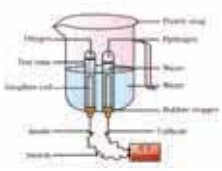
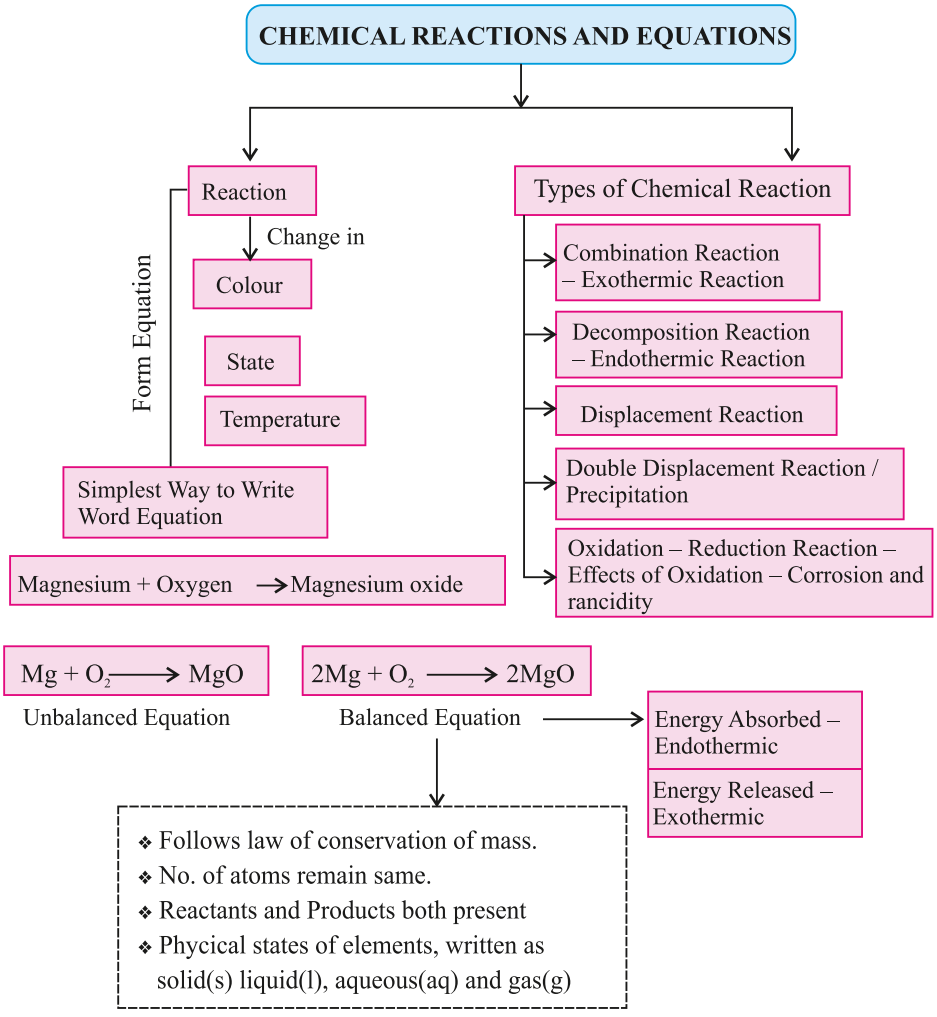


Chapter - 1 Chemical Reactions And Equations



Note: Skeletal equations are usually unbalanced equation but there are few which need not to be balanced as they are already balanced e.g.

Skeleton Equation	Balanced Equation
$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$	$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$
$Zn_{(s)} + H_2SO_{4(l)} \longrightarrow ZnSO_4 + H_{2(g)}$	$Zn_{(s)} + H_2SO_{4(l)} \longrightarrow ZnSO_4 + H_{2(g)}$
$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$	$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$
$NaCl_{(aq)} + AgNO_{3(aq)} \longrightarrow NaNO_{3(aq)} + AgCl_{(aq)}$	$NaCl_{(aq)} + AgNo_{3(aq)} \longrightarrow NaNo_{3(aq)} + AgCl_{(aq)}$

The process in which new substances with new properties are formed 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

Word Equation

Zinc + Sulphuric Acid → Zinc sulphate + Hydrogen

LHS (Reactant) | RHS (Product)

Chemical Equation

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

LHS (Reactant) | RHS (Product)

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.

$$2\,Mg + O_2 \rightarrow 2\,MgO$$

Balancing Chemical Equation

* Law of conservation of Mass : Matter can neither be created nor be destroyed in a chemical reaction.
* So number of atoms of the 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 them.

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

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

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

* 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 reactants combine to form a single product. A+B→C

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

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

(ii) Respiration is also an exothermic reaction.

