CHAPTER : No.1
FUNDAMENTALS OF CHEMISTRY

Chemistry:-

Chemistry is the science that examines the materials of the universe and the changes takes place in the material.

Branches of Chemistry:-

1. Physical Chemistry:-

The branch of chemistry in which we study about changes in matter and the laws and theories to understand these changes is called physical chemistry.

2. Organic Chemistry:-

The branch of chemistry in which we study about the compounds of carbon is called organic chemistry.

3. Inorganic Chemistry:-

The branch of chemistry in which we study about the compounds other than carbon is called inorganic chemistry.

4. Bio Chemistry:-

The branch of chemistry in which we study about the physical and chemical changes that occur in living things is called bio chemistry.

5. Industrial Chemistry:-

The branch of chemistry in which we study about the use of technology in the large scale production of different chemical substances is called industrial chemistry.

6. Nuclear Chemistry:-

The branch of chemistry in which we study about the changes that takes place in atomic nuclei is called nuclear chemistry.

7. Analytical Chemistry:-

The branch of chemistry in which we study about methods and instruments which are used to check (Find) the composition of matter is called Analytical chemistry.

8. Environmental Chemistry:-

The branch of chemistry in which we study about the chemical and toxic substances and their effect on living things and environment is called environmental chemistry.

Differentiate between Branches of Chemistry:-

Vinegar contains 5% of acetic acid. Acetic acid (CH_3 COOH) is a colourless liquid that has characteristic vinegar like smell. It is used to flavour food. The study of this compound help us to differentiate between branches of chemistry.

1. Organic Chemistry:-

We know that vinegar contains acetic acid (CH_3 COOH). This acetic acid is a carbon compound therefore the study of its properties is called organic chemistry.

2. In Organic Chemistry:-

We know that the study of compounds other than carbon is called inorganic chemistry. In this case the study of elements like 'H' and 'O' is called inorganic chemistry.

3. Bio Chemistry:-

The vinegar is used in food that we eat. Therefore the study of chemical reactions that takes place in human body due to vinegar is called biochemistry.

4. Physical Chemistry:-

The study of the structure of acetic acid (CH_3 COOH) and its different physical properties is called physical chemistry.

5. Industrial Chemistry:-

Use of technology and the methods to obtain acetic acid on large scale is called industrial chemistry.

6. Analytical Chemistry:-

The study of different properties of vinegar like its composition, melting point and boiling point is called analytical chemistry.

7. Environmental Chemistry:-

The study of the effects of vinegar on the environment is called environmental chemistry.

8. Nuclear Chemistry:-

The study of the effect of neutrons on vinegar is called nuclear chemistry.

Dalton's Atomic Theory:-

In 1803 a British Chemist John Dalton presented a theory on nature of matter. The main points of this theory are as follows.

1. All elements are composed of tiny indivisible particles called atoms..

2. Atoms of the same elements are identical and they have same mass and same volume.

3. During a chemical reaction atoms of an element combine or separate or re-arrange. Atoms combine with each other in simple ratios.

4. Atoms can neither be created nor destroyed.

Defects in Dalton's atomic theory:-

1. After daltons's atomic theory a series of experiments were performed in 1850's. These experiment shows that atom is divisible. It consists of three particles electron, proton, neutron.

2. These experiments also shows that mass of atoms of some elements may be different.

Page No.4 Example No. 1.1 Identify the branch of chemistry in each of the following examples.

QNo.1 Photosynthesis produces glucose and oxygen from carbon dioxide and water in presence of chlorophyll and sunlight.

Ans. We know that photosynthesis is a chemical process that occur in plants. As plants are living things therefore the study of this process is called biochemistry.

QNo.2 Plantation helps in overcoming green house effect.

Ans. We know that green house effect is an environmental problem therefore the study of this process is called environmental chemistry.

QNo.3 Hybers process converts large quantity of hydrogen and nitrogen into ammonia (NH_3). Identify the branch of chemistry.

Ans. Since hyber's process is used for large scale production of NH_3 (ammonia) therefore it is an example of industrial chemistry.

QNo.4 Amonia (NH_3) no carbon is a colourless gas with pungent irritating odour. It is highly soluble in water. Identify the branch of chemistry.

