CHEMICAL REACTIONS

Introduction

The chemical reaction is the process in which atoms or molecules interact with each other, resulting in the formation of a new molecule. The bonds between the atoms are broken and new bonds are formed with form new molecules. These chemical reactions can happen with anything, as long as a chemical change is taking place. This reaction could be between atoms, ions, compounds or molecules of a single element.

Physical Effects and Types of Chemical Reactions – Detail Study

The biggest question arises is how you would know whether chemical reactions is actually occurring or not. Simple answer – Different physical effects are observed whenever a chemical reaction takes place. These physical effects include:

- Emission of light –Different combinations of molecules results in emission of light. The light is produced due to chemical reaction.
- Color Change – When a color change is observed in a chemical reaction, it indicates a change in the molecules.

- Heat Production – In all chemical reactions, the heat content of the reactants and the products is never the same. Sometimes, there is a great difference which can be easily detected. Sometimes, the difference is slight, which is difficult to detect.
- Gas Production – In some chemical reactions, a gaseous product is formed which can be detected through bubbles. A colorless gas produced in a chemical reaction of solids is harder to detect.
- Formation of Precipitate – Precipitates are insoluble products that are produced in a chemical reaction taking place in a liquid solution. Precipitates ultimately settle to the bottom and appear immediately by turning the clear solution cloudy.

Absolute confirmation of a chemical change can only be confirmed through the proper chemical analysis of the products.

Reactions mainly comprise of a sequence of individual sub-steps, these are called elementary reactions; and the information on the exact procedure is the component of reaction mechanism. Chemical reactions are denoted with chemical equations, which symbolically represent the starting and the end products. It sometimes includes intermediate products along with reaction conditions.

Chemical reacts take place at a particular temperature and chemical concentration. With the increase in temperature, the reaction rate increases as there is more thermal energy available to reach the activation energy required for breaking the bonds between the atoms.

Types of reactions

There are different types of chemical reactions. These have been classified into general categories. These include:

Synthesis Reaction

Synthesis reaction, also known as combination reaction, takes place when two or more substances combine to form a new compound. The general representation of this type of reaction is:

$$A + B \quad AB$$

Here, A and B represent the reacting atoms or compounds while AB represents a compound formed after chemical reaction, also known as product. Given below is the list of examples of synthesis reactions:

$$S + O_2 \quad SO_2$$

sulphur oxygen sulphur dioxide

$$2S + 3O_2 \quad 2SO_3$$

sulphur oxygen sulphur trioxide

$$2Fe + O_2 \quad 2FeO$$

iron oxygen iron (II) oxide

Single Replacement Reaction

Single replacement reaction, also known as displacement reaction, takes place when one element replaces a similar element in the compound. This type of chemical reaction can be represented as follows:

$$AB + C \quad AC + B$$

Here, AB represents one reacting compound and C is the other reacting atom or compound while AC and B represent the products formed after displacement chemical reaction. Given below is the list of examples of synthesis reactions:

$$\underset{\text{zinc}}{Zn} + \underset{\text{hydrochloric acid}}{2\,HCl} \qquad \underset{\text{hydrogen}}{H_2} + \underset{\text{zinc chloride}}{ZnCl_2}$$

$$\underset{\text{copper}}{Cu} + \underset{\text{silver nitrate}}{2\,AgNO_3} \qquad \underset{\text{silver}}{2\,Ag} + \underset{\text{copper (II) nitrate}}{Cu(NO_3)_2}$$

$$\underset{\text{hydrogen}}{H_2} + \underset{\text{silver nitrate}}{2\,AgNO_3} \qquad \underset{\text{silver}}{2\,Ag} + \underset{\text{nitric acid}}{2\,HNO_3}$$

$$\underset{\text{sodium}}{2\,Na} + \underset{\text{water}}{2\,H_2O} \qquad \underset{\text{sodium hydroxide}}{2\,NaOH} + \underset{\text{hydrogen}}{H_2}$$

