BASIC CONCEPT OF CHEMISTRY

• INTRODUCTION

- The word chemistry has been derived from Egyptian word "**CHEMEA**" which means Black Colour.
- Chemistry concerns itself with the composition properties, constitutions and mutual interactions of different kinds of matter.

• SYMBOLS, ELEMENTARY FORMULA

SYMBOLS :

- Just as a steno uses shorthand to save time in taking down notes from his officer, in the same manner a chemist, instead of writing full and lengthy names of elements, uses certain abbreviations called symbols.
- A symbol represents one atom of an element and is usually the first letter of the name of the element. Example – O – oxygen, N – Nitrogen, H – Hydrogen, S – Sulphur.
- When two or more elements begin with the same letter, another characteristic letter from its name is added in order to avoid confusion Carbon – C, Calcium – Ca, Cadmium – Cd, Cobalt – Co.
- The first letter is always capital and the second is always small.
- The abbreviations used for the lengthy names of elements are termed symbols.

ELEMENTARY FORMULA :

- You know that English alphabet has 26 letters. By combining these 26 letters we can make millions of English Words.
- Much the same way, by combining elements in different combinations, we can make an endless number of compounds.
- Each compound is represented by a formula.
- A symbolic representation of one molecule of a compound representing the number of atoms of various elements present in it, is called formula of the compound.

Formula of Some Common compounds

1. Hydrochloric acid HCl
2. Nitric acid HNO_3

3. Sulphuric Acid H_2SO_4

How to read information in the formula of a compound?

(i) The symbols in a formula can be prefixed or suffixed by a numeral. When the numeral is written on the left hand side before the formula, it represents number of molecules of the compound, and hence, the number of atoms present in each molecule.

Following examples will make it clear :

(a) When we write 2S, 3Cl or 4Al, it means two atoms of sulphur; three atoms of chlorine or four atoms of aluminium respectively.

(b) When we write 2NaCl, 4ZnO, etc. it means two molecules of sodium chloride (which contains two atoms of sodium and two atoms of chlorine), four molecules of zinc oxide (which contains four atoms of zinc and four atoms of oxygen).

(ii) When the numeral is written on the right bottom side of the symbol, it represents the number of atoms in one molecule of a compound.

Following examples will make it clear :

(a) When we write H_2, O_2 etc., it means that one molecule of hydrogen has two atoms in it. Similarly, one molecule of oxygen has two atoms in it.

(b) When we write SO_2, it means one molecule of sulphur dioxide has one atom of sulphur and two atoms of oxygen.

(c) When we write $Al_2(SO_4)_3$, it means a molecule of aluminium sulphate has two atoms of aluminium, three atoms of sulphur and twelve atoms of oxygen.

(d) When we write $3KNO_3$, it means there are three molecules of potassium nitrate. Furthermore, total number of various atoms in three molecules are : three atoms of potassium; three atoms of nitrogen and nine atoms of oxygen.

Illustrations –1:	(i)	What is the symbol of Copper?
Solution:		Cu
	(ii)	What is the symbol of Sodium?
Solution :		Na
	(iii)	What is the formula of Sodium hydroxide?
Solution :		NaOH

• ACID AND BASE

ACID :

- The word acid comes from the latin word "ACERE" which means sour.
- Curd, lemon, orange and vinegar taste sour. These substance taste sour because they contain acids.
- **A substance which dissolves in water to furnish H^+ ions is called acid.**

$$HCl \xrightarrow{H_2O} H^+ + Cl^-$$

$$H_2SO_4 \xrightarrow{H_2O} 2H^+ + SO_4^{2-}$$

Name of acid	Found in
Acetic acid	Vinegar
Formic acid	Ant's sting
Citric acid	Citrus fruits such as oranges, lemons, etc.
Lactic acid	Curd
Oxalic acid	Spinach
Ascorbic acid (Vitamin C)	Amla, Citrus fruits
Tartaric acid	Tamarind, grapes, unripe mangoes, etc.

