



1. Chemical Reactions — Introduction

CHEMICAL REACTION → A process in which one or more substances are converted into one or more new substances with different properties. The original substances are called **Reactants** and the new substances are called **Products**.

Signs / Evidences of a Chemical Reaction

- ① **Change in State** — e.g., solid + liquid → gas (wax burning)
- ② **Change in Colour** — e.g., copper turns green (basic copper carbonate forms)
- ③ **Evolution of Gas** — e.g., zinc + dilute $\text{H}_2\text{SO}_4 \rightarrow \text{H}_2$ gas released with effervescence
- ④ **Change in Temperature** — heat released (exothermic) or absorbed (endothermic)
- ⑤ **Formation of Precipitate** — insoluble solid formed; e.g., $\text{BaSO}_4 \downarrow$ (white ppt) when $\text{BaCl}_2 + \text{Na}_2\text{SO}_4$ react

⚠ परीक्षा के लिए | All 5 evidences must be remembered — frequently asked in board exams as "How do we know a chemical reaction has taken place?"

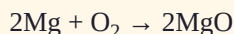
2. Chemical Equations

CHEMICAL EQUATION → A symbolic representation of a chemical reaction using chemical formulae of reactants and products. Reactants on left, products on right, separated by arrow (→).

Word Equation → Symbol Equation

→ Word equation example: Magnesium + Oxygen → Magnesium oxide

SYMBOL EQUATION →



- **Skeletal / Unbalanced equation** — does not follow Law of Conservation of Mass
- **Balanced equation** — number of atoms of each element equal on both sides

Writing a Chemical Equation — Steps

- ① Write word equation (reactants → products)
- ② Replace names with correct chemical formulae
- ③ Balance the equation by adjusting coefficients (never change subscripts)
- ④ Add state symbols: (s) solid, (l) liquid, (g) gas, (aq) aqueous
- ⑤ Add conditions above/below arrow: heat (Δ), catalyst, light (hv), pressure etc.

State Symbols

- (s) = Solid | (l) = Liquid | (g) = Gas | (aq) = Aqueous solution
- ↑ = gas evolved upward | ↓ = precipitate formed
- Δ above arrow = heat required | hv = light required

⚠ परीक्षा के लिए | State symbols aur conditions — board mein equation likhte waqt ZAROOR daalo, marks milte hain

3. Balancing Chemical Equations

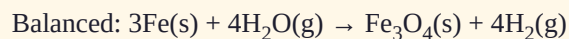
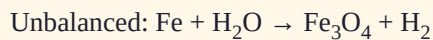
LAW OF CONSERVATION OF MASS → Mass can neither be created nor destroyed in a chemical reaction.

Total mass of reactants = Total mass of products. (Given by **Antoine Lavoisier**, 1789)

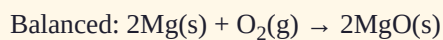
Hit and Trial Method (Balancing by Inspection)

- Change coefficients (numbers before formulae) only — never change subscripts inside formula
- Start with the most complex formula, balance it first
- Balance H and O atoms last (usually)

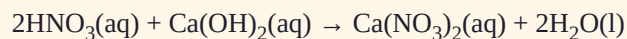
BALANCING EXAMPLE — $\text{Fe} + \text{H}_2\text{O} \rightarrow$



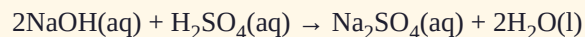
BALANCING EXAMPLE — $\text{Mg} + \text{O}_2 \rightarrow$



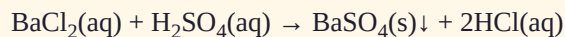
BALANCING EXAMPLE — $\text{HNO}_3 + \text{Ca(OH)}_2 \rightarrow$



BALANCING EXAMPLE — $\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow$



BALANCING EXAMPLE — $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow$



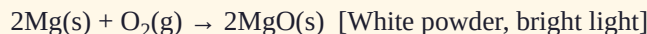
4. Types of Chemical Reactions

4.1 Combination Reaction

COMBINATION REACTION → Two or more substances combine to form a single new substance. $A + B \rightarrow AB$

