerful oxidising agent. It oxidises Fe^{2+} (from FeSO_4) \rightarrow Fe^{3+} .

In doing so, Mn^{7+} in KMnO_4 gets reduced \rightarrow Mn^{2+} (colourless MnSO_4).

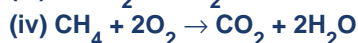
The purple colour of Mn^{7+} disappears because it is converted to colourless Mn^{2+} .

This is a classic redox titration used in labs (permanganometry).

■ EXAM TIP *The decolourisation of KMnO_4 by reducing agents is a key indicator in redox chemistry. KMnO_4 is ALWAYS the oxidising agent here.*

Q7.

Which of the following is(are) double displacement reaction(s)?



✗ (a) (i) and (iv)

✓ (b) (ii) only

✗ (c) (i) and (ii)

✗ (d) (iii) and (iv)

✓ CORRECT ANSWER: (b) (ii) only

(ii) ✓ **Double displacement:** Na replaces Ba AND Ba replaces Na simultaneously — two pairs of ions exchange partners. BaSO_4 precipitates out.

(i) ✗ **Single displacement:** Pb replaces Cu from CuCl_2 . Only ONE pair exchanges.

(iii) ✗ **Combination:** Two substances combine to form one product.

(iv) ✗ **Combustion/Redox:** CH_4 burns in O_2 . Not a displacement.

Q8.

Silver chloride exposed to sunlight turns grey. Which statement(s) are TRUE?

(i) Grey colour is due to formation of silver by decomposition of AgCl

(ii) Sublimation of silver chloride (iii) Decomposition of Cl_2 gas from AgCl

(iv) Oxidation of silver chloride

✓ (a) (i) only

x (b) (i) and (iii)

x (c) (ii) and (iii)

x (d) (iv) only

✓ **CORRECT ANSWER: (a) (i) only**

Reaction: $2\text{AgCl(s)} \xrightarrow{\text{Sunlight}} 2\text{Ag(s)} + \text{Cl}_2\text{(g)}$

The grey colour is due to finely divided metallic silver (Ag) formed by photodecomposition.

Chlorine gas is released, but it is the SILVER metal (not AgCl or oxidation) that causes the grey colour.

This is a PHOTOCHEMICAL decomposition reaction. It is NOT sublimation or oxidation.

■ **NOTE:** This is why photographic film used to contain silver salts — light decomposes them to silver, creating an image.

Q9.

Solid CaO reacts vigorously with water forming Ca(OH)_2 with heat (slaking of lime). Ca(OH)_2 dissolves in water to form lime water. Which are TRUE?

(i) Endothermic (ii) Exothermic (iii) pH > 7 (iv) pH < 7

x (a) (i) and (ii)

✓ **(b)** (ii) and (iii)

x (c) (i) and (iv)

x (d) (iii) and (iv)

✓ **CORRECT ANSWER: (b) (ii) and (iii)**

(ii) ✓ **Exothermic:** Heat is liberated during slaking. Temperature rises.

(iii) ✓ **pH > 7:** Ca(OH)_2 is a base. Its solution (lime water) is alkaline → pH > 7.

$\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{Heat}$

Q10.

$\text{BaCl}_2 + (\text{NH}_4)_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{NH}_4\text{Cl}$. Type of reaction?

(i) Displacement (ii) Precipitation (iii) Combination (iv) Double displacement

x (a) (i) only

x (b) (ii) only

x (c) (iv) only

✓ **(d)** (ii) and (iv)

✓ **CORRECT ANSWER: (d) (ii) and (iv)**

Double displacement: Ba^{2+} and NH_4^+ swap anion partners.

Precipitation: BaSO_4 is insoluble → forms white precipitate.

A reaction can be BOTH double displacement AND precipitation simultaneously.

Q11.

Electrolysis of water: mole ratio of H₂ to O₂ gases liberated?

x (a) 1 : 1

✓ (b) 2 : 1

x (c) 4 : 1

x (d) 1 : 2

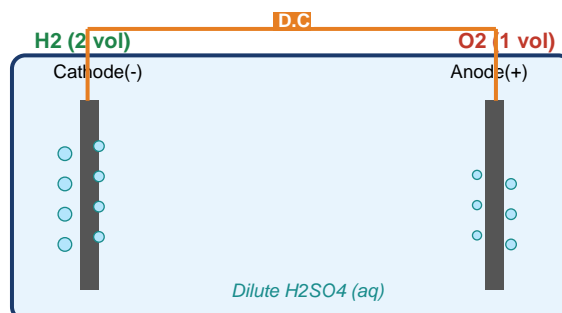
✓ CORRECT ANSWER: (b) 2 : 1

Reaction: $2\text{H}_2\text{O}(\text{l}) \rightarrow \text{Electrolysis} \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$

From the balanced equation: 2 moles H₂ : 1 mole O₂

H₂ is released at the cathode (-), O₂ at the anode (+).

