Types of Chemical Reactions

In this chapter, we will study about the various types of chemical reactions and their symbolic representation.

1.2.1 Combination Reaction

A combination reaction is a chemical reaction in which two or more substances (elements or compounds) combine to form a single product.

Examples of combination reactions:

- Burning of magnesium in air to form magnesium oxide:

  $2Mg(s) + O2(g) \rightarrow 2MgO(s)$

- Burning of hydrogen in air to form water:

  $2H2(g) + O2(g) \rightarrow 2H2O(l)$

- Formation of carbon dioxide from carbon and oxygen:

  $C(s) + O2(g) \rightarrow CO2(g)$

Characteristics of combination reactions:

- Combination reactions are always exothermic, meaning that they release heat.
- The products of a combination reaction are always more complex than the reactants.
- Combination reactions are often used to synthesize new compounds.

1.2.2 Decomposition Reaction

A decomposition reaction is a chemical reaction in which a single compound breaks down into two or more simpler substances.

Examples of decomposition reactions:

- Decomposition of water into hydrogen and oxygen:

  $2H2O(l) \rightarrow 2H2(g) + O2(g)$

- Decomposition of limestone into calcium oxide and carbon dioxide:

  $CaCO3(s) \rightarrow CaO(s) + CO2(g)$

- Decomposition of ammonia into nitrogen and hydrogen:

  $2NH3(g) \rightarrow 3H2(g) + N2(g)$

Characteristics of decomposition reactions:

- Decomposition reactions are always endothermic, meaning that they absorb heat.
- The products of a decomposition reaction are always simpler than the reactants.
- Decomposition reactions are often used to extract metals from their ores.

1.2.3 Single-Replacement Reaction

A single-replacement reaction is a chemical reaction in which one element replaces another element in a compound.

Examples of single-replacement reactions:

- Reaction of iron with copper sulfate to form iron sulfate and copper:

  $Fe(s) + CuSO4(aq) \rightarrow FeSO4(aq) + Cu(s)$

- Reaction of zinc with hydrochloric acid to form zinc chloride and hydrogen:

  $Zn(s) + 2HCl(aq) \rightarrow ZnCl2(aq) + H2(g)$

- Reaction of sodium with water to form sodium hydroxide and hydrogen:

  $2Na(s) + 2H2O(l) \rightarrow 2NaOH(aq) + H2(g)$

Characteristics of single-replacement reactions:

- Single-replacement reactions can be either exothermic or endothermic.
- The products of a single-replacement reaction are always different from the reactants.
- Single-replacement reactions are often used to extract metals from their ores.

1.2.4 Double-Replacement Reaction

A double-replacement reaction is a chemical reaction in which two compounds exchange ions to form two new compounds.

Examples of double-replacement reactions:

- Reaction of sodium chloride and silver nitrate to form sodium nitrate and silver chloride:

  $NaCl(aq) + AgNO3(aq) \rightarrow NaNO3(aq) + AgCl(s)$

- Reaction of barium chloride and sodium sulfate to form barium sulfate and sodium chloride:

  $BaCl2(aq) + Na2SO4(aq) \rightarrow BaSO4(s) + 2NaCl(aq)$

- Reaction of copper sulfate and sodium hydroxide to form copper hydroxide and sodium sulfate:

  $CuSO4(aq) + 2NaOH(aq) \rightarrow Cu(OH)2(s) + Na2SO4(aq)$

Characteristics of double-replacement reactions:

- Double-replacement reactions can be either exothermic or endothermic.
- The products of a double-replacement reaction are always different from the reactants.
- Double-replacement reactions are often used to precipitate solids from solution.