→ Burning of coal: $C(s) + O_2(g) \rightarrow CO_2(g)$ — **exothermic**

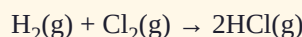
REACTION 1 — BURNING OF MAGNESIUM



REACTION 2 — QUICKLIME + WATER



REACTION 3 — $H_2 + Cl_2$



★ **Most combination reactions are exothermic** — heat is released

4.2 Decomposition Reaction

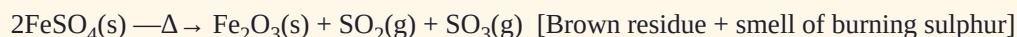
DECOMPOSITION REACTION → A single compound breaks down into two or more simpler substances. $AB \rightarrow A + B$. Opposite of combination.

→ Requires energy input: heat (**thermal decomposition**), electricity (**electrolytic decomposition**), or light (**photolytic decomposition**)

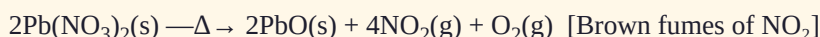
THERMAL DECOMP — CALCIUM CARBONATE (LIMESTONE)



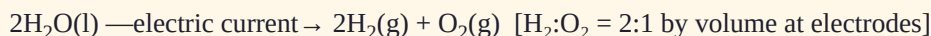
THERMAL DECOMP — FERROUS SULPHATE



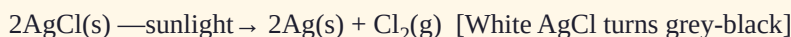
THERMAL DECOMP — LEAD NITRATE



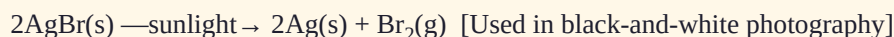
ELECTROLYTIC DECOMP — WATER



PHOTOLYTIC DECOMP — SILVER CHLORIDE



PHOTOLYTIC DECOMP — SILVER BROMIDE



⚠ **परीक्षा के लिए** | Decomposition reactions are endothermic (energy is **ABSORBED**). $AgCl/AgBr$ in photography — board favourite question!

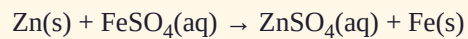
4.3 Displacement Reaction

DISPLACEMENT REACTION → A more reactive element displaces a less reactive element from its compound. $A + BC \rightarrow AC + B$

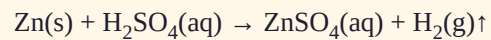
REACTION — IRON DISPLACES COPPER

$\text{Fe(s)} + \text{CuSO}_4\text{(aq)} \rightarrow \text{FeSO}_4\text{(aq)} + \text{Cu(s)}$ [Blue solution fades; copper deposits on iron nail]

REACTION — ZINC DISPLACES IRON



REACTION — ZINC DISPLACES HYDROGEN



→ Reactivity order: **Zn** > **Fe** > **H** > **Cu** — more reactive displaces less reactive

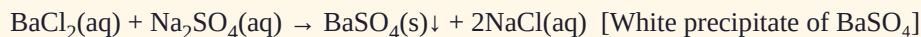
→ Blue colour of CuSO_4 fades as Cu^{2+} is replaced by Fe^{2+} (light green)

4.4 Double Displacement Reaction

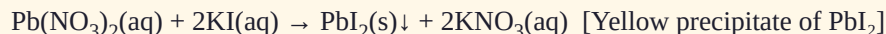
DOUBLE DISPLACEMENT → Two compounds react by exchanging ions to form two new compounds.

Usually one product is a precipitate, gas, or water. $AB + CD \rightarrow AD + CB$

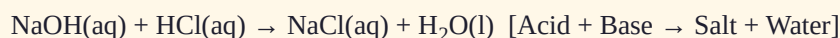
REACTION — $BaCl_2 + Na_2SO_4$



REACTION — $Pb(NO_3)_2 + KI$ (ACTIVITY 1.10)



REACTION — $NaOH + HCl$ (NEUTRALISATION)



PRECIPITATION REACTION → A type of double displacement where an insoluble solid (precipitate ↓) is formed. Used to test for SO_4^{2-} , Cl^- , CO_3^{2-} ions.