Volume ratio is also 2:1 since equal moles = equal volumes at same T & P.



■ EXAM TIP

Remember: Hydrogen is produced in DOUBLE the amount of oxygen. Volume at cathode is twice that at anode.

Q12.

Which are endothermic processes?

(i) Dilution of H₂SO₄ (ii) Sublimation of dry ice (iii) Condensation of water vapours (iv) Evaporation of water

x (a) (i) and (iii)

x (b) (ii) only

x (c) (iii) only

✓ (d) (ii) and (iv)

✓ CORRECT ANSWER: (d) (ii) and (iv)

(ii) **✓ Sublimation of dry ice (CO₂):** Requires heat energy to convert solid CO₂ → gas.

(iv) **✓ Evaporation:** Requires heat energy. That is why the body cools when sweat evaporates.

(i) **x Dilution of H₂SO₄:** EXOTHERMIC — always releases heat. Always add acid to water!

(iii) **x Condensation:** EXOTHERMIC — gas releases heat when turning to liquid.

Q13.

In double displacement between KI(aq) + Pb(NO₃)₂(aq) → yellow PbI₂ precipitate. If Pb(NO₃)₂ is unavailable, which can replace it?

x (a) Lead sulphate (insoluble — cannot provide Pb²⁺ ions in solution)

✓ (b) Lead acetate (soluble, provides Pb²⁺ ions)

x (c) Ammonium nitrate (no Pb²⁺ ions)

x (d) Potassium sulphate (no Pb²⁺ ions)

✓ CORRECT ANSWER: (b) Lead acetate

To replace Pb(NO₃)₂, we need a SOLUBLE lead salt that can dissociate into Pb²⁺ ions.

Lead sulphate is INSOLUBLE — it won't give Pb^{2+} ions in solution.

Lead acetate $[\text{Pb}(\text{CH}_3\text{COO})_2]$ is SOLUBLE → provides Pb^{2+} → reacts with I^- → PbI_2 precipitate.

Q14.

Which gases can be used to store a fresh sample of oil for a long time?

X (a) Carbon dioxide or oxygen

X (b) Nitrogen or oxygen

X (c) Carbon dioxide or helium

✓ (d) Helium or nitrogen

✓ CORRECT ANSWER: (d) Helium or nitrogen

Oil goes rancid when it reacts with oxygen from air (oxidation). To prevent this, air (and especially O_2) must be excluded.

Helium (He) and Nitrogen (N_2) are chemically inert — they do NOT react with oil.

O_2 causes oxidation → rancidity. CO_2 can also react (though slowly) and form acids.

Nitrogen is cheap, abundant, and used commercially to store crisps, oils, etc.

■ **NOTE:** This is also called 'antioxidant packaging'. Chips packets are filled with N_2 to prevent rancidity.

Q15.

$2\text{KClO}_3(\text{s}) \rightarrow (\text{Heat/Catalyst}) \rightarrow 2\text{KCl}(\text{s}) + 3\text{O}_2(\text{g})$. Which statement is correct?

✓ (a) Decomposition reaction; endothermic in nature

X (b) Combination reaction

X (c) Decomposition reaction accompanied by release of heat

X (d) Photochemical decomposition, exothermic

✓ CORRECT ANSWER: (a)

Decomposition: One substance (KClO_3) breaks into two simpler ones ($\text{KCl} + \text{O}_2$).

Endothermic: External heat is required to drive the reaction → it absorbs energy.

The catalyst (MnO_2) reduces the activation energy but the reaction is still endothermic.

It is NOT photochemical (does not use light) and NOT exothermic.

Q16.

Which process involves a chemical reaction?

X (a) Storing oxygen gas under pressure

X (b) Liquefaction of air

X (c) Keeping petrol in a china dish

✓ (d) Heating copper wire in presence of air at high temperature

✓ CORRECT ANSWER: (d) Heating copper wire in air

Copper + Oxygen → Copper oxide: $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$

A NEW substance (black CuO) is formed — this is a chemical change.

(a), (b), (c) involve only physical changes (compression, cooling, evaporation).

The black coating on copper wire confirms a chemical reaction has occurred.

Q17.

Which equation uses correct state abbreviations at reaction temperature?

- (a) $2\text{H}_2(\text{l}) + \text{O}_2(\text{l}) \rightarrow 2\text{H}_2\text{O}(\text{g})$ (b) $2\text{H}_2(\text{g}) + \text{O}_2(\text{l}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
(c) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$ (d) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$

x (a) H₂ is gas at reaction temperature, not liquid

x (b) O₂ is gas at reaction temperature, not liquid

x (c) At high temperature of combustion, water is steam (gas), not liquid

✓ (d) Both reactants are gases; product water is steam at reaction temperature

✓ CORRECT ANSWER: (d)

At the high temperature of the combustion reaction, both H₂ and O₂ are gases.