Ans. As Amonia (NH_3) does not contain carbon so it an inorganic compound and we know that the study of inorganic compound is called inorganic chemistry.

QNo.5 A chemist performed an experiment to check the percentage purity of a sample of glucose ($C_6H_{12}O$) Indentify the branch of chemistry.

Ans. When we check percentage purity of a compound then this study is called analytical chemistry.

QNo.6 An analyst determines that 'NO2' is responsible for acid rain. Identify the branch of chemistry.

Ans. As acid rain effect our environment therefore the study of this compound is called environmental chemistry.

QNo.7 Chloroflouro carbon compounds are responsible for depletion of Ozone layer. Identify the branch of chemistry?

Ans. The depletion of ozone layer is an environmental problem therefore the study of this compound is called environmental chemistry.

QNo.7 α - Particles (He^{++}) When bombarded with a nitrogen atom a proton is emitted Identify the branch of chemistry?

Ans. We know that the study of the properties of an atom and its nucleus is called nuclear chemistry.

Page No.5 Self Assessment Exercise 1.1

QNo.1 Hair contain special class of proteins called keratins which is present in nail and wool. Identify the branch of chemistry?

Ans. We know that proteins are present in living things. Therefore the study of their properties is called biochemistry.

QNo.2 Acetyline is the simplest hydrocarbon that contains carbon – carbon triple bond? Hydrocarbons are the compounds of carbon and Hydrogen Identify the branch of chemistry.

Ans. Acetyline is a compound of carbon and we know that the study of the compounds of carbon is called organic chemistry.

QNo.3 White lead is a pigment used by artist for centuries, the metal lead 'Pb' in the compound is extracted from its ore galena 'PbS' Identify the branch of chemistry?

Ans. Whit lead is a pigment and it is to produced on large scale, therefore this statement belongs to industrial chemistry.

QNo.4 Sulphuric acid (H_2 SO_4) is weaker than hydrochloric acid. Identify the branch of chemistry?

Ans. According to given statement we are comparing (analyzing) two compounds therefore this statement belongs to analytical chemistry.

QNo.5 Gases can be compressed by applying pressure. Identify the branch of chemistry?

Ans. We know that change in shape and physical properties of a substance is related to physical chemistry. Therefore this statement belongs to physical chemistry.

QNo.6 Some examples of complete protein food are meat, milk and eggs. Identify the branch of chemistry?

Ans. We know that protein are present in living things therefore this statement belongs to bio chemistry.

QNo.7 Element radium decays by emitting $\propto$ - particles and is converted into another element radon. Indentify the branch of chemistry?

Ans. When an element changes in to another element then its nucleus also changes and we know that the study of properties of nucleus is called nuclear chemistry.

QNo.8 Calorimeter is a device that measures the amount of heat a substance absorbs on heating or emits on cooling. Identify the branch of chemistry?

Ans. According to this statement we are analyzing a substance. Therefore this statement belongs to analytical chemistry.

Questions

Define Following Terms:-

1. Matter 2. Element 3. Mixture 4. Compound.

1. Matter:-

Anything that has mass or weight and occupy space is called matters.

2. Element:-

A substance that cannot be converted into another simpler substances is called an element.

In an element all the atoms have same atomic number.

3. Compound:-

A compound is a substance that consist of two or more elements chemically combined together in a fixed ratio by mass.

The properties of a compound are different from the properties of elements, from which they are formed.

Examples:-

Water, sodium chloride and carbondioxide are compounds.

4. Mixture:-

A mixture is a substance that consists of two or more elements or compounds physically Combined together without any fix ratio by mass.

Examples:-

Air, Salt dissolve in water, are example of mixture.

Types of Mixture:-

There are two types of mixture.

1. Heterogeneous mixture
2. Homogeneous mixture

1. Heterogeneous Mixture:-

A mixture that consist of two or more visibly different components is called heterogeneous mixture.

Examples:-

Oil floating on water and a mixture of sand and water is called heterogeneous mixture.

2. Heterogeneous Mixture:-

A mixture in which the components are mix together in such a way that these components are not visibly different is called homogeneous mixture.

