Chemical Reactions and Equations

- In a chemical reaction, at least one of the following will occur:
- Change in state
- Change in colour
- Evolution of a gas
- Change in temperature

- **Balanced chemical equation**

Reactants → Products

LHS RHS

Total number of atoms on the LHS = Total number of atoms on the RHS

- **How to balance an equation**
- Write reactants and products
- Balance the max. number of a particular atom on both sides
- Balance other atoms
- A complete balanced equation should look like

$$CO_{(g)} + 2H_{2(g)} \xrightarrow{340\,atm} CH_3OH_{(l)}$$

Types of reactions

- **Combination reaction**
  - Two or more reactants combine to form one single product.
  - **Examples**

$$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$$
$$Ca(OH)_2 \rightarrow \text{Slaked lime}$$
$$C + O_2 \rightarrow CO_2$$
$$2H_2 + O_2 \rightarrow 2H_2O_{(l)}$$

- **Exothermic reaction** – Heat gets released in the reaction. Most combination reactions are exothermic. For example,

$$\underset{\text{Calcium oxide (Quick lime)}}{CaO(s)} + \underset{\text{Water}}{H_2O(l)} \rightarrow \underset{\text{Calcium hydroxide (Slaked lime)}}{Ca(OH)_2(aq)}$$

- **Endothermic reaction** – Heat is absorbed in the reaction. Very few combination reactions are endothermic. For example,

$$\frac{1}{2}N_2(g) + O_2(g) \rightarrow NO_2(g)$$

- **Decomposition reaction**
  - A single reactant breaks into several simple products.
  - **Examples**

$$\underset{\text{(Ferrous sulphate)}}{2FeSO_4} \xrightarrow{\text{Heat}} \underset{\text{(Ferric oxide)}}{Fe_2O_3} + SO_2 + SO_3$$

$$\underset{\text{(Limestone)}}{CaCO_3} \xrightarrow{\text{Heat}} \underset{\text{(Calcium oxide)}}{CaO} + CO_2$$

$$\underset{\text{Silver chloride}}{2AgCl} \xrightarrow{\text{Sunlight}} \underset{\text{Silver}}{2Ag} + Cl_2$$

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  - All decomposition reactions are **endothermic [they absorb heat**].

- **Oxidation** → When a substance gains oxygen or looses hydrogen

$$2Cu + O_2 \xrightarrow{\text{Heat}} 2CuO \qquad [\text{Oxidation of Cu}]$$

$$CuO + H_2 \xrightarrow{\text{Heat}} Cu + H_2O \qquad [\text{Oxidation of } H_2]$$

- **Oxidation in everyday life**
  - **Corrosion –** When a metal is oxidised by action of air and moisture [that's why metals are coated]
  - **Rancidity** – When fats and oils are oxidised, their smell and taste change [that's why food is kept in air-tight containers]

- **Reduction** → When one substance loses oxygen or gains hydrogen

$$CuO + H_2 \xrightarrow{\text{Heat}} Cu + H_2O \qquad [\text{Reduction of CuO}]$$

- **Redox** – Oxidation–reduction reaction