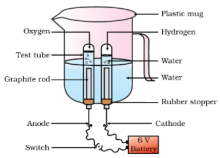



# Chapter - 1 Chemical Reactions And Equations

The process in which new substances with new properties are formed from one or more substances is called **Chemical Reaction.**

* The substances which take part in chemical reaction are called **Reactants.**
* The substances which are formed in a chemical reaction are called **Products.**

*Examples :*

(i) Digestion of food

(ii) Respiration

(iii) Rusting of iron

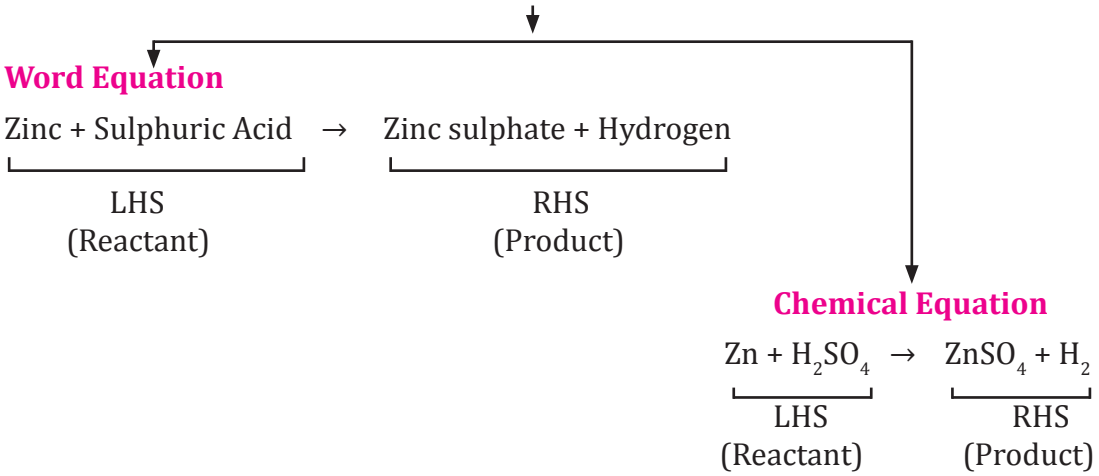
(iv) Burning of Magnesium ribbon

(v) Formation of curd

**Chemical reaction involves :**

- Change in state
- Change in colour
- Change in temperature
- Evolution of gas

## Ways of Representing a Chemical Reaction




### Chemical Equation

* A chemical reaction can be represented by chemical equation. It involves uses of symbol of elements or chemical formula of reactant and product with mention of physical state.
* The necessary conditions such as temperature, pressure or any catalyst should be written on arrow between reactant and products.

  *e.g.,* Magnesium is burnt in air to form magnesium oxide.

$$Mg + O_2 \rightarrow MgO$$

### Balancing Chemical Equation

* Law of conservation of Mass. Matter can neither be created nor destroyed in a chemical reaction.
* So number of elements involved in chemical reaction should remain same at reactant and product side.

### STEPWISE BALANCING (Hit and Trial)

**Step 1.** Write a chemical equation and draw boxes around each formula.

$$Fe + H_2O \rightarrow Fe_3O_4 + H_2$$

* Do not change anything inside the box.

**Step 2.** Count the number of atoms of each element on both the sides of chemical equation.

| | Element | No. of atoms at reactant side | No. of atoms at product side |
|---|---|---|---|
| 1. | Fe | 1 | 3 |
| 2. | H | 2 | 2 |
| 3. | O | 1 | 4 |

**Step 3.** Equalise the number of atoms of element which has maximum number by putting in front of it.

$$Fe + 4H_2O \rightarrow Fe_3O_4 + H_2$$

**Step 4.** Try to equalize all the atoms of elements on reactant and product side by adding coefficient in front of it.

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$

* Now all the atoms of elements are equal on both sides.