The water produced is at high temperature → it exists as steam (g), not liquid.

State symbols represent conditions DURING the reaction, not at room temperature.

Q18.

Which are combination reactions?

- (i) $2\text{KClO}_3 \xrightarrow{\text{Heat}} 2\text{KCl} + 3\text{O}_2$
(ii) $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg}(\text{OH})_2$
(iii) $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$
(iv) $\text{Zn} + \text{FeSO}_4 \rightarrow \text{ZnSO}_4 + \text{Fe}$

x (a) (i) and (iii)

x (b) (iii) and (iv)

x (c) (ii) and (iv)

✓ (d) (ii) and (iii)

✓ CORRECT ANSWER: (d) (ii) and (iii)

A combination (synthesis) reaction: $\text{A} + \text{B} \rightarrow \text{AB}$ (two reactants → one product).

(ii) ✓ $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg}(\text{OH})_2$ — two reactants combine to form one product.

(iii) ✓ $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$ — aluminium combines with oxygen.

(i) x $\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_2$: This is a DECOMPOSITION (one reactant → two products).

(iv) x $\text{Zn} + \text{FeSO}_4 \rightarrow \text{ZnSO}_4 + \text{Fe}$: This is a DISPLACEMENT reaction.

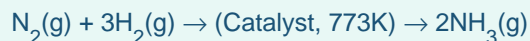
SECTION B: SHORT ANSWER QUESTIONS

Q19.

Write balanced equations for the following and identify the reaction type:

(a) Nitrogen + hydrogen (catalyst, 773K) → ammonia gas

Answer 19(a)

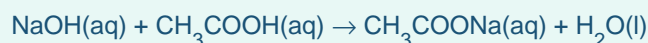


Type: **Combination reaction** (two elements combine to form one compound).

Also called the Haber Process — industrially important for making fertilisers.

(b) NaOH solution + acetic acid → sodium acetate + water

Answer 19(b)

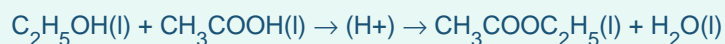


Type: **Double displacement reaction / Neutralisation reaction.**

Base (NaOH) + Acid (acetic acid) → Salt + Water. Classic acid-base neutralisation.

(c) Ethanol + ethanoic acid (conc. H_2SO_4) → ethyl acetate + water

Answer 19(c)

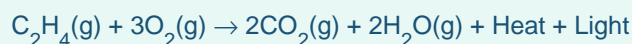


Type: **Double displacement / Esterification reaction.**

H_2SO_4 acts as catalyst. Product ($\text{CH}_3\text{COOC}_2\text{H}_5$) is an ester with fruity smell.

(d) Ethene + oxygen → carbon dioxide + water + heat + light

Answer 19(d)



Type: **Redox reaction / Combustion reaction.**

Carbon in C_2H_4 is oxidised (gains O). This is also exothermic.

Q20.

Write balanced equations and identify the type:

(a) Thermite: $\text{Fe}_2\text{O}_3 + \text{Al} \rightarrow$ iron (molten) + Al_2O_3 + heat

Answer 20(a)



Type: **Displacement reaction / Redox reaction.**

Al (more reactive) displaces Fe from its oxide. Used in thermite welding of railway tracks.

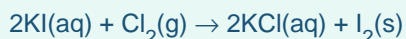
(b) Mg ribbon burnt in nitrogen atmosphere → magnesium nitride

Answer 20(b)

Type: **Combination reaction.**

Mg continues burning in N₂ forming Mg₃N₂ (magnesium nitride), a grey solid.

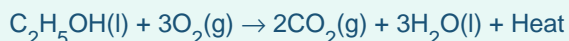
(c) Chlorine gas passed into aqueous KI → KCl + solid iodine

Answer 20(c)

Type: **Displacement reaction.**

Cl₂ is more reactive than I₂, so it displaces iodine. The solution turns brown/violet.

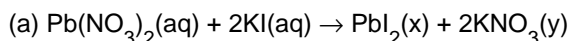
(d) Ethanol burnt in air → CO₂ + H₂O + heat

Answer 20(d)

Type: **Redox reaction / Combustion reaction.** Carbon is oxidised.

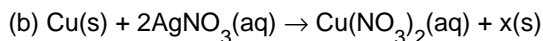
Q21.

Complete the missing variables x and y:



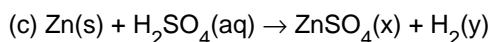
✓ Answer

x = (s) — PbI₂ is insoluble precipitate. y = (aq) — KNO₃ is soluble.