Examples:-

Salt dissolve in water, sugar dissolve in water, Air and ice cream are examples of homogeneous mixture.

Atomic Number:-

The number of protons present in the nucleus of an atom is called atomic number.

Examples:-

There is only one proton in the nucleus of Hydrogen atom. Therefore the atomic number of Hydrogen is one.

Mass Number:-

The total number of protons and neutrons in an atom is called mass number.

Examples:-

There are six protons and six neutrons in carbon atom therefore mass number of Carbon atom will be:-

Mass number = Number of proton's + Number of neutrons
= 6 + 6
Mass number = 12

Formulas:-

1. Atomic number = Number of protons
2. Mass number = Number of protons + Number of neutrons.

Page No. 8 Examples 1.2:-

Atomic number = 17
Mass number = 35
Number of protons = ?
Number of Neutrons = ?

We know that

Number of proton's = Atomic number
Number of proton's = 17
Number of proton's = 17

We know that

Mass number = number of protons + number of Neutrons

Mass number – Number of protons = Number of Neutrons.

35 – 17 = Number of Neutrons.

18 = Number of Neutrons

Number of Neutrons = 18

Question

Differentiate between compound and mixture?

	Compound		Mixture
1.	A compound is a substance that consist of two or more elements chemically combined together in a fix ratio by mass	1.	A mixture is a substance that consist of two or more elements physically combined together without any fix ratio by mass
2.	All compound have fix melting and boiling points.	2.	All mixtures have different melting and boiling points.
3.	The elements forming the compound can be separated by any physical method	3.	The elements forming the mixture can be separated by a physical method.
4.	Corbon dioxide (CO_2) and Hydrochloric acid (HCl) are examples of compound.	4.	Air and ice cream are examples of mixture.

Isotopes:-

Those atoms of an element that has same atomic number but different mass number are called isotopes.

OR

Those atoms of an element that has same number of protons but different number of neutrons are called isotopes.

Relative atomic mass:-

The mass of an atom of an element relative to the mass of an atom C-12 is called relative atomic mass.

12amu = Mass of one C-12

And

1 amu = $\frac{\text{Mass of one C-12}}{12}$

One Atomic Mass:-

One Atomic mass unit is defined as "a mass exactly equal to one-twelfth of the mass of one C-12 atom"

Question

1. What are the main advantages of garlic:-

Ans: Bad breath may be good for us. Because garlic contains more than 200 compounds. People who eat a lot of garlic have a lower chance of getting stomach cancer, suffering from heart disease or having stroke.

Question

2. Define empirical formula and molecular formula:-

Ans. Empirical formula:-

Empirical formula of a compound is the formula that gives simplest whole number ratio of atoms of each element.

Examples:-

1. Empirical formula of benzene (C_6H_6) is CH.

2. Empirical formula of Hydrogen peroxide (H_2O_2) is HO.

Molecular Formula:-

Molecular formula of a compound is the formula that give actual whole number ratio of atoms of each element.

Examples:-

1. Molecular formula of benzene (C_6H_6) is C_6H_6.

2. Molecular formula of Hydrogen per oxide H_2O_2 is H_2O_2.

Question

3. There are many compounds for which empirical formula and molecular formula are same why?

Ans. There are many compounds for which empirical formula and molecular formula are same. This is because in these compounds the simplest whole number ratio and actual whole number ratio are same.

Examples:-

Water, 'H_2O' carbon dioxide are the compounds whose empirical and molecular formula are same.

Page No. 10 Self Assessment Example No. 1.3

Part I.

Number of carbon atoms = 9
Number of Hydrogen atoms = 8
Number of oxygen atoms = 4
Molecular formula = $C_9H_8O_4$
Empirical formula = $C_9H_8O_4$

Part II.

Number of carbon atoms = 2
Number of Hydrogen atoms = 4
Number of oxygen atoms = 2
Molecular formula = $C_2H_4O_2$
Empirical formula = CH_2O

Part III.

Formula of caffeine = $C_8H_{10}N_4O2$
Empirical formula = $C_4H_5N_2O$

Molecular Mass:-

The sum of atomic masses of all the atoms present in a molecule is called molecular mass.