▲ परीक्षा के लिए | Neutralisation is a type of double displacement. Always write "salt + water" as products for acid-base reactions.

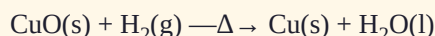
4.5 Oxidation and Reduction (Redox Reactions)

OXIDATION → Gain of oxygen OR loss of hydrogen OR loss of electrons. The substance oxidised is called the **reducing agent**.

REDUCTION → Loss of oxygen OR gain of hydrogen OR gain of electrons. The substance reduced is called the **oxidising agent**.

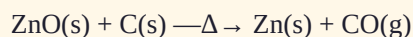
REDOX REACTION → Both oxidation AND reduction occur simultaneously. One substance gets oxidised while the other gets reduced.

REDOX EXAMPLE 1 — $CuO + H_2$



CuO : loses O → **REDUCED** (oxidising agent) | H_2 : gains O → **OXIDISED** (reducing agent)

REDOX EXAMPLE 2 — $ZnO + C$



ZnO : loses O → **REDUCED** | C : gains O → **OXIDISED**

REDOX EXAMPLE 3 — $MnO_2 + HCl$



HCl : oxidised (loses H) | MnO_2 : reduced (gains H / loses O)

→ **Oxidising agent**: gets reduced (gains electrons / adds O / removes H)

→ **Reducing agent**: gets oxidised (loses electrons / removes O / adds H)

→ Memory trick: **OIL RIG** — Oxidation Is Loss, Reduction Is Gain (of electrons)

▲ परीक्षा के लिए | In $CuO + H_2$ reaction — identify oxidising and reducing agent separately. 2-mark question in board.

5. Effects of Oxidation in Everyday Life

5.1 Corrosion

CORROSION → Slow deterioration of metals by reaction with moisture, oxygen, acids, or other substances in their environment. Results in undesirable compounds forming on the metal surface.

- **Rusting of Iron:** $4\text{Fe} + 3\text{O}_2 + x\text{H}_2\text{O} \rightarrow 2\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ (Hydrated iron(III) oxide — reddish brown)
- **Tarnishing of Silver:** $\text{Ag} + \text{H}_2\text{S} \text{ (in air)} \rightarrow \text{Ag}_2\text{S}$ (black tarnish)
- **Copper Corrosion:** $\text{Cu} + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$ (green patina — basic copper carbonate)
- Corrosion causes huge economic loss — bridges, ships, vehicles, railway tracks affected
- Prevention: painting, oiling, galvanising, alloying, electroplating, chrome plating

RANCIDITY → Oxidation of fats and oils in food, making them smell and taste unpleasant (stale/off). The food becomes unfit for consumption. Scientific term for food "going rancid."

→ Causes: prolonged exposure to oxygen, moisture, heat, and light

→ **Methods to prevent rancidity:**

- ① **Antioxidants added** — e.g., BHA, BHT in packaged chips; Vitamin C (ascorbic acid)
- ② **Nitrogen flushing** — chips packets filled with N_2 gas instead of air (no O_2)
- ③ **Refrigeration** — slows down oxidation rate
- ④ **Airtight containers** — less contact with oxygen
- ⑤ **Dark containers** — less light exposure

▲ परीक्षा के लिए | Why are chips packets filled with nitrogen? — Rancidity prevention. Very commonly asked board question!

6. Exothermic and Endothermic Reactions

EXOTHERMIC REACTION → Chemical reaction in which **heat is released** to the surroundings. Products have less energy than reactants. Temperature of surroundings **INCREASES**.

ENDOTHERMIC REACTION → Chemical reaction in which **heat is absorbed** from the surroundings. Products have more energy than reactants. Temperature of surroundings **DECREASES**.

