

1. Chemical Reactions and Equations

Learning Points:

- Chemical reaction
- Chemical equation
- Balancing chemical equation
- Types of chemical reaction
 - Combination Reaction
 - Decomposition Reaction
 - Displacement Reaction
 - Oxidation and Reduction Reaction
- The effects of oxidation and reduction in everyday life
 - Corrosion
 - Rancidity

Learning Objective:

1. Express chemical reaction through a chemical equation.
2. Apply Law of Conservation of Mass in order to balance chemical equations
3. Classify chemical reactions into different types.

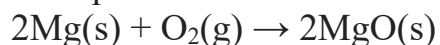
Chemical Reaction:

The transformation of chemical substance into another chemical substance is known as Chemical Reaction. For example: Rusting of iron, the setting of milk into curd, digestion of food, respiration, etc.

In a chemical reaction, a new substance is formed which is completely different in properties from the original substance, so in a chemical reaction, a chemical change takes place.

- The substances which take part in a chemical reaction are called reactants.
- The new substances produced as a result of a chemical reaction are called products.

Example: The burning of magnesium in the air to form magnesium oxide is an example of a chemical reaction.



Characteristics of Chemical Reactions :

These are the following changes to determine that the chemical reaction has taken place:

- (i) Change in state
- (ii) Change in colour
- (iii) Evolution of gas
- (iv) Change in temperature

Chemical Equation

→ A chemical equation is the symbolic representation of a chemical reaction in the form of symbols and formulae, wherein the reactant entities are given on the left-hand side and the product entities on the right-hand side.



Balanced Chemical Equation:

A balanced chemical equation has the number of atoms of each element equal on both sides.

Example: $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$

In this equation, numbers of zinc, hydrogen and sulphate are equal on both sides, so it is a Balanced Chemical Equation.

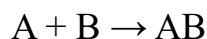
- Gaseous state is represented by symbol (g).
- Liquid state is represented by symbol (l).
- Solid state is written by symbol (s).
- Aqueous solution is written by symbol (aq).

Types of Chemical Reactions:

Chemical reactions can be classified in following types:

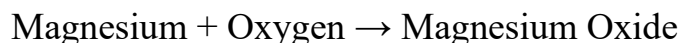
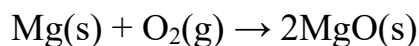
(i) Combination Reaction: Reactions in which two or more reactants combine to form one product are called Combination Reactions.

A general combination reaction can be represented by the chemical equation given here:

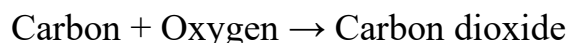
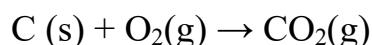


Examples:

When magnesium is burnt in the air (oxygen), magnesium oxide is formed. In this reaction, magnesium is combined with oxygen.

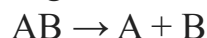


When carbon is burnt in oxygen (air), carbon dioxide is formed. In this reaction, carbon is combined with oxygen.



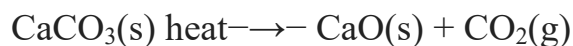
(ii) Decomposition Reaction: Reactions in which one compound decomposes in two or more compounds or elements are known as Decomposition Reaction. A decomposition reaction is just the opposite of combination reaction.

A general decomposition reaction can be represented as follows :



Examples:

When calcium carbonate is heated, it decomposes into calcium oxide and carbon dioxide.



Calcium carbonate \rightarrow Calcium oxide + Carbon dioxide

Thermal Decomposition: The decomposition of a substance on heating is known as Thermal Decomposition.

Example:

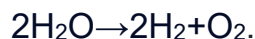
i) Decomposition of Ferrous Sulphate



ii) Decomposition of Lead Nitrate



Electrolytic Decomposition: Reactions in which compounds decompose into simpler compounds because of passing of electricity, are known as Electrolytic Decomposition. This is also known as Electrolysis.



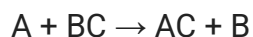
Photolysis or Photo Decomposition Reaction: Reactions in which a compound decomposes because of sunlight are known as Photolysis or Photo Decomposition Reaction.

Example: When silver chloride is put in sunlight, it decomposes into silver metal and chlorine gas.



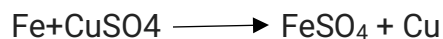
(iii) Displacement Reaction: The chemical reactions in which a more reactive element displaces a less reactive element from a compound is known as Displacement Reactions. Displacement reactions are also known as Substitution Reaction or Single Displacement/ replacement reactions.