Basicity of an acid

The number of hydrogen ions (H^+) furnished by one molecule of an acid, on dissolving in water, is called basicity of an acid.

Example : $\underset{\text{Hydrochloric acid}}{HCl} \xrightarrow{H_2O} \underset{\text{Hydrogen ion}}{H^+} + \underset{\text{Chloride ion}}{Cl^-}$

One molecule of hydrochloric acid furnishes one hydrogen ion, therefore, its basicity is 1. In other words, hydrochloric acid is monobasic acid.

Strong and weak acid

All the acid can be divided into two groups

(1) Strong acid (2) Weak acid

(1) Strong acids : Acids which are almost completely ionized in water are known as strong acids

$$HCl(\ell) \xrightarrow{H_2O} H^+(aq.) + Cl^-(aq.)$$

$$H_2SO_4(\ell) \xrightarrow{H_2O} 2H^+(aq.) + SO_4^{2-}(aq.)$$

(2) Weak acids : Acids which are weakly ionized in water are known as weak acids.

$$CH_3COOH(\ell) \overset{H_2O}{\rightleftharpoons} CH_3COO^-(aq.) + H^+(aq.)$$

List of strong acids and weak acid

Strong acid	Weak acid
Sulphuric acid – H_2SO_4	Carbonic acid – H_2CO_3
Hydrochloric acid – HCl	Sulphurous acid – H_2SO_3
Nitric acid – HNO_3	Nitrous acid – HNO_2

General physical properties of acids :

1. They have a sour taste.

2. They turn blue litmus solution red.
3. They turn methyl orange solution pink.
4. They do not affect phenolphthalein solution.

General chemical properties of acids :

1. **Action with metals** : Metals displace hydrogen from the acids. It has been found that when metals like magnesium, aluminium, zinc and iron are treated with dilute hydrochloric acid or dilute sulphuric acid, they displace hydrogen.

   Examples : Metal + acid (dil.) $\rightarrow$ Metal salt + Hydrogen

   $$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

2. **Action with metallic oxides :** All dilute mineral acids (sulphuric acid, hydrochloric acid and nitric acid), react with all metallic oxides to form their respective metallic salts and water only.

   Example : Metallic oxide + acid (dil.) $\rightarrow$ Metallic salt + Water

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

3. **Action with metallic hydroxides :** All dilute mineral acids react with all metallic hydroxides to form their respective metallic salts and water only.

   Example : Metallic hydroxide + Acid (dil.) $\rightarrow$ Metallic salt + water

   $$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

Uses of acids :

(a) Sulphuric acid :

(i) It is used in the manufacture of fertilizers.

(ii)It is used in car batteries.

(iii) It is used in the manufacture of dyes, drugs, paints, plastics, detergents etc.

(b) Hydrochloric acid

(i) It is used for cleaning metal surfaces during tinning and galvanizing.

(ii)It is used in dyeing industry.

(iii) It is used for preparing glucose from starch.

(c) Tartaric acid

It is used in the manufacture of baking powder.

BASE :

- **Substance which are bitter in taste and feel soaps on touching are known as bases.**
- **A substance which dissolves in water to furnish OH^- ions is called base.**
  (i) All oxides of metals are bases.
  (ii) All hydroxides of metals are bases.