Property	Exothermic	Endothermic
Heat	Released	Absorbed
Temp change	Surroundings heat up	Surroundings cool down
Example	Burning, respiration, $CaO + H_2O$	Photosynthesis, decomposition, dissolving NH_4Cl
Energy of products	Less than reactants	More than reactants

EXOTHERMIC — NATURAL GAS BURNING



EXOTHERMIC — RESPIRATION



ENDOTHERMIC — PHOTOSYNTHESIS



★ **Decomposition reactions are endothermic** (energy needed to break bonds)

★ **Combination reactions are mostly exothermic** (energy released when bonds form)

7. Summary Table — Types of Reactions

Type	Pattern	Key Example	Energy
Combination	$A + B \rightarrow AB$	$2Mg + O_2 \rightarrow 2MgO$	Exothermic
Decomposition	$AB \rightarrow A + B$	$CaCO_3 \rightarrow CaO + CO_2$	Endothermic
Displacement	$A + BC \rightarrow AC + B$	$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$	Varies
Double Displacement	$AB + CD \rightarrow AD + CB$	$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 \downarrow + 2NaCl$	Varies
Oxidation	Gain of O / Loss of H	$2Mg + O_2 \rightarrow 2MgO$	Usually exo

8. Important NCERT Activities — Summary

LS

Ch. 1 | Class 10 | Science

Activity	Observation	Inference
1.1 Magnesium ribbon burns	Bright white light; white powder (MgO) formed	Chemical change; combination rxn
1.2 $\text{CuSO}_4 + \text{Fe nail}$	Blue solution fades; brown copper deposits on nail	Displacement rxn; $\text{Fe} > \text{Cu}$ in reactivity
1.3 $\text{BaCl}_2 + \text{Na}_2\text{SO}_4$	White precipitate (BaSO_4) forms immediately	Double displacement; precipitation rxn
1.4 $\text{CaO} + \text{H}_2\text{O}$	Heat released; Ca(OH)_2 (slaked lime) formed	Combination rxn; exothermic
1.5 AgCl in sunlight	White AgCl $\rightarrow$ grey-black (Ag forms)	Photolytic decomposition
1.6 CuSO_4 electrolysis	Cu deposits at cathode; O_2 at anode	Electrolytic decomposition
1.7 FeSO_4 heated	Green crystals $\rightarrow$ brown Fe_2O_3 ; SO_2 smell	Thermal decomposition
1.8 $\text{Pb(NO}_3)_2 + \text{KI}$	Yellow precipitate (PbI_2)	Double displacement; precipitation
1.9 $\text{CuO} + \text{H}_2$	Black CuO $\rightarrow$ reddish Cu; water droplets on tube wall	Redox rxn; CuO reduced, H_2 oxidised
1.10 Rancid butter smell	Smell of old/stale butter	Oxidation of fats = rancidity

▲ परीक्षा के लिए | Activity-based questions carry 2–3 marks. Learn observation + inference for each NCERT activity above.

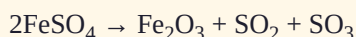
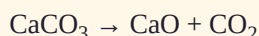
9. Important Formulae and Reactions — Quick Revision

KEY FORMULA — REACTANT $\rightarrow$ PRODUCT

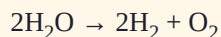
Reactants (Left) $\rightarrow$ Products (Right) | Balanced using coefficients only

Decomposition Reactions

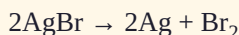
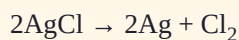
THERMAL



ELECTROLYTIC

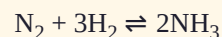
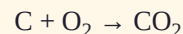
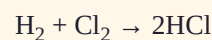
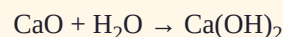
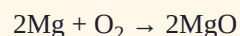


PHOTOLYTIC



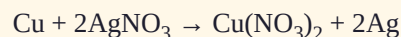
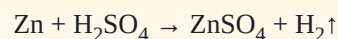
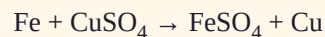
Combination Reactions

