🟦 Chapter 1: Chemical Reactions and Equations

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🔹 What is a Chemical Reaction?

A chemical reaction is a process in which one or more substances (reactants) are changed into new substances (products) with different properties.

💡 Examples from daily life:

- Milk turning sour
- Iron getting rusty
- Grapes fermenting
- Cooking of food
- Digestion
- Respiration

These involve change in identity or chemical nature — that's why they are chemical changes.

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🔹 How Do You Know a Chemical Reaction Has Happened?

You can say a chemical reaction has occurred if you observe:

1. **Change in colour**
2. **Change in state**
3. **Evolution of gas**
4. **Change in temperature**

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🔹 Word Equation

A word equation represents a chemical reaction using names of reactants and products.

Example:
Magnesium + Oxygen → Magnesium oxide

Reactants are written on the left-hand side (LHS), products on the right-hand side (RHS), and an arrow → shows the direction of the reaction.

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🔹 Chemical Equation

Instead of words, we can use chemical formulas:

$Mg + O_2 \rightarrow MgO$

This is called a skeletal chemical equation (unbalanced).

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🔹 Balanced Chemical Equation

To follow the Law of Conservation of Mass, number of atoms of each element must be same on both sides.

Example:
$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ ✅ (Balanced)

If atoms are unequal, you adjust the equation by adding small whole number coefficients.

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🔹 Physical States in a Chemical Equation

To make equations more informative, physical states are written as:

- (s) – solid
- (l) – liquid
- (g) – gas
- (aq) – aqueous (dissolved in water)

Example:
$3Fe(s) + 4H_2O(g) \rightarrow Fe_3O_4(s) + 4H_2(g)$

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⚛️ Types of Chemical Reactions

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1️⃣ Combination Reaction

When two or more substances combine to form a single product.

Example:
$CaO + H_2O \rightarrow Ca(OH)_2$ + Heat (Exothermic)

Other examples:

- $C + O_2 \rightarrow CO_2$
- $2H_2 + O_2 \rightarrow 2H_2O$

🧠 **Exothermic Reaction** = Heat is released during the reaction

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2 Decomposition Reaction

A single compound breaks down into two or more simpler substances.

⚠ Usually needs heat, light, or electricity.

Types:
(a) **Thermal decomposition** (by heat)
$FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$
$CaCO_3 \rightarrow CaO + CO_2$

(b) **Photodecomposition** (by light)
$2AgCl \rightarrow 2Ag + Cl_2$ (sunlight)

(c) **Electrolytic decomposition** (by electricity)
$2H_2O \rightarrow 2H_2 + O_2$

🧠 **Endothermic Reaction** = Energy is absorbed

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3 Displacement Reaction

A more reactive element displaces a less reactive element from its compound.

Example:
$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

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4 Double Displacement Reaction

Exchange of ions between two compounds to form new compounds.

Example:
$Na_2SO_4 + BaCl_2 \rightarrow BaSO_4\downarrow + 2NaCl$
Here $BaSO_4$ is a white insoluble solid → called a precipitate

🧠 **Precipitation Reaction** = An insoluble substance (solid) is formed

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5 Oxidation and Reduction (Redox)

Definitions:

- **Oxidation** = Gain of oxygen or loss of hydrogen
- **Reduction** = Loss of oxygen or gain of hydrogen

💡 Example:
$2Cu + O_2 \rightarrow 2CuO$ (Oxidation)

$CuO + H_2 \rightarrow Cu + H_2O$
CuO is reduced (loses oxygen), H_2 is oxidised (gains oxygen)

These reactions are called redox reactions.

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🧪 Important Daily Life Effects

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🔸 Corrosion

When a metal reacts slowly with air, water, or acids, it gets damaged.
Example: Iron becomes reddish-brown (rust), copper becomes green, silver becomes black.

This process is called corrosion.

💡 It leads to damage of iron bridges, railings, etc.

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🔸 Rancidity

Spoiling of food containing oil/fat due to oxidation.
It smells bad and tastes sour.

🧠 **Prevent rancidity by:**

- Using antioxidants
- Packing food in nitrogen
- Keeping food in airtight containers

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📝 Summary Points

Type of Reaction	Definition	Example
Combination	2 or more reactants → 1 product	$CaO + H_2O \rightarrow Ca(OH)_2$
Decomposition	1 compound → 2 or more products	$CaCO_3 \rightarrow CaO + CO_2$
Displacement	1 element replaces another in a compound	$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
Double Displacement	Exchange of ions between 2 compounds	$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + NaCl$
Oxidation	Gain of oxygen / Loss of hydrogen	$C + O_2 \rightarrow CO_2$
Reduction	Loss of oxygen / Gain of hydrogen	$CuO + H_2 \rightarrow Cu + H_2O$
Exothermic	Heat is released	$CH_4 + O_2 \rightarrow CO_2 + H_2O +$ Heat
Endothermic	Heat/energy is absorbed	$2AgCl \rightarrow 2Ag + Cl_2$