Example : $NaOH \xrightarrow{H_2O} Na^+ + OH^-$

$KOH \xrightarrow{H_2O} K^+ + OH^-$

(a) Alkalies : All bases which are soluble in water are called alkalies. This special name given to the bases indicates that they are soluble in water.
Sodium hydroxide – NaOH , Potassium hydroxide – KOH

Acidity of an Bases

The number of replaceable hydroxyl groups present in a base which it can release when dissolved in water or in aqueous solution as ions

Example : NaOH, KOH – Monoacid base

$Ca(OH)_2$ – Diacid Base

$Al(OH)_3$ – Triacid Base

Name of base	Found in
Calcium hydroxide	Lime water
Ammonium hydroxide	Window cleaner
Sodium hydroxide / Potassium hydroxide	Soap
Magnesium hydroxide	Milk of magnesia

Strong Base and Weak Base

All the bases can be divided into two groups

(1) Strong bases (2) Weak bases

(1) Strong bases : A base which is completely ionizes in water and thus produces a large amount of hydroxide ion (OH^-) is called strong base, as NaOH, KOH

(2) Weak Base : A base which is partially ionized in water and thus produces a small amount of hydroxide ion $\left(OH^-\right)$ is called weak base, as NH_4OH, $Ca(OH)_2$

General physical properties of Bases :

1. **Taste** : All bases/ alkalis have a bitter taste.
2. **Slippery touch** : All bases/ alkali solutions have a slippery touch, much like that of soap. Sometimes we say that alkalis have a soapy touch.
3. **Corrosive action** : The bases / alkalis, on in contact with skin, produce very painful blisters. Sodium hydroxide and potassium hydroxide are extremely corrosive in nature and should not be touched with bare hands.
4. **Action with indictors** : The action of indicators is shown in the following table :

Indicator	Change in colour
Litmus	From red to blue
Methyl orange	From pink to yellow
Phenolphthalein	From colourless to pink

General chemical properties of Bases :

1. **Action with heat** :

(a) Sodium hydroxide (NaOH) and potassium hydroxide (KOH) do not decompose on heating. However, they melt, when strongly heated.

(b) Ammonium hydroxide decomposes rapidly on warming to form ammonia gas and water.

$$\underset{\text{Ammonium hydroxide}}{NH_4OH} \xrightarrow{\text{warm}} \underset{\text{Ammoniagas}}{NH_3} + \underset{\text{Water}}{H_2O}$$

(c) All other metallic hydroxides decompose on strong heating to form their respective metallic oxides and water.

Examples : Metallic hydroxide $\xrightarrow{\text{heat}}$ Metallic oxide + Water

$$\underset{\text{Calcium hydroxide}}{Ca(OH)_2} \xrightarrow{\text{heat}} \underset{\text{Calcium oxide}}{CaO} + \underset{\text{Water}}{H_2O}$$

$$\underset{\text{Copper hydroxide}}{Cu(OH)_2} \xrightarrow{\text{heat}} \underset{\text{Copper oxide}}{CuO} + \underset{\text{Water}}{H_2O}$$

2. **Action with Acids :** All acids react with base to form salt and water as the only products.

Uses of bases / alkalis :

1. Caustic soda and caustic potash
   (a) They are extensively used in the manufacture of soap from vegetable.
   (b) They are used in paper pulp from wood.
   (c) They are used for making artificial fibres such as rayon, nylon, etc.
   (d) They are used in the manufacture of medicines.

2. Calcium oxide and Calcium hydroxide
   (a) They are used for neutralization of acidity of the acidic soils.
   (b) Calcium hydroxide is used for removing hair from the animal skins.
   (c) Calcium hydroxide is used for preparing bleaching powder.

3. Magnesium hydroxide and Aluminium hydroxide
   They are used as antacids for relieving acidity in the stomach.

Illustrations –2:	(i)	HCl is a Monobasic or Dibasic
Solution:		Monobasic
	(ii)	H_2SO_4 is a strong acid or weak acid.
Solution:		Strong acid
	(iii)	KOH is a strong base or weak base.
Solution:		Strong base

SALT AND INDICATORS

SALT :

- **A substance formed by the neutralization of an acid with a base is called salt.**

Example : Acid + Base $\rightarrow$ Salt + Water

$$\underset{\text{Sulphuric acid}}{H_2SO_4} + \underset{\text{Sodium hydroxide}}{2NaOH} \longrightarrow \underset{\text{Sodium sulphate}}{Na_2SO_4} + \underset{\text{water}}{2H_2O}$$

Kinds of salts

All the salts can be divided into three groups

(1) Normal salts (2) Acid salts (3) Basic salts

(1) Normal salts : A salt formed by the complete replacement of the hydrogen ions (H^+) of an acid with metal ions (or positively charged ions) is called normal salt.