KEY COMBOS



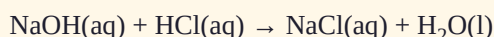
Displacement

DISPLACEMENT

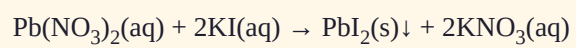
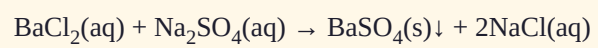


Double Displacement — Key Reactions

NEUTRALISATION



PRECIPITATION



Section 1.1 — Chemical Equations (Pg 6)

- Q1.** Why should a balanced equation obey Law of Conservation of Mass? → Atoms are neither created nor destroyed; total atoms on both sides must be equal.
- Q2.** Write balanced equation for: Hydrogen + Chlorine → Hydrogen chloride

$$\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g})$$
- Q3.** Barium Chloride + Aluminium Sulphate → Barium Sulphate + Aluminium Chloride

$$3\text{BaCl}_2(\text{aq}) + \text{Al}_2(\text{SO}_4)_3(\text{aq}) \rightarrow 3\text{BaSO}_4(\text{s})\downarrow + 2\text{AlCl}_3(\text{aq})$$

Section 1.2 — Types of Reactions (Pg 13)

- Q1.** A solution of substance X is used for whitewashing. Name X and write reaction with water.
 $\text{X} = \text{CaO}$ (Quicklime/Calcium oxide). $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$ (Slaked lime)
- Q2.** Why is decomposition reaction opposite to combination? → Combination: $\text{A} + \text{B} \rightarrow \text{AB}$ (merging).
 Decomposition: $\text{AB} \rightarrow \text{A} + \text{B}$ (breaking). Exactly opposite direction.

Section 1.3 — Oxidation (Pg 18)

- Q1.** Define the terms: Oxidation = gain of O / loss of H. Reduction = loss of O / gain of H.
- Q2.** What is a reducing agent? → Substance that reduces another (itself gets oxidised). E.g., H_2 in $\text{CuO} + \text{H}_2$ reaction.

11. What Have You Learnt — Chapter Summary

- ✓ A **chemical reaction** involves transformation of substances with evidence like colour change, gas evolution, precipitate, temperature/state change.
- ✓ Chemical equations use formulae; must be balanced to satisfy **Law of Conservation of Mass**.
- ✓ State symbols (s, l, g, aq) and condition symbols (Δ , light, catalyst) make equations more informative.
- ✓ **Combination**: $\text{A} + \text{B} \rightarrow \text{AB}$ (mostly exothermic). **Decomposition**: $\text{AB} \rightarrow \text{A} + \text{B}$ (endothermic).
- ✓ Decomposition types: **thermal** (heat), **electrolytic** (electricity), **photolytic** (light).
- ✓ **Displacement**: more reactive displaces less reactive element. **Double displacement**: exchange of ions; gives precipitate/water/gas.
- ✓ **Oxidation** = gain O/loss H. **Reduction** = loss O/gain H. Both happen simultaneously in **redox reactions**.
- ✓ **Exothermic**: heat released (combination, respiration, combustion). **Endothermic**: heat absorbed (decomposition, photosynthesis).
- ✓ **Corrosion**: metals reacting with environment (rusting of Fe, tarnishing of Ag, patina of Cu). Prevented by painting, alloying, galvanising.
- ✓ **Rancidity**: oxidation of fats/oils in food. Prevented by antioxidants, N_2 flushing, refrigeration, airtight containers.

▲ परीक्षा के लिए | Most important reactions to memorise: $\text{Mg} + \text{O}_2$, $\text{CaO} + \text{H}_2\text{O}$, $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$, $\text{Fe} + \text{CuSO}_4$, $\text{BaCl}_2 + \text{Na}_2\text{SO}_4$, $\text{CuO} + \text{H}_2$, $2\text{AgCl} \xrightarrow{\text{sunlight}} 2\text{Ag} + \text{Cl}_2$