INTRODUCTION

Chemistry involves the study of a large number of elements and compounds. As it is not convenient to write the full names of the elements and compounds, the use of symbols has made the job very easy. Chemistry also involves the writing of many chemical reactions in the form of equations. The writing of chemical equations involves writing of reactants and products.

CHEMICAL REACTIONS

- Any chemical change in matter which involves its transformation into one or more new substances is called a chemical reaction.
- A chemical reaction also involves transfer of energy.
- A Chemical Reaction is a process to show a chemical change.
- A Chemical Reaction is represented by a chemical equation.
- For example, the reaction between magnesium and oxygen: -

  $2H_2 + O_2 \longrightarrow 2H_2O$

- In the above reaction, hydrogen and oxygen are the elements that undergo chemical change to form a new substances water, a compound which is completely different from hydrogen and oxygen.
- It has been observed that the total mass of the reactants is equal to the total mass of the products.
- This is possible when the total number of atoms of each kind remains same before and after the chemical reactions.
- This is supported by the "LAW OF CONSERVATION OF MATTER" which states

that "Matter can neither be created nor destroyed. It can only be transformed from one form to another

CONDITIONS NECESSARY FOR CHEMICAL REACTIONS

CLOSE CONTACT

- The reactants must be mixed for a chemical reaction to take place.
- For example, sodium reacts violently when in close contact to produce sodium hydroxide and hydrogen gas.
- Sodium + water----------→ Sodium hydroxide + hydrogen

SOLUTION FORM

- Some substances reacts only when they are in the form of solution.
- For example, when sodium chloride is added to silver nitrate in the aqueous form of in the solution form, they react to produce a white precipitate of silver nitrate
- Silver nitrate + Sodium chloride----------→ Silver chloride + Sodium nitrate

White ppt.

HEAT

- Some chemical reactions take place in the presence of heat.
- For example, Iron reacts with sulphur in the presence of heat to produce Iron Sulphide.
- Iron + Sulphur ----------→ Iron Sulphide

LIGHT

- Some Chemical Reaction takes place in the presence of light.
- For example, Photosynthesis.
- Carbon Dioxide + Water------Light/Chlorophyll----------→Glucose + Oxygen

CATALYST

- A Catalyst is a substance that changes the rate of chemical reactions without undergoing any change by itself.
- Some reactions need a catalyst to take place.
- For example, Potassium chloride can be decomposed in the presence of Manganese dioxide as a catalyst to produce potassium chloride and oxygen.
- Potassium Chloride------MnO_2----------→ Potassium Chloride + Oxygen

CHARACTERISTICS OF A CHEMICAL REACTION

CHANGE IN THE COLOUR

- Some Chemical Reactions are accompanied by change in colour.
- For Example, Rust which is brown in colour whereas iron is grey in colour.
- The colour of copper sulphate changes from blue to green when it is exposed to iron.
- The reaction between lead nitrate and potassium iodide changes the colour from colourless to yellow

EVOLUTION OF A GAS

- A Chemical Reaction often involves an evolution of a gas.
- For example, the reaction between Zinc and Hydrochloric acid results in the evolution of Hydrogen gas.

- $Zn + 2HCl \longrightarrow ZnCl_2 + H_2 (g)$
- When lead nitrate is heated in a hard glass test tube, results in the evolution of Nitrogen dioxide gas.
- $2Pb(NO_3)_2 \xrightarrow{Heat} 2PbO + 4NO_2 + O_2$
- The reaction between Zinc and Sulphuric acid result in the formation of Hydrogen gas
- $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2(g)$

FORMATION OF A PRECIPITATE

- ✔ A Chemical Reaction often involves the formation of a precipitate.
- ✔ A Precipitate is an insoluble solid that is obtained from the solution.
- ✔ For example, when lead nitrate is heated in a hard glass test tube, results in the production of potassium nitrate along with a yellow precipitate of Lead Iodide.
- ✔ $Pb(NO_3)_2 + 2KI \longrightarrow PbI_2 + 2KNO_3$

White ppt.

- ✔ For example, the reaction between Barium Chloride and sodium sulphate results in the formation of white ppt. of Barium Sulphate.
- ✔ $BaCl_2 + Na_2SO_4 \longrightarrow BaSO_4 + 2NaCl$

White ppt.

CHANGE OF STATE

- ☐ A chemical reaction often involves a change in the state of matter.
- ☐ For example, Solid wax (in the form of candle) burns to form water vapour and carbon dioxide which are gaseous.

