Chapter 1: Chemical Reactions & Equations

Chemical reactions: A chemical reaction is a process in which new substances (products) with different properties are formed as a result of the breaking of bonds in reactants.

Chemical equation: A chemical equation is a symbolic representation of a chemical reaction where the reactants and the products are shown by their symbols or formulas. For example:

$$Na + Cl \rightarrow NaCl$$

(Sodium) (Chlorine) (Sodium chloride)

Balanced chemical equation:
The chemical equation in which the number of atoms of each element in the reactants side is equal to that of the products side is called a balanced chemical equation.

Why it is necessary to balance a chemical equation?

Answer:
According to the law of conservation of mass, "mass can neither be created nor be destroyed in a chemical reaction. That is, the total mass of the elements present in the products of a chemical reaction has to be equal to the total mass of the elements present in the reactants. This is possible only if total number of atoms on the reactants side is equal to total number of atoms on products side. Thus, a chemical reaction should always be balanced.

What is a skeletal chemical equation?

Answer:
A skeletal equation is an unbalanced chemical equation, i.e., a chemical equation in which the total number of atoms of each element on the reactant side is not equal to the number of atoms of the same element on the product side.

Types of chemical reactions:

(i) Combination: The reaction in which two or more reactants combine to form one product is called Combination Reactions.
For example:

$$Mg(s) + O_2(g) \rightarrow 2MgO(s)$$

(Magnesium) (Oxygen) (Magnesium Oxide)

(ii) Decomposition: The reaction in which one compound decomposes in two or more compounds or elements is known as Decomposition Reaction.
For Example:

(iii) Displacement: The chemical reaction in which a more reactive element displaces a less reactive element from a compound is known as Displacement Reaction. It is also known as Substitution Reaction.
For Example:

When zinc reacts with copper sulphate, it forms zinc sulphate and copper metal.
$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$

(iv) Double displacement: The Reaction in which ions are exchanged between two reactants forming new compounds is called Double Displacement Reaction.
For Example: When barium chloride reacts with sodium sulphate, white precipitate of barium sulphate is formed along with sodium chloride.
$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl\ (aq)$

(v) Precipitation: The reaction in which an insoluble substance (precipitate) is formed by the mixing of two solutions containing salts is called the Precipitation Reaction.

For Example:

When barium chloride reacts with sodium sulphate, white precipitate (ppt.) of barium sulphate is formed along with sodium chloride.

$BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s)$ (white ppt.) $+ 2NaCl\ (aq)$

(vi) Neutralization: The reaction in which an acid reacts with a base to form salt and water by an exchange of ions is called Neutralization Reaction.
For example:

When sodium hydroxide reacts with hydrochloric acid, action of both gets neutralised forming sodium chloride and water.

$NaOH(aq) + HCl(aq) \rightarrow NaCl\ (aq) + H_2O\ (l)$
(vii) Oxidation: A reaction that includes gain of oxygen or removal of hydrogen (or loss of electrons).

For example:

$C + O_2 \rightarrow CO_2$

Reduction: A reaction that includes removal of oxygen or addition of hydrogen (or gain of electrons).
For example:

- A substance that gains oxygen during a reaction, it is said to be oxidised.
- A substance that loses oxygen during a reaction, it is said to be reduced.

Oxidising agent : A substance that oxidises another substance and itself gets reduced.

Reducing agent: A substance that reduces another substance and itself gets oxidised.

Effects of oxidation reaction in everyday life:

Corrosion: The gradual eating up of metals by the action of air and moisture on their surface is called corrosion.
The most common example of corrosion is rusting of iron.

$4Fe + 3O_2 + 2nH_2O \rightarrow 2Fe_2O_3.nH_2O$
Steps to prevent rusting of iron:

(i) Coating the iron surface with oil, grease or paint
(ii) Depositing a layer of zinc on the surface of iron. This process is called Galvanisation.
(iii) Forming alloys of iron

Rancidity: When fats and oils are exposed to air, they get oxidized and become rancid and their smell and colour change. This phenomenon is called rancidity
Steps to prevent rancidity:
(i) Storing food materials in air-tight containers
(ii) Packaging food items in bags containing nitrogen
(iii) Refrigeration of food items
(iv) Addition of antioxidants or preservatives to the foods containing fats and oils

Questions for self-assessment:

1. Why should a magnesium ribbon be cleaned before burning in air?

2. What happens when a piece of silver metal is added to copper sulphate solution?

3. Write a balanced chemical equation for the following:

(i) when 1 mL of dil. Hydrochloric acid is added to 1g of Sodium metal.

(ii) when a solution of potassium chloride is mixed with sodium chloride.

(iii) A piece of sodium metal is added to absolute ethanol to form sodium ethoxide and hydrogen gas.