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

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

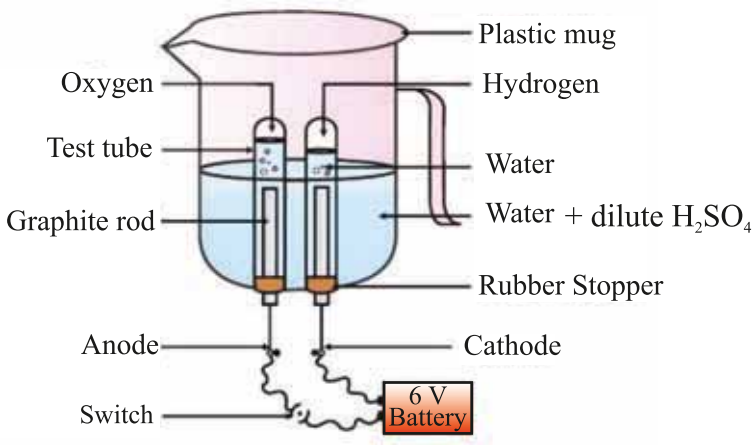
(Lime stone) (Quick lime)

(iii) $2Pb\ (NO_3)_2(s) \xrightarrow{Heat} 2PbO(s) + 4NO_2(g) + O_2$

(lead nitrate) (lead oxide) (Nitogen dioxide)

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

e.g., $2H_2O(l) \xrightarrow[\text{current}]{\text{Electric}} 2H_2(g) + O_2(g)$



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

The decomposition reactions are mostly endothermic in nature. Energy in the form of heat, light or electricity is generally absorbed in these reactions.

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

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

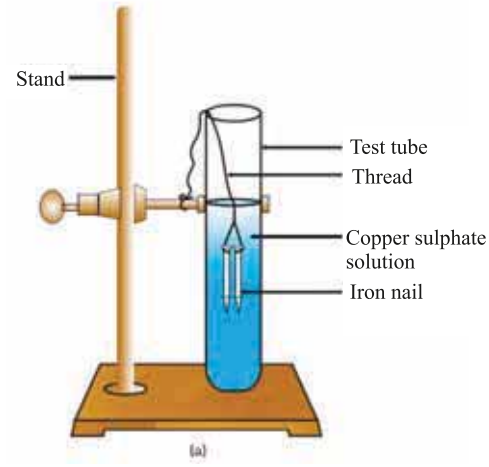
Silver chloride turns grey on exposure to sunlight

* Above reaction is used in black and 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.

(a) **$Fe\ (s) + CuSO_4\ (aq) \longrightarrow FeSO_4\ (aq) + Cu\ (s)$**



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

(b) **$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$**

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.

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

(Sodium sulphate)	(Barium chloride)	(Barium sulphate)	(Sodium chloride)

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

Note: All double displacement reactions are not precipitation reactions.

(ii) $2KI + Pb(NO_3)_2 \rightarrow +PbI_2 + 2KNO_3$

Potassium iodide — Lead nitrate — Lead iodide (Yellow ppt) — Potassium nitrate

(iii) $2KBr + BaI_2 \rightarrow 2KI + BaBr_2$

Potassium bromide — Barium iodide — Potassium iodide — Barium bromide

V. OXIDATION AND REDUCTION :

Oxidation : (i) The addition of oxygen to reactant.

(ii) The removal of hydrogen from a reactant.

$$C + O_2 \rightarrow CO_2$$

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

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

Reduction : (i) The addition of hydrogen to reactant.

(ii) The removal of oxygen from a reactant.

oxidation

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

Reduction

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 moisture, air, acid etc. for some time, a layer of hydrated oxide is formed which weakens the metal and hence metal is said to be corroded.
- Rusting of iron, black coating on silver and green coating on copper are examples of corrosion.
- Corrosion can be prevented by galvanization, electroplating or by **applying paints.**

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)

MULTIPLE CHOICE QUESTIONS

Q. 1 The shiny finish of wall after white wash is because of.

a) Calcium oxide b) Calcium hydroxide

c) Calcium Carbonate d) Calcium phosphate

Q. 2 Electrolysis of water is decomposition reaction. The mole ratio of hydrogen and oxygen gases liberated during electrolysis of water is

a) 1:1 b) 2:1 c) 4:1 d) 1:2

Q. 3 Which the following statements about the given reaction are correct:

$3Fe(s) + 4H_2O(g) \longrightarrow Fe_2O_3(s) + 4H_2(g)$

i) Iron metal is getting oxidized

ii) Water is getting reduced

iii) Water is acting as reducing agent

iv) Water is acting as oxidizine agent

a) (i), (ii) and (iii) b) (iii) and (iv)

c) (i), (ii) and (iv) d) (ii) and (iv)

Q. 4 In order to prevent the spoilage of potato chips, they are packed in plastic bags containing the gas

a) Cl_2 b) O_2 c) N_2 d) H_2

Q. 5 The process of respiration is -

a) an oxidation reaction which is endo thermic

b) a reduction reaction which is exothermic

c) a combination reaction which is endo thermic

d) an oxidation reaction which is exothermic