**Step 5.** Write the physical states of reactants and products.

$$3Fe\ (s) + 4H_2O\ (g) \rightarrow Fe_3O_4\ (s) + 4H_2\ (g)$$

Solid state = (s)

Liquid state = (*l*)

Gaseous state = (g)

Aqueous state = (aq)

**Step 6.** Write necessary conditions of temperature, pressure or catalyst on arrow above or below.

## TYPES OF CHEMICAL REACTIONS

**I. COMBINATION REACTION :** The reaction in which two or more reactant combine to form a single product.

*e.g.* (i) Burning of coal

$C\ (s) + O_2\ (g) \rightarrow CO_2\ (g)$

(ii) Formation of water

$2H_2\ (g) + O_2\ (g) \rightarrow 2H_2O\ (l)$

(iii) $CaO\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (aq)$

Quick lime Slaked lime

**Exothermic Reactions :** Reaction in which heat is released along with formation of products.

*e.g.,* (i) Burning of natural gas

$CH_4\ (g) + O_2\ (g) \rightarrow CO_2\ (g) + 2H_2O\ (g) + \text{Heat}$

(ii) Respiration is also an exothermic reaction.

$C_6H_{12}O_6\ (aq) + 6O_2\ (g) \rightarrow 6CO_2\ (aq) + 6H_2O\ (l) + \text{energy}$

**II. DECOMPOSITION REACTION :** The reaction in which a compound splits into two or more simple substances is called decomposition reaction.

$$A \rightarrow B + C$$

- **Thermal decomposition :** When decomposition is carried out by heating.

*e.g.,* (i) $2FeSO_4\ (s) \xrightarrow{Heat} Fe_2O_3\ (s) + SO_2\ (g) + SO_3\ (g)$

(Ferrous sulphate) (Ferric oxide)

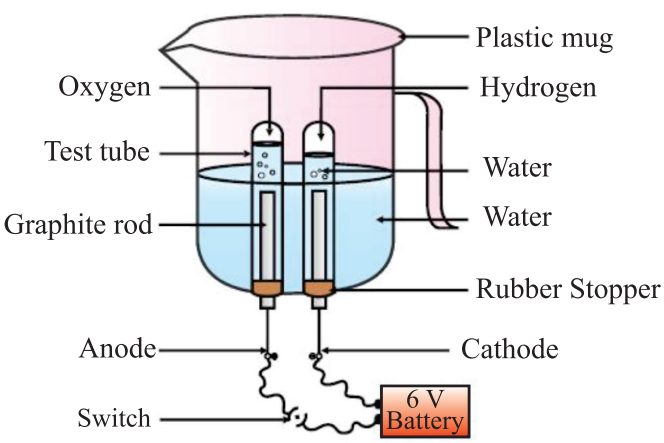
Green colour Red-brown colour

(ii) $CaCO_3\ (s) \xrightarrow{Heat} CaO\ (s) + CO_2\ (g)$

(Lime stone) (Quick lime)

- **Electrolytic Decomposition :** When decomposition is carried out by passing electricity.

*e.g.,* $2H_2O \xrightarrow[current]{Electric} 2H_2 + O_2$




- **Photolytic Decomposition :** When decomposition is carried out in presence of sunlight.

*e.g.,* $2AgCl\ (s) \xrightarrow{Sunlight} 2Ag\ (s) + Cl_2\ (g)$

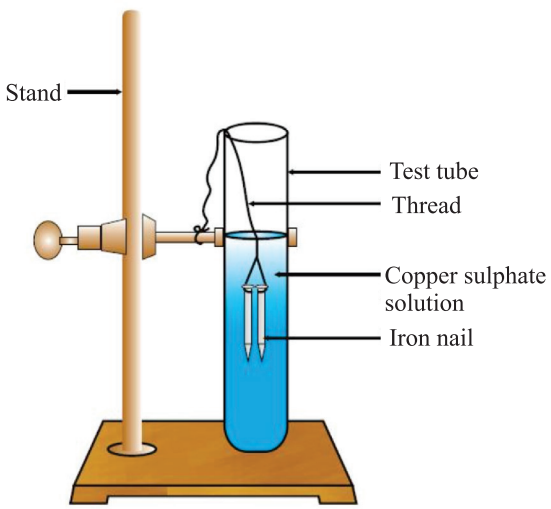
$2AgBr\ (s) \xrightarrow{Sunlight} 2Ag\ (s) + Br_2\ (g)$

* Above reaction is used in black & white photography.