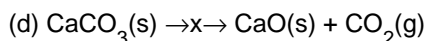
✓ Answer

x = 2Ag — copper displaces silver from silver nitrate solution.



✓ Answer

x = (aq) — ZnSO₄ dissolves. y = (g) — H₂ is released as gas.



✓ Answer

x = Heat — calcium carbonate requires heating to decompose.

Q22.

Classify as exothermic or endothermic:



Change	Type	Reason
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(a) Decomposition of FeSO ₄	Endothermic	Requires heat to break FeSO ₄ into Fe ₂ O ₃ , SO ₂ , SO ₃
(b) Dilution of H ₂ SO ₄	Exothermic	Heat is released when acid is diluted with water
(c) Dissolving NaOH in water	Exothermic	NaOH dissolves with heat release; solution gets hot
(d) Dissolving NH ₄ Cl in water	Endothermic	Heat is absorbed; solution becomes cold

Q23.

Identify the reducing agent in each reaction:

Reaction	Reducing Agent	Explanation
(a) $4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O}$	NH₃ (Ammonia)	N is oxidised from -3 in NH ₃ to +2 in NO → NH ₃ gets oxidised → it is the reducing agent
(b) $\text{H}_2\text{O} + \text{F}_2 \rightarrow \text{HF} + \text{HOF}$	H₂O (Water)	F ₂ gets reduced to HF; H ₂ O provides H (gets oxidised) → H ₂ O is reducing agent
(c) $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$	CO (Carbon monoxide)	C in CO is oxidised from +2 to +4 in CO ₂ → CO gets oxidised → CO is reducing agent
(d) $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$	H₂ (Hydrogen)	H ₂ gets oxidised (adds to O) → H ₂ is the reducing agent

■ **EXAM TIP** Reducing agent = gets **OXIDISED**. Oxidising agent = gets **REDUCED**. Identify which substance loses electrons/hydrogen or gains oxygen.

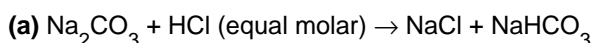
Q24.

Identify the oxidising agent in each reaction:

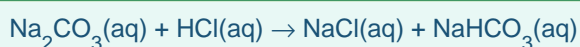
Reaction	Oxidising Agent
(a) $\text{Pb}_3\text{O}_4 + 8\text{HCl} \rightarrow 3\text{PbCl}_2 + \text{Cl}_2 + 4\text{H}_2\text{O}$	Pb ₃ O ₄
(b) $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$	O ₂
(c) $\text{CuSO}_4 + \text{Zn} \rightarrow \text{Cu} + \text{ZnSO}_4$	CuSO ₄
(d) $\text{V}_2\text{O}_5 + 5\text{Ca} \rightarrow 2\text{V} + 5\text{CaO}$	V ₂ O ₅
(e) $3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$	H ₂ O
(f) $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$	CuO

Q25.

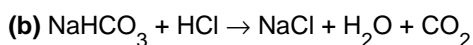
Write balanced equations for:



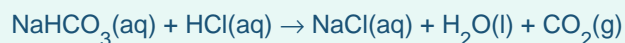
Answer 25(a)



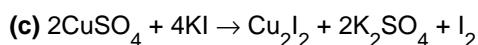
Equal molar means only one of the two Na is replaced. Product is sodium bicarbonate, not CO₂.



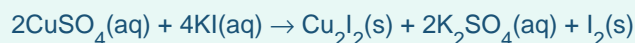
Answer 25(b)



CO₂ causes effervescence (bubbles). Used in baking soda chemistry.



Answer 25(c)

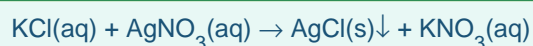


Cuprous iodide (Cu₂I₂) precipitates. Iodine is released (gives brown colour).

Q26.

$\text{KCl}(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow$ white insoluble substance. Write reaction and type.

✓ Answer 26



White precipitate = Silver chloride (AgCl) — insoluble in water.

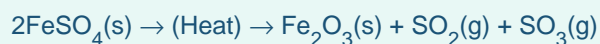
Type: **Double displacement reaction AND Precipitation reaction.**

K⁺ and Ag⁺ swap anion partners. AgCl is so insoluble it immediately precipitates.

Q27.

FeSO_4 decomposes with burning sulphur smell. Write reaction and type.

✓ Answer 27



The characteristic smell of burning sulphur comes from SO₂ and SO₃ gases.

Type: **Thermal decomposition reaction** — heat breaks down one compound into multiple products.

FeSO₄ (pale green) → Fe₂O₃ (reddish-brown) — colour change is an observable indicator.

Q28.

Why do fireflies glow at night?

✓ Answer 28

Fireflies contain a special protein called **luciferin**.

In the presence of an enzyme (luciferase), luciferin undergoes aerial oxidation.

This chemical reaction releases energy in the form of **visible light**.