Formula Mass:-

The sum of atomic masses of all the atoms present in formula unit of a substance is called formula mass.

Page No. 11 Example 1.3

Part I.

Molecular mass of glucose $C_6H_{12}O_6$ = ?

Molecular mass of $C_6H_{12}O_6$ = 6(Atomic mass of C) + 12(Atomic mass of H) + 6 (Atomic mass of O)

Molecular mass of $C_6H_{12}O_6$ = 6(12) + 12 (11) + 6 (16)
= 72 + 12 + 96
= 180 amu

Part II.

Molecular mass of $C_{10}H_8$ = 10 (Atomic mass of C) + 8 (Atomic mass of H)

Molecular mass of $C_{10}H_8$ = 10 (12) + 8 (1)
= 120 + 8
= 128 amu

Reminder:-

Atomic masses of different elements:-

Hydrogen 'H'	=	1.008 or 1
Carbon 'C'	=	12
Oxygen 'O'	=	16
Sodium 'Na'	=	23
Chlorine 'Cl'	=	35.5
Potassium 'K'	=	39

Atoms and Ions:-

Atoms:-

Atom is the smallest particle of an element that cannot exists in free state. Atom is electrically neutral particle therefore it has no charge.

Ion:-

An ion is a charged particle which is formed from an atom or chemically bonded group of atoms by adding or removing electrons.

Types of Ions:-

There are two types of ions.

1. Cation
2. Anion

1. Cation:-

The positively charged ions are called cations. Generally metal atom lose one or more electrons and from cation e.g Na^{+1}.

Ion:-

The negatively charged ions are called anions. Generally non-metal gain one or more electron and from anion e.g $C1^{-1}$.

Molecular Ion:-

When a molecule losses or gain electrons then resulting particle is called Molecular ion.

Free Radical:-

A free radical is an atom which has unpaired electron and it has no electrical charge.

Example:-

When substances like Halogens are exposed to sunlight then their molecules are converted into free radical.

Page no 12 Self Assessment Exercise 1.4

Part 'I'

Formula mass of potassium chloride ($KClO_3$) = ?

Solution

Formula mass of $KClO_3$ = (39) + (35.5) + 3 (16)
= 39 + 35.5 + 48
= 122.5 amu

Part 'II'

Formula mass of Baking soda ($NaHCO_3$) = ?
Formula mass of carbon dioxide (CO_2) = ?

Solution

Formula mass of ($NaHCO_3$) = (23) + (1) + (12) + 3 (16)
= 23 + 1 + 12 + 48
= 84 amu.
Formula mass of Co_2 = 12 + 2 (16)
= 12 + 32 + 44 amu

Part 'III'

Formula mass of Urea $(NH_2)_2 CO$ = ?
Formula mass of carbon dioxide(CO_2) = ?
Formula mass of Amonium nitrate (NH_4NO_3) = ?

Solution

Formula mass of (NH_2) = Co = 2 [14 + 2 (1)] + 12 + 16
= $2[14^2 + 2] + 12 + 16$
= 2 (16) + 12 + 16
= 60 amu.

Now

Formula mass of $NH_4 No_3$ = (14) + 4 (1) + (14) + 3 (16)
= $14 + 4^3 + 14 + 48$
= 804 amu

Types of Molecules:-

1. Monoatomic molecule
2. Poly atomic molecule

1. Monoatomic Molecule:-

A molecule that contain only atom is called monoatomic molecule.

Examples:-

Inert gases consist of monoatomic molecule i.e Helium (He) Neon (Ne) and Argon (Ar) are monoatomic molecule.

2. Poly atomic molecule:-

A molecule that contains two or more similar or different atoms is called polyatomic molecule.

Example:-

H_2, O_2 and HCl are poly atomic molecules.

Pseudo – Science or Alchemy:-

In the beginning of chemistry during 600 – 1600 AD some scientist tried to convert cheap metals in to gold. They performed many experiment but could not succeed and wasted their time and money. These scientists are called alchemists and this branch of chemistry is called alchemy. However during that period these scientist discovered many new processes such as distillation, sublimation and extraction. Such processes are contributing a lot in the progress of science. This means that the work of different scientist promote (Hanicap) the growth of science.