Example : Sodium chloride (NaCl), Potassium Chloride (KCl), Lead sulphide (PbS)

(2) Acid Salts : A salt formed by the partial replacement of H^+ ions of an acid from its molecule, with metal ions, is called acid salt.

$$\underset{\text{Sodium hydroxide}}{NaOH} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Sodium hydrogen sulphate}}{NaHSO_4} + \underset{\text{Water}}{H_2O}$$

Preparation and properties of Salts :

(a) Preparation of salts :

A salt is formed from an acid when a metal takes the place of hydrogen in acids.
The metals can take the place of hydrogen when the acids react chemically with the following

(i) Metal hydroxides
(ii) Metal oxides
(iii)Metal carbonates
(iv)Active metals such as magnesium, zinc, etc.

(b) Properties of salts :

(i) Most of the salts are solids with high melting points and boiling points.

(ii) Salts are usually soluble in water. However, salts like carbonates, oxides and sulphates are generally insoluble in water.

(iii)Salt solutions in water are good conductors of electricity.

(iv) Crystals of some salts have some fixed number of water molecules attached to them. Such salts are called hydrated salts and the water molecules attached to them are called water of crystallization.

Uses of salts in daily life :

1. **Common salt : (NaCl) :** It is used amount as table salt. It is used for preservation of food in pickling. It is used to preserve raw hides. It is used in the manufacture of chemical such as chlorine and caustic soda (NaOH).

2. **Baking Soda : ($NaHCO_3$) :** It is used for making baking powder. It is used for preparing antacid tablet, for controlling acidity of stomach.
3. **Washing soda : ($Na_2CO_3.10H_2O$) :** It is used by washermen to wash clothes. It is used in manufacture of glass and caustic soda. It is used in fire extinguishers. It is used in the manufacture of detergents.
4. **Green vitriol : ($FeSO_4.7H_2O$) :** It is used in making blue inks and incurring leather.
5. **Plaster of Paris : ($CaSO_4.1/2H_2O$) :** It is used for making statues. It is used for setting broken bones.

INDICATORS :

- **A Special type of substances are used to test whether a substance is acidic or basic. These substances are known as indicators.**
- The indicators change their colour when added to a solution containing an acidic or basic substances.
- Turmeric, Litmus, China rose petals etc., are some of the naturally occurring indicators.
- Indicators are basically coloured organic substances extracted from different plants

Illustrations –3:	(i)	The chemical name of marble is
Solution:		Calcium carbonate
	(ii)	Plaster of paris is made from
Solution:		Gypsum

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KEY POINTS

- The abbreviations used for the lengthy names of elements are termed symbols.
- Symbolic expression for a molecule is called a formula.
- Acids are sour in taste. Bases are bitter in taste and soapy to touch.
- Acid turns blue litmus red. Bases turn red litmus blue.
- An acid and a base neutralize each other and form a salt. A salt may be acidic, basic or neutral in nature.
- Solutions of substances that show different colour in acidic, basic and neutral solutions are called indicators.