This phenomenon is called **bioluminescence** — a biochemical reaction that produces light.

It is a chemical change (oxidation reaction) producing light energy.

Q29.

Grapes on plant don't ferment, but plucked grapes can. Under what conditions? Chemical or physical change?

✓ Answer 29

Grapes attached to plants are living — their immune system (defence mechanisms) prevents microbial attack and fermentation.

After plucking, the immune mechanism stops. Microorganisms (yeast) can then grow.

Fermentation requires: (i) Absence of oxygen (anaerobic conditions), (ii) Presence of microbes (yeast), (iii) Warmth.

Glucose → Ethanol + CO₂ (in absence of O₂, via yeast fermentation)

This is a **chemical change** — new substances (alcohol, CO₂) are formed; irreversible.

Q30.

Classify as physical or chemical change:

(a) Evaporation of petrol (b) Burning of LPG

(c) Heating iron rod to red hot (d) Curdling of milk (e) Sublimation of NH₄Cl

Change	Type	Reason
(a) Evaporation of petrol	Physical	Petrol changes state (liquid→vapour). Same substance. Reversible.
(b) Burning of LPG	Chemical	Combustion produces CO ₂ and H ₂ O. New substances formed. Irreversible.
(c) Heating iron rod to red hot	Physical	Iron just gets heated (glows). No new substance. Cools back to original.
(d) Curdling of milk	Chemical	Proteins denature, lactic acid forms. New substance. Irreversible.
(e) Sublimation of NH ₄ Cl	Physical	NH ₄ Cl converts solid→vapour without changing identity. Reversible.

Q31.

Explain observations when metals react with dilute HCl:

Metal	Observation	Explanation
(a) Silver (Ag)	No change	Ag is below H in the activity series → cannot displace H from HCl. No reaction occurs.
(b) Aluminium (Al)	Temperature rises	2Al + 6HCl → 2AlCl ₃ + 3H ₂ . This is exothermic → heat released → temperature rises.
(c) Sodium (Na)	Highly explosive	Na is extremely reactive. Reacts violently with HCl releasing huge heat and H ₂ gas rapidly. Explosion hazard.
(d) Lead (Pb)	Bubbles of gas seen	Pb + 2HCl → PbCl ₂ + H ₂ . Lead can displace H from HCl. H ₂ gas bubbles are produced.

Q32.

Substance X: oxide of Group 2 element, used in cement industry, present in bones, turns red litmus blue with water. Identify X.

✓ Answer 32

X = **Calcium oxide (CaO)** — also called quicklime.

Group 2 element = Ca (Calcium). CaO is an oxide of calcium.

Reaction with water: CaO(s) + H₂O(l) → Ca(OH)₂(aq) + Heat

Ca(OH)₂ is calcium hydroxide (slaked lime) — a base → turns red litmus BLUE.

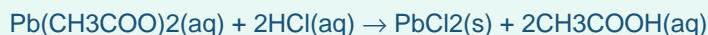
Used in cement industry and in bones as calcium phosphate (Ca₃(PO₄)₂).

Q33.

Write balanced equations and classify:

(a) Lead acetate + dilute HCl → lead chloride + acetic acid

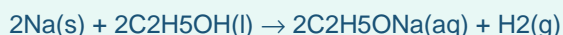
✓ Answer



Type: Double displacement reaction

(b) Sodium metal + absolute ethanol → sodium ethoxide + H₂

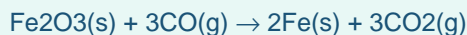
✓ Answer



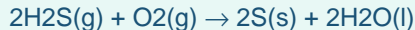
Type: Displacement reaction (Na displaces H from ethanol)

(c) Fe₂O₃ + CO (heat) → solid iron + CO₂

✓ Answer

Type: Redox reaction (CO is oxidised; Fe₂O₃ is reduced)**(d) H₂S + O₂ → solid sulphur + liquid water**

✓ Answer

Type: Redox reaction (S in H₂S is oxidised; O₂ is reduced)**Q34.**

Why is silver chloride stored in dark-coloured bottles?

✓ Answer 34

AgCl is sensitive to light. On exposure to sunlight, it decomposes:

This is a **photochemical decomposition**. Light provides energy to break bonds.

Dark-coloured bottles block out light, preventing this decomposition.

AgCl is used in photography — its light sensitivity is an asset in that context.

Q35.