Double Replacement Reaction

In a double replacement reaction, the ions or atoms of two different compounds exchange their places in the aqueous solution to form two new compounds. This type of chemical reaction can be represented as follows:

$$AB + CD \qquad AC + BD$$

Here, AB represents one reacting compound and CD is the other reacting compound while AC and BC represent the products formed after double displacement chemical reaction. Given below is the list of examples of synthesis reactions:

$$\underset{\text{hydrochloric acid}}{HCl} + \underset{\text{sodium hydroxide}}{NaOH} \qquad \underset{\text{sodium chloride}}{NaCl} + \underset{\text{water}}{HOH}$$

$$BaCl_2 + 2\,AgNO_3 \qquad 2\,AgCl + Ba(NO_3)_2$$

barium chloride	silver nitrate	silver chloride	barium nitrate (precipitate)

$$CaCO_3 + 2\,HCl \qquad CaCl_2 + H_2CO_3$$

calcium carbonate	hydrochloric acid	calcium chloride	carbonic acid

Decomposition Reaction

In decomposition reaction, a single compound goes through the chemical reaction that produces two or more simple compounds or elements. This type of chemical reaction can be represented as follows:

$$AB \qquad A + B$$

Here, AB represents reacting compound while A and B represent the products formed after decomposition of AB. Given below is the list of examples of synthesis reactions:

$$CaCO_3 \qquad CaO + CO_2$$

calcium carbonate	calcium oxide	carbon dioxide

$$2\,H_2O \qquad 2\,H_2 + O_2$$

water	hydrogen	oxygen

$$2\,KClO_3 \qquad 2\,KCl + 3\,O_2$$

potassium chlorate	potassium chloride	oxygen

Combustion Reaction

In a combustion reaction, an element or a compound combines with oxygen and releases a great amount of energy in the form of heat and light. This type of chemical reaction can be represented as follows:

$$A + O_2 \qquad AO_2$$

Here, A represents the reacting element and O_2 represents the oxygen while AO_2 represents a compound formed after chemical reaction, also known as oxidation product. Given below is the list of examples of synthesis reactions:

C + O2 → CO2

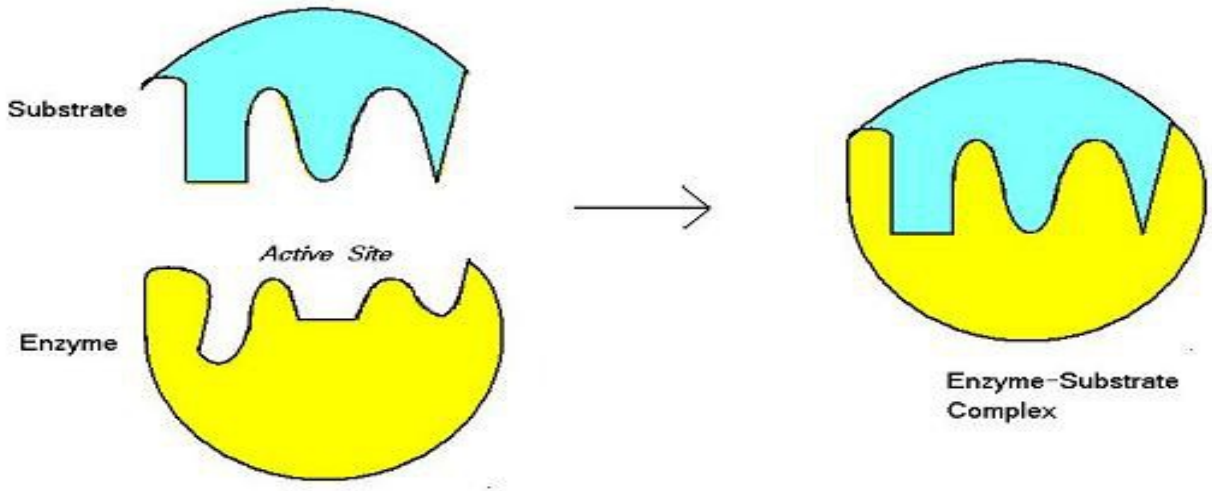
Carbon Oxygen Carbon dioxide

CH_4 + 2 O2 → CO_2 + 2 H_2O

Methane Oxygen Carbon dioxide Water

Biochemical Reactions

These are the reactions that are controlled by enzymes. These enzymes are generally proteins that catalyze a single reaction in order to control the reactions in a precise manner. The enzyme has an active site where the reaction takes place. This site is like a cleft or a pocket lined by amino acid residues. The catalytic action of enzymes depends on several mechanisms like the bond strain, induced fit, proximity and orientation of molecules, acid/base catalysis and many others.



Applications

Chemical reactions are commonly used in chemical engineering industries as these companies use different chemical reactions for the synthesis of new compounds derived from natural raw material. The finest example is mineral ores and petroleum. Thermite reaction is used to generate heat and light in welding and pyrotechnics.

Photosynthesis in plants is a natural chemical reaction which involves carbon dioxide, water and light to produce oxygen and food for plants. Beer, yogurt, cheese, wine and bread are produced from the aerobic respiration which also involves set of chemical reactions. So, it can be said that we are surrounded in the environment where natural chemical reactions are taking place continuously.