ASSIGNMENT – I

1. The abbreviation used for the lengthy name of an element is termed
   (A) Formula (B) Valency
   (C) Symbol (D) Radicals

2. The symbolic expression for a molecule is called
   (A) Formula (B) Valency
   (C) Symbol (D) Radicals

3. What is the symbol of Cobalt?
   (A) Co (B) Cd
   (C) Cl (D) Ca

4. What is the symbol of Antimony?
   (A) As (B) At
   (C) Al (D) Sb

5. What is the symbol of Lead?
   (A) La (B) Le
   (C) Pb (D) As

6. What is the symbol of Mercury?
   (A) Mg (B) Mn
   (C) Hg (D) Ag

7. What is the symbol of Silver?
   (A) Si (B) Sl
   (C) Ag (D) Au

8. What is the symbol of Gold?
   (A) Go (B) Ga
   (C) Gl (D) Au

9. What is the formula of sulphur dioxide?
   (A) SO_3 (B) SO_2
   (C) SO_4 (D) CO_2

10. What is the formula of water?
    (A) K_2O (B) H_2O
    (C) HCl (D) H_2S

ASSIGNMENT – II

1. The term 'Acere' means?
   (A) Biffer (B) Sweet
   (C) Sour (D) none of these

2. Citric acid found in
   (A) Orange (B) Curd
   (C) Spinach (D) Grapes

3. Tartaric acid found in
   (A) Orange (B) Lemon
   (C) Amla (D) Grapes

4. Calcium hydroxide present in
   (A) Soap (B) Window clearner
   (C) Lime water (D) none

5. Magnesium hydroxide present in
   (A) Lime water (B) Milk of magnesia
   (C) Soap (D) None

6. Ammonium hydroxide present in
   (A) Lime water (B) Window cleaner
   (C) Soap (D) None

7. Ammonium hydroxide and copper hydroxide are
   (A) Strong acids (B) Weak acids
   (C) Weak bases (D) Strong bases

8. The strongest base that can exist in aqueous solution is
   (A) NH_4^+ (B) Cl^-
   (C) OH^- (D) H_2F^+

9. NaOH is a
   (A) Strong acid (B) Strong base
   (C) Weak acid (D) Weak base

10. $Al(OH)_3$ is a
    (A) Monoacid base (B) Diacid base
    (C) Triacid base (D) none

ASSIGNMENT – III

1. Epsom salt is
   (A) Copper sulphate (B) Ferrous sulphate
   (C) Magnesium sulphate (D) Calcium sulphate

2. Marble is
   (A) Copper sulphate (B) Calcium carbonate
   (C) Zinc sulphate (D) Calcium sulphate

3. White vitriol is
   (A) Copper sulphate (B) Zinc sulphate
   (C) Calcium sulphate (D) Calcium carbonate

4. In which of the following is used for washing clothes
   (A) $NaHCO_3$ (B) NaCl
   (C) $Na_2CO_3.\ 10H_2O$ (D) $CaCO_3$

5. In which of the following is used for making baking powder :
   (A) NaCl (B) $NaHCO_3$
   (C) $Na_2CO_3.10H_2O$ (D) $CaCO_3$

6. Plaster of paris is made from
   (A) Lime stone (B) Slacked lime
   (C) Quick lime (D) Gypsum

7. The chemical name of common salt
   (A) Calcium chloride (B) Sodium chloride
   (C) Calcium carbonate (D) Calcium sulphate

8. The colour of copper sulphate ($CuSO_4.5H_2O$)
   (A) Green (B) Red
   (C) Orange (D) Blue

9. The colour of Iron sulphate ($FeSO_4.7H_2O$)
   (A) Red (B) Orange
   (C) Blue (D) Green

10. The colour of zinc sulphate ($ZnSO_4.7H_2O$)
    (A) Red (B) Blue
    (C) White (D) Green

KEY & HINTS

BASIC CONCEPT OF CHEMISTRY

ASSIGNMENT – I

1. (C)
2. (A)
3. (A)
4. (D)
5. (C)
6. (C)
7. (C)
8. (D)
9. (B)
10. (B)

ASSIGNMENT – II

1. (C)
2. (a)
3. (D)
4. (C)
5. (B)
6. (B)
7. (C)
8. (C)
9. (B)
10. (C)

ASSIGNMENT – III

1. (C)
2. (B)
3. (D)
4. (C)
5. (B)
6. (D)
7. (B)
8. (D)
9. (D)
10. (C)

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