- **Endothermic Reactions :** The reactions which require energy in the form of heat, light or electricity to break reactants are called endothermic reactions.

**III. DISPLACEMENT REACTION :** The chemical reaction in which more reactive element displaces less reactive element from its salt solution.

$$Fe\ (s) + CuSO_4\ (aq) \rightarrow FeSO_4\ (aq) + Cu\ (s)$$




The iron nail becomes brownish in colour by deposition of Cu and blue colour of $CuSO_4$ changes dirty green colour due to formation of $FeSO_4$.

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

Zn is more reactive than copper.

**IV. DOUBLE DISPLACEMENT REACTION :** A reaction in which new compounds are formed by mutual exchange of ions between two compounds.

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

| (Sodium sulphate) | (Barium chloride) | (Barium sulphate) | (Sodium chloride) |
|---|---|---|---|

White precipitate of $BaSO_4$ is formed, so it is also called precipitation reaction.

## V. OXIDATION AND REDUCTION :

**Oxidation :** (i) The addition of oxygen to substance.

(ii) The removal of hydrogen from a substance.

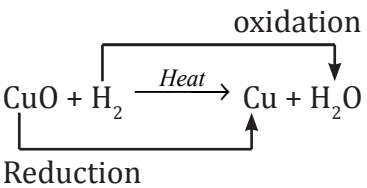
$$C + O_2 \rightarrow CO_2$$

$$2Cu + O_2 \xrightarrow{Heat} 2CuO$$

$$CuO + H_2 \xrightarrow{Heat} Cu + H_2O$$

**Reduction :** (i) The addition of hydrogen to substance.

(ii) The removal of oxygen from a substance.




In this reaction CuO is reduced to Cu and $H_2$ is oxidized to $H_2O$. So, oxidation and reduction taking place together is redox reaction.

### Effects of Oxidation in Daily Life

**1) Corrosion**

- When a metal is exposed to substances such as moisture, acid etc. for some time, a layer of hydrated oxide is formed which weakens the metal and hence metal is said to be corrode
- Rusting of iron, black coating on silver and green coating on copper are examples of corrosion.
- Corrosion can be prevented by galvanization, electroplating or painting.

**2) Rancidity :** The oxidation of fats and oils when exposed to air is known as rancidity. It leads to bad smell and bad taste of food.

**Methods to Prevent Rancidity**

(i) By adding antioxidants

(ii) Keeping food in air tight containers

(iii) Replacing air by nitrogen

(iv) Refrigeration

## QUESTIONS

### VERY SHORT QUESTIONS (1 Mark)

1. What changes do you observe in the iron nails and colour of copper sulphate solution, if iron nails are dipped in $CuSO_4$ solution for 15 minutes ?
2. Identify the chemical change :

   Melting of ice or conversion of milk into curd.
3. Why is respiration considered an exothermic reaction ?
4. Why do copper vessel lose shine when exposed to air ?
5. Potato chips manufacturers fill the packet of chips with nitrogen gas. Why ?
6. Why we store silver chloride in dark coloured bottles ?
7. Write a chemical equation of double displacement reaction.
8. $N_2 + 3H_2 \rightarrow 2NH_3$, name the type of reaction.
9. What happens when milk is left open at room temperature during summers ?
10. What happens when quick lime is added to water ?

### SHORT TYPE QUESTIONS (2 Marks)

1. Define combination reaction. Give one example of combination reaction which is exothermic in nature.
2. What is decomposition reaction ? Explain with the help of an example.
3. Name and state the law which is kept in mind when we balance a chemical equation.
4. Give one example of each :

   (a) Chemical reaction showing evolution of gas.

   (b) Change in substance's colour during a chemical reaction.
5. What is rancidity ? Write two ways by which it can be prevented.
6. What are two conditions which promotes corrosion ?
7. A small amount of ferrous sulphate is heated in hard glass tube.

   (a) Write the chemical equation.

   (b) What type of reaction is taking place.