- Petrol, which is a liquid, burns to form water vapour and carbon dioxide which are gaseous

CHANGE OF SMELL

- During some chemical reactions, sometime a strong smell is experienced.
- For example, when solid ammonium chloride is heated with sodium hydroxide, a gas ammonia is evolved which has a strong pungent smell.
- Ammonium chloride + Sodium hydroxide----------→ sodium Chloride + Water + ammonia

  (Pungent smell gas)
- The reaction between Iron and Hydrochloric acid in the dilute form, results in the production of hydrogen sulphide (H_2S) which has a rotten egg smell
- Iron + dil. Hydrochloric Acid----------→ Iron Chloride + Hydrogen sulphide

  (rotten egg smell)

HEAT IS RELEASED OR EVOLVED

- During many chemical reactions heat is evolved indicating the formation of products.
- For example, the reaction between Calcium Oxide and water produces heat.
- Calcium Oxide + Water----------→ Calcium Hydroxide + Heat
- For Example, the reaction between sodium hydroxide and dil. Hydrochloric acid produces heat along with sodium chloride and water.
- Sodium hydroxide + dil. Hydrochloric acid----------→ Sodium chloride + water + Heat

CHEMICAL EQUATIONS

- A Chemical equation is a symbolic representation of a chemical reaction using symbols and formulae of the reactants and the products formed in the reaction.
- The chemical reaction can be written both by word form or statement form or in the form of symbols.
- For example, Carbon + Oxygen----------→ Carbon dioxide (word form)
- $C + O_2$----------→ CO_2 (Symbolic form)

STEPS INVOLVED IN WRITING A CHEMICAL EQUATION

- Write the symbols or the formula of the reactants on the left side, with a (+) sign between them if they are two or more than two.
- Write the symbols or the formula of the products on the right-hand side, with a (+) sign between them if they are two or more than two.
- Put the sign of an arrow (→) in between the reactant side and the product side.
- Represent the reactants and the products in their molecular form.

Now Consider this Example: -

- Reaction between Zinc oxide and carbon to form zinc and Carbon monoxide
- Zinc Oxide + Carbon ----------→ Zinc + Carbon Monoxide [Word equation]
- ZnO + C ----------→ Zn + CO [symbolic form]

SKELETAL EQUATION

- The equations in which the number of atoms on the left side is not equal to the number of atoms in the right are known as SKELETAL EQUATIONS.
- For Example, $H_2 + O_2$----------→ H_2O
- Mg + O_2 ----------→ MgO

- $N_2 + H_2$----------→ NH_3

BALANCED CHEMICAL EQUATION

- The equation in which the number of atoms in the reactant side is equal to the number atoms in the product is known as BALANCED CHEMICAL EQUATION
- For Example, $H_2 + Cl_2$----------2HCl

HOW TO BALANCE A CHEMICAL REACTION

Consider the reaction between Magnesium and Oxygen to produce Magnesium Oxide

The Skeletal is Equation is as follows: -

Mg + O_2----------→ MgO

Let's Balance this Equation by *Trial-and-Error Method*

Step-1: Count the number of atoms of each element on either side. It is convenient to start balancing with the molecule that contains the maximum number of atoms

Number of atoms of each element on the	
REACTANT SIDE	PRODUCT SIDE
Mg= 1 O=2	Mg =1 O =1

Step-2: Multiply the product side by 2 because there are two atoms of the oxygen on the reactant side.

Mg + O2 ----------→ 2 Mg

Number of atoms of each element on the	
REACTANT SIDE	PRODUCT SIDE
Mg= 1	Mg =1 X2 =2

O=2	O =1 X2 =2

Step-3: Multiply the magnesium atom on the left side with 2

2 Mg + O2 ----------→2 MgO

Number of atoms of each element on the	
REACTANT SIDE	PRODUCT SIDE
Mg= 1 X2 =2 O=2	Mg =1 O =1

Need for Balancing a chemical equation

- A chemical equation must be balanced in order to satisfy the LAW OF CONSERVATION OF MASS/MATTER

SIGNIFICANCE OF A BALANCED EQUATION

- It shows which substances are taking part in the chemical reaction and what are the products formed.
- It shows both the number of atoms and the number of molecules in the reaction
- It satisfies the Law of Conservation of Mass.
- It makes the study of chemistry universally standardized.