TYPES OF REACTIONS

Chemical reactions are changes in which some new substances are formed. The substance which undergo the chemical change are known as *reactants*, while the new substances formed are called *products*. Chemical reactions can be grouped in the following way: combination, decomposition, displacement, double decomposition, catalytic reaction, reversible reactions and thermal dissociation.

Combination. When two or more substance combine to form one single compound, a combination reaction is said to have taken place. Combinations can occur in any one of the following ways:

- element + element $\longrightarrow$ compound
- compound + compound $\longrightarrow$ bigger compound

Many organic compounds undergo combination reactions. The polymerization of ethyne, for example, is a spcial type of combination reaction.

Decomposition. Decomposition reactions are characterized by a single compound splitting up into two or more simpler substances. When heat is needed to bring about decomposition, the reaction is known as *thermal decomposition*.

Displacement. In displacement, one element (or radical) replaces another element (or radical) in a compound, i.e.

$$A + BY \longrightarrow B + AY$$

The ability of an element (or radical) to displace another is determined by their relative positions in the electrochemical series. Thus, the more electropositive zinc will displace the less electropositive copper from an aqueous solution of a copper (II) salt.

$$Zn_{(s)} + CuSO_{4\,(aq)} \longrightarrow ZnSO_{4\,(aq)} + Cu_{(s)}$$

Chlorine which is a more electronegative non-metal will displace bromine which is less electronegative from a solution of a bromide.

$$Cl_{2\,(g)} + 2KBr_{\,(aq)} \longrightarrow 2KCl_{\,(aq)} + Br_{2\,(l)}$$

Double Decomposition. In double decomposition, the reactants decompose to form new substance by an exchange of radicals.

$$AB + CD \longrightarrow AD + CB$$

The two reactants are soluble, and one of the products is soluble while the other is insoluble, volatile or gaseous, e.g.

$$AgNO_{3\,(aq)} + NaCl_{(aq)} \longrightarrow \underset{\text{precipitate}}{AgCl_{(s)}} + NaNO_{3\,(aq)}$$

$$KNO_{3\,(aq)} + H_2SO_{4(aq)} \longrightarrow \underset{\text{volatile}}{HNO_{3(g)}} + KHSO_{4\,(aq)}$$

Catalytic Reaction. Certain substances are used to alter the rates of chemical reactions. These substances, which remain chemically and quantitatively unchanged at the end of the reactions, are known as catalysts. The acceleration or retardation of reactions by catalysts is known as *catalysis*. Any type of chemical reaction which uses a catalyst is a catalytic reaction. There are two

types of catalyzed reactions: homogenous catalysis and heterogenous catalysis.

Reversible Reactions. Many reactions can only proceed in one direction. There are other reactions, however, in which the direction of chemical change can be reversed. Depending on the reaction conditions, the products formed may react to form the original reactants. Such reactions are known as reversible reactions. To represent the reversibility of a reaction in an equation, the symbol $\rightleftharpoons$ is used. For example:

$$A + B \rightleftharpoons C + D$$

Thermal Dissociation. In thermal dissociation, each molecule of a substance dissociates into two or more simpler molecules or atoms on the application of heat. Unlike thermal decomposition, thermal dissociation is reversible.

Example at high temperatures, ammonium chloride dissociates into ammonia and hydrogen

chloride. When these products are cooled together, ammonium chloride is formed again.

$$NH_4Cl_{(s)} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} NH_{3\,(g)} + HCl_{(g)}$$