A general displacement reaction can be represented by using a chemical equation as follows :

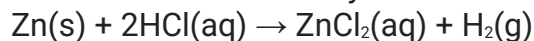


Displacement reaction takes place only when 'A' is more reactive than B. If 'B' is more reactive than 'A', then 'A' will not displace 'C' from 'BC' and reaction will not be taking place.

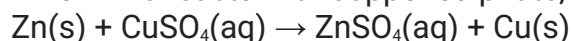
Examples: When Iron reacts with copper sulphate solution, Copper is displaced by iron.



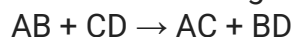
When zinc reacts with hydrochloric acid, it gives hydrogen gas and zinc chloride.



When zinc reacts with copper sulphate, it forms zinc sulphate and copper metal.



iv) Double Displacement Reaction: Reactions in which ions are exchanged between two reactants forming new compounds are called Double Displacement Reactions.

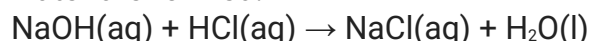


Examples:

When the solution of barium chloride reacts with the solution of sodium sulphate, white precipitate of barium sulphate is formed along with sodium chloride.



When sodium hydroxide (a base) reacts with hydrochloric acid, sodium chloride and water are formed.



Note: Double Displacement Reaction, in which precipitate is formed, is also known as precipitation reaction. Neutralisation reactions are also examples of double displacement reaction.

(v) Oxidation and Reduction Reactions:

Oxidation: Addition of oxygen or non-metallic element or removal of hydrogen or metallic element from a compound is known as Oxidation.

Reduction: Addition of hydrogen or metallic element or removal of oxygen or non-metallic element from a compound is called Reduction.

Oxidizing Agent

It is the substance which gives oxygen or gains hydrogen.

Or it the substance which is reduced itself and oxidizes other.

Reducing Agent

It is the substance which gives hydrogen or gains oxygen.

Or it the substance which is oxidized itself and reduces other.

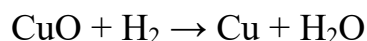
The reaction in which oxidation and reduction both take place simultaneously is called Redox reaction.

When oxygen is added to copper and copper oxide is formed.



CuO is black in colour and Copper colour is brown.

When copper oxide is heated with hydrogen, then copper metal and hydrogen are formed.



In this reaction, CuO is changing into Cu. Oxygen is being removed from copper oxide. Removal of oxygen from a substance is called Reduction, so copper oxide is being reduced to copper.

Exothermic and Endothermic Reactions:

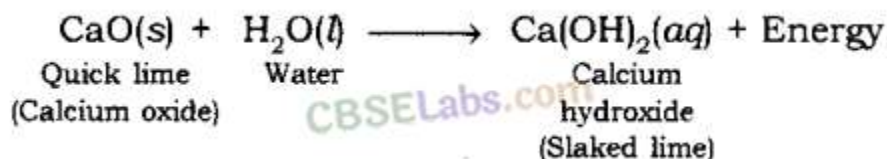
Exothermic Reaction: Reaction which produces energy is called Exothermic Reaction. Most of the decomposition reactions are exothermic.

Example:

Respiration is a decomposition reaction in which energy is released.



When quick lime (CaO) is added to water, it releases energy.



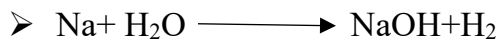
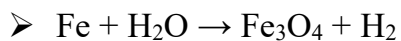
Endothermic Reaction: A chemical reaction in which heat energy is absorbed is called Endothermic Reaction.

Example: Decomposition of calcium carbonate.



Class Assignment

1. Balance the Following Reactions



2. Write the balanced chemical equation for photodecomposition of Silver bromide.
3. Complete the Following Reaction
 $\text{Pb (s)} + \text{CuCl}_2 \text{ (aq)} \rightarrow \text{PbCl}_2 \text{ (aq)} + \text{Cu (s)}$

Home Assignment

1. Balance the following chemical equations.
(a) $\text{HNO}_3 + \text{Ca(OH)}_2 \rightarrow \text{Ca(NO}_3)_2 + \text{H}_2\text{O}$
(b) $\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$
(c) $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$
(d) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{HCl}$
2. Write the reactivity Series of metals.
3. Why is respiration considered an exothermic reaction? Explain.