Balance the equations and identify type:

Reaction	Balanced Equation	Type
(a) Mg + Cl ₂ → MgCl ₂	Mg(s) + Cl ₂ (g) → MgCl ₂ (s) [already balanced]	Combination
(b) HgO → Hg + O ₂	2HgO(s) → (Heat) → 2Hg(l) + O ₂ (g)	Decomposition

(c) $\text{Na} + \text{S} \rightarrow \text{Na}_2\text{S}$	$2\text{Na}(\text{s}) + \text{S}(\text{s}) \rightarrow (\text{Fuse}) \rightarrow \text{Na}_2\text{S}(\text{s})$	Combination
(d) $\text{TiCl}_4 + \text{Mg} \rightarrow \text{Ti} + \text{MgCl}_2$	$\text{TiCl}_4(\text{l}) + 2\text{Mg}(\text{s}) \rightarrow \text{Ti}(\text{s}) + 2\text{MgCl}_2(\text{s})$	Displacement
(e) $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$	$\text{CaO}(\text{s}) + \text{SiO}_2(\text{s}) \rightarrow \text{CaSiO}_3(\text{s})$ [already balanced]	Combination
(f) $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$	$2\text{H}_2\text{O}_2(\text{l}) \rightarrow (\text{UV}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$	Decomposition

Q36.

Mg ribbon burnt in $\text{O}_2 \rightarrow$ white compound X + light. In N_2 atmosphere \rightarrow continues burning \rightarrow compound Y.
(a) Chemical formulae of X and Y. (b) Balanced equation when X is dissolved in water.

✓ Answer 36

(a) X = MgO (Magnesium oxide — white powder). Y = Mg₃N₂ (Magnesium nitride).

Reactions: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ and $3\text{Mg} + \text{N}_2 \rightarrow \text{Mg}_3\text{N}_2$

(b) $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg}(\text{OH})_2$

MgO dissolves in water to form magnesium hydroxide (a base). Solution is alkaline.

Q37.

Zinc liberates H_2 with dilute HCl, but copper does not. Explain.

✓ Answer 37

The **activity series** ranks metals by reactivity.

Zinc (Zn) is ABOVE hydrogen in the activity series \rightarrow can displace H from acids.

$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$ (gas produced, recognised by pop test)

Copper (Cu) is BELOW hydrogen in the activity series \rightarrow cannot displace H from acids.

$\text{Cu} + \text{HCl} \rightarrow$ No reaction

Only metals above H in the activity series can displace hydrogen from dilute acids.

■ COMMON MISTAKE

Students often confuse activity series order. Remember: $\text{Na} > \text{Mg} > \text{Al} > \text{Zn} > \text{Fe} > \text{H} > \text{Cu} > \text{Ag}$. Above H \rightarrow reacts with acid.

Q38.

Silver articles turn black when kept in the open. Rubbing with toothpaste restores shine.

(a) Why does silver turn black? Name the phenomenon.

(b) Name the black substance and give its chemical formula.

✓ Answer 38

(a) Silver reacts with hydrogen sulphide (H_2S) present in air.

Reaction: $4\text{Ag}(\text{s}) + 2\text{H}_2\text{S}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{Ag}_2\text{S}(\text{s}) + 2\text{H}_2\text{O}$

This phenomenon is called **CORROSION** (specifically tarnishing of silver).

(b) The black substance is **Silver sulphide (Ag_2S)**.

Toothpaste acts as a mild abrasive — it scrubs off the Ag_2S layer, exposing shiny silver.

SECTION C: LONG ANSWER QUESTIONS

Q39.

Blue-coloured $\text{Cu}(\text{NO}_3)_2$ heated \rightarrow black $\text{CuO} + \text{O}_2$ + brown gas X.

(a) Balanced equation (b) Identify X (c) Type of reaction (d) pH range of aqueous solution of X

✓ Answer 39

(a) **Balanced equation:**



(b) **Identity of X:** The brown gas X is Nitrogen dioxide (NO_2).

NO_2 is a reddish-brown toxic gas with a pungent smell.

(c) **Type of reaction:** Thermal decomposition reaction.

One compound ($\text{Cu}(\text{NO}_3)_2$) breaks into multiple simpler substances on heating.

(d) **pH range:** NO_2 dissolves in water: $3\text{NO}_2 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3 + \text{NO}$

HNO_3 (nitric acid) is acidic. So $\text{pH} < 7$. Approximately $\text{pH} 2-4$ for aqueous NO_2 .

Q40.

Give characteristic tests for: (a) CO_2 (b) SO_2 (c) O_2 (d) H_2

Gas	Characteristic Test	Observation / Reaction
CO₂	Pass through lime water [$\text{Ca}(\text{OH})_2$ solution]	Lime water turns milky due to CaCO_3 formation. $\text{Ca}(\text{OH})_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$
SO₂	Pass through acidic KMnO_4 solution (purple) OR acidic $\text{K}_2\text{Cr}_2\text{O}_7$ (orange)	KMnO_4 turns colourless ($\text{Mn}^{7+} \rightarrow \text{Mn}^{2+}$) OR $\text{K}_2\text{Cr}_2\text{O}_7$ turns green ($\text{Cr}^{6+} \rightarrow \text{Cr}^{3+}$). SO_2 is a strong reducing agent.
O₂	Bring a glowing splinter near mouth of test tube	Glowing splinter relights (bursts into flame). O_2 supports combustion.
H₂	Bring a burning candle near mouth of test tube	Burns with a squeaky "pop" sound. H_2 is combustible.

