BASIC CHEMISTRY

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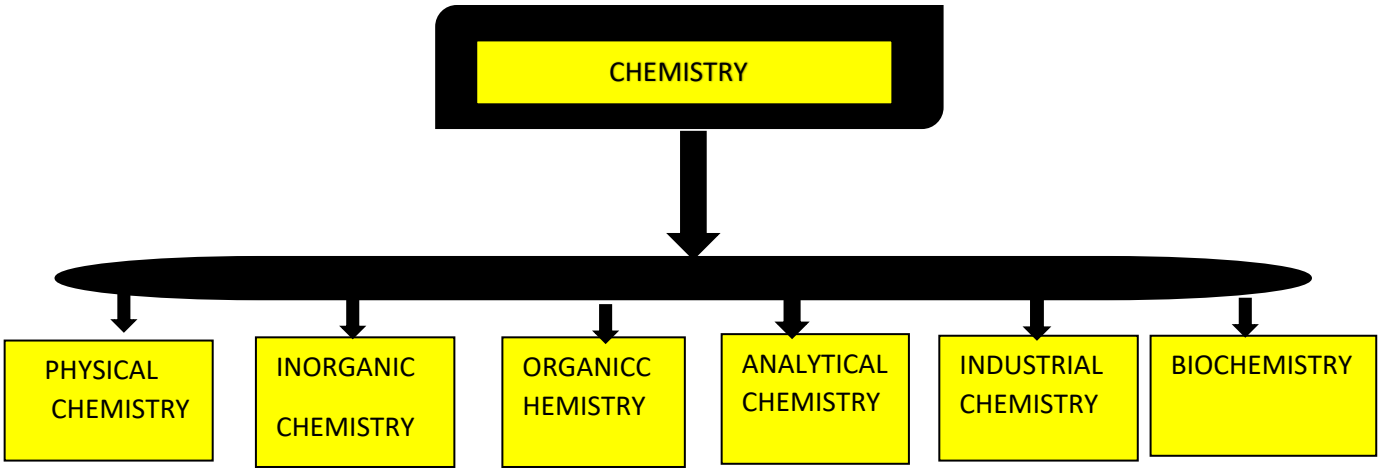
INTRODUCTION:

Definition: It is that branch of basic science which deals with study of composition of matter and the chemical change involved with it.

It describes the composition of matter in microscopic level in molecular forms. It gives details regarding type of similar/dissimilar atom/atoms contained in the molecule of a particular type of matter. Its gives us chemical interactions amongst different type of matters at molecular level and transformation of one or more new maters. It also describes the physical and chemical properties of matter elaborately.

Classification: This subject, Chemistry may be classified as follows,



PHYSICAL CHEMISTRY: It is that branch of chemistry which deals with the fundamental principle involved with any chemical phenomena.

INORGANIC CHEMISTRY: It is that branch of chemistry which deals with the study of all the elements and their compounds excluding covalent compounds of carbon.

ORGANIC CHEMISTRY: It is that branch of chemistry which deals with study of structure, composition and properties of compound of carbon.

ANALYTICAL CHEMISTRY: It is that branch of chemistry which deals with the detection and estimation of elements and compounds.

INDUSTRIAL CHEMISTRY: It is that branch of chemistry which deals with chemical processes in an industry.

BIOCHEMISTRY: It is that branch of chemistry which deals chemical processes take place in a living organism.

APPLICATIONS: The subject chemistry has wide applications in daily practical life as well as in several fields. They are as follows.

- Health
- Food
- Amenities of life
- Industry

- Warfare

Health: The Chemical processes are the part and parcel of living organisms. The digestion of food such as carbohydrates, proteins, fats, growth of cells of living organisms involved with basic chemical transformations. The Anaesthetics during medical surgery, medicines such as sulpha drugs and antibiotics have prime contribution to modern medical science to bring our health to normal state.

Food: The use of fertilizers such as urea, ammonium sulphate, calcium ammonium nitrate have major role for increasing food production. The use of DDT,BHC are helpful to protect crops from insects.

Amenities of Life: The clothes are dyed and bleached with chemicals. The soaps and cosmetics used in daily life are chemical products. The synthetic fibre s such as decaron, terylene are major contribution to modern fabrics. The petrol, diesel and several petrochemicals are signs of modern civilization.

Industry: The chemistry has wide applications in several chemical industries such as vegetable oil, sugar, paper cement and artificial rubber etc.

Warfare: The chemistry has major contribution towards modern warfare by using explosives such as TNT(Trinitrotoluene),poisonous gas like phosgene, atomic bombs and hydrogen bombs

MATTER