8. What happens when Zn strip is dipped in $CuSO_4$ solution ?

**SHORT TYPE QUESTIONS (3 Marks)**

1. What is redox reaction ? Write down a chemical reaction representing it.
2. In electrolysis of water :
   (a) Name the gas collected at cathode and anode.
   (b) Why is volume of one gas collected at one electrode is double of another ?
   (c) Why are few drops of dil. $H_2SO_4$ added to water ?
3. In the reaction

   $CuO\ (s) + H_2\ (g) \rightarrow Cu(s) + H_2O\ (g)$

   (a) Name the oxidized substance.
   (b) Name the reduced substance.
   (c) Name the oxidizing agent.
4. Give reasons :
   (a) White silver chloride turns grey in sunlight.
   (b) Brown coloured copper powder on heating in air turns into black coloured substance.
5. Compound 'X' decomposes to form compound 'Y' and $CO_2$ gas. Compound Y is used in manufacturing of cement.
   (a) Name the compounds 'X' and 'Y'.
   (b) Write the chemical equation for this reaction.
6. A metal salt MX when exposed to light splits upto to form metal M and gas $X_2$. Metal M is used to make ornaments whereas gas $X_2$ is used in making bleaching powder. The salt MX is used in black & white photography.
   (a) Identify the metal M and gas $X_2$.
   (b) Identify MX.
   (c) Write down the chemical reaction when salt MX is exposed to sunlight.
7. A metal strip X is dipped in blue coloured salt solution $YSO_4$. After some time a layer of metal 'Y' is formed on metal strip X. Metal X is used in galvanization whereas metal Y is used for making electric wires.

(a) What could be metal 'X' and 'Y' ?

(b) Name the metal salt $YSO_4$.

(c) What type of chemical reaction takes place between X and $YSO_4$ ? Write the balanced chemical equation.

## LONG TYPE QUESTIONS (5 Marks)

1. White wash was being done at Mukesh's house. Mukesh saw that the painter added quick lime to drum having water. Mukesh touched outer surface of drum, it is unbelievably hot.

   (a) Write the chemical equation for above reaction.

   (b) What type of reaction is it ?

   (c) What is utility of this reaction ?

2. What types of reactions are represented by following :

   (a) $CaCO_3 \rightarrow CaO + CO_2$

   (b) $2Ca + O_2 \rightarrow 2CaO$

   (c) $Pb + CuCl_2 \rightarrow PbCl_2 + Cu$

   (d) $2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$

   (e) $Na_2SO_4 + BaCl_2 \rightarrow BaCl_2 + 2NaCl$

3. Balance the following equations :

   (a) $H_2 + O_2 \rightarrow H_2O$

   (b) $MnO_2 + HCl \rightarrow MnCl_2 + H_2O + Cl_2$

   (c) $Pb(NO_3) \rightarrow PbO + NO_2 + O_2$

   (d) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

   (e) $Ca(OH)_2 + HNO_3 \rightarrow Ca(NO_3)_2 + H_2O$

4. Write down the balanced chemical equation for the following :

   (a) Silver chloride is decomposed in presence of sunlight to give silver and chlorine gas.

   (b) Calcium oxide reacts with water to give lime water.

   (c) Sodium hydroxide reacts with hydrochloric acid to give sodium chloride and water.

(d) Die hydrochloric acid is added to copper oxide to give green coloured copper chloride and water.

(e) Solution of barium chloride and sodium sulphate in water reacts to give insoluble barium sulphate and solution of sodium chloride.

## Hints to Long Answer Type Questions

2. (a) Decomposition reaction

   (b) Combination reaction

   (c) Displacement reaction

   (d) Decomposition reaction

   (e) Double displacement reaction

3. (a) $2H_2 + O_2 \rightarrow 2H_2O$

   (b) $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

   (c) $2Pb(NO_3) \rightarrow 2PbO + NO_2 + O_2$

   (d) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

   (e) $Ca(OH)_2 + 2HNO_3 \rightarrow Ca(NO_3)_2 + 2H_2O$

4. (a) $2AgCl \xrightarrow{Sunlight} 2Ag + Cl_2$

   (b) $CaO + H_2O \rightarrow Ca(OH)_2$

   (c) $NaOH + HCl \rightarrow NaCl + H_2O$

   (d) $CuO + 2HCl\ (dil.) \rightarrow CuCl_2 + H_2O$

   (e) $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$