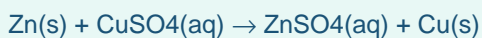
■ **EXAM TIP** Gas tests are very commonly asked in exams. Learn all four: CO_2 =milky, SO_2 =decolourises KMnO_4 , O_2 =relights splinter, H_2 =pop sound.

Q41.

What happens when: (a) Zn added to CuSO_4 solution? (b) Al added to dilute HCl? (c) Ag added to CuSO_4 ?

✓ Answer 41(a) — Zinc + Copper Sulphate

Zinc is more reactive than copper in the activity series.

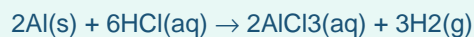


Blue colour of CuSO_4 fades (becomes colourless ZnSO_4). Copper metal deposits as reddish-brown solid.

This is a **displacement reaction**.

✓ Answer 41(b) — Aluminium + Dilute HCl

Al is more reactive than H → displaces hydrogen gas.

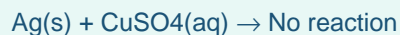


Bubbles of H₂ gas are released. The solution becomes hot (exothermic).

H₂ burns with a pop sound — confirmatory test.

✓ Answer 41(c) — Silver + Copper Sulphate

Silver (Ag) is LESS reactive than copper in the activity series.



A less reactive metal cannot displace a more reactive metal from its salt solution.

There is no observable change.

Q42.

What happens when Zn granules react with dilute H₂SO₄, HCl, HNO₃, NaCl and NaOH? Write equations where reaction occurs.

Reagent	Observation	Equation
Dilute H ₂ SO ₄	Bubbles (H ₂ gas); exothermic	$\text{Zn(s)} + \text{H}_2\text{SO}_4\text{(aq)} \rightarrow \text{ZnSO}_4\text{(aq)} + \text{H}_2\text{(g)}$
Dilute HCl	Bubbles (H ₂ gas); exothermic	$\text{Zn(s)} + 2\text{HCl(aq)} \rightarrow \text{ZnCl}_2\text{(aq)} + \text{H}_2\text{(g)}$
Dilute HNO ₃	No H ₂ (HNO ₃ oxidises it to water)	$4\text{Zn} + 10\text{HNO}_3\text{(dil)} \rightarrow 4\text{Zn(NO}_3)_2 + 5\text{H}_2\text{O} + \text{N}_2\text{O(g)}$
NaCl solution	No reaction	$\text{Zn} + \text{NaCl} \rightarrow \text{No reaction (Na is more reactive than Zn)}$
NaOH solution	Bubbles (H ₂ gas)	$\text{Zn} + 2\text{NaOH} \rightarrow \text{Na}_2\text{ZnO}_2\text{(aq)} + \text{H}_2\text{(g)}$ [sodium zincate formed]

■ **NOTE:** Zinc is amphoteric — reacts with both acids AND bases. HNO₃ is special because it is an oxidising acid — no H₂ with HNO₃!

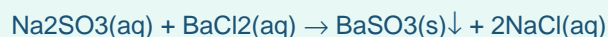
Q43.

Drop of BaCl₂ added to Na₂SO₃ → white precipitate.

(a) Balanced equation (b) Other name for this type (c) Why precipitate disappears on adding HCl?

✓ Answer 43

(a) **Balanced equation:**

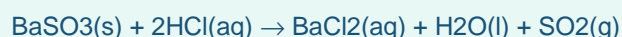


White precipitate = Barium sulphite (BaSO₃) — insoluble.

(b) **Other name:** Double displacement reaction (ions exchange partners).

(c) **Why precipitate disappears:**

BaSO₃ is a salt of weak acid (H₂SO₃). When strong HCl is added:



BaCl₂ is soluble → white precipitate dissolves. SO₂ gas (burning sulphur smell) is released.

Q44.

Copper and aluminium containers; solutions: dilute HCl, dilute HNO₃, ZnCl₂, H₂O. Which solutions can be kept in which container?

Solution	Copper Container	Aluminium Container
Dilute HCl	✓ CAN keep — Cu does not react with dilute HCl	✗ CANNOT — $\text{Al} + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2$ (Al dissolves)
Dilute HNO ₃	✗ CANNOT — HNO ₃ (oxidising acid) attacks Cu: $3\text{Cu} + 8\text{HNO}_3(\text{dil}) \rightarrow 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$	✓ CAN keep — Al forms protective Al ₂ O ₃ layer (passivation)
ZnCl ₂	✓ CAN keep — Zn is more reactive than Cu, no displacement	✗ CANNOT — Al more reactive than Zn: $2\text{Al} + 3\text{ZnCl}_2 \rightarrow 2\text{AlCl}_3 + 3\text{Zn}$
H ₂ O	✓ CAN keep — Cu does not react with water	✓ CAN keep — Al does not react with cold/hot water (reacts with steam: $2\text{Al} + 3\text{H}_2\text{O} \rightarrow \text{Al}_2\text{O}_3 + 3\text{H}_2$)

QUICK REVISION: TYPES OF REACTIONS

Types of Chemical Reactions

Combination: $A + B \rightarrow AB$

Decomposition: $AB \rightarrow A + B$

Displacement: $A + BC \rightarrow AC + B$

Double Displacement: $AB + CD \rightarrow AD + CB$

Redox: Oxidation + Reduction

Combination $A + B \rightarrow AB$. Two reactants \rightarrow one product.

Decomposition $AB \rightarrow A + B$. One reactant \rightarrow two+ products. Needs energy.

Displacement $A + BC \rightarrow AC + B$. More reactive A displaces less reactive B.

Double Disp. $AB + CD \rightarrow AD + CB$. Two pairs of ions exchange. Often precipitation.

Redox Oxidation and reduction happen simultaneously. OIL RIG.

Combination Releases heat + light. e.g. combustion.

MCQ ANSWER KEY SUMMARY GRID

Q	Ans	Q	Ans	Q	Ans
1	(d)	2	(c)	3	(c)
4	(a)	5	(c)	6	(a)
7	(b)	8	(a)	9	(b)
10	(d)	11	(b)	12	(d)
13	(b)	14	(d)	15	(a)
16	(d)	17	(d)	18	(d)

EXAM TIPS AND COMMON MISTAKES

■ **EXAM TIP** Always balance equations first before identifying type of reaction.

■ **COMMON MISTAKE** Students write wrong products or miss balancing — marks are deducted.

■ **EXAM TIP** Remember: OIL RIG — Oxidation Is Loss (of electrons/H or gain of O); Reduction Is Gain (of electrons/H or loss of O).

■ **COMMON MISTAKE** Confusing oxidising agent with oxidised substance — they are OPPOSITES.

■ **EXAM TIP** Dilution of acid = EXOTHERMIC. Evaporation = ENDOTHERMIC. Always add acid to water (never water to acid).

■ **COMMON MISTAKE**

Mixing up exothermic and endothermic processes.

■ **EXAM TIP**

Physical change = reversible, no new substance. Chemical change = new substance, usually irreversible.

■ **COMMON MISTAKE**

Treating sublimation of camphor as chemical (it's physical).

■ **EXAM TIP**

Activity series order: Na > Mg > Al > Zn > Fe > H > Cu > Ag. Only metals above H react with dilute acids.

■ **COMMON MISTAKE**

Assuming all metals react with all acids — silver and copper do NOT react with dilute HCl.

■ **EXAM TIP**

For double displacement, two ionic compounds exchange anions. One product is usually a precipitate, gas, or water.

■ **COMMON MISTAKE**

Confusing single and double displacement — check if ONE or TWO pairs exchange.

QUICK REVISION TABLE

Concept	Key Point	Example
Combination	$A + B \rightarrow AB$	$2Mg + O_2 \rightarrow 2MgO$
Decomposition	$AB \rightarrow A + B$ (+ energy needed)	$2KClO_3 \rightarrow 2KCl + 3O_2$
Displacement	More reactive displaces less reactive	$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
Double Displacement	$AB + CD \rightarrow AD + CB$	$NaCl + AgNO_3 \rightarrow AgCl\downarrow + NaNO_3$
Exothermic	Heat released; temperature rises	$CaO + H_2O \rightarrow Ca(OH)_2 + \text{Heat}$
Endothermic	Heat absorbed; temperature falls	Dissolving NH_4Cl in water
Oxidation	Gain of O / loss of H	$Fe \rightarrow Fe_3O_4$ (gains O)
Reduction	Loss of O / gain of H	$H_2O \rightarrow H_2$ (loses O)
Oxidising agent	Gets REDUCED (accepts e^-)	$O_2, KMnO_4, HNO_3$
Reducing agent	Gets OXIDISED (donates e^-)	H_2, CO, NH_3
Corrosion	Slow metal degradation by environment	$Ag + H_2S \rightarrow Ag_2S$ (black)
Rancidity	Oxidation of oils/fats	Prevented by N_2/He atmosphere
Precipitation	Insoluble solid formed in solution	$AgCl\downarrow$ (white), $BaSO_4\downarrow$ (white)
Electrolysis of H_2O	$H_2 : O_2 = 2 : 1$ (mole ratio)	H_2 at cathode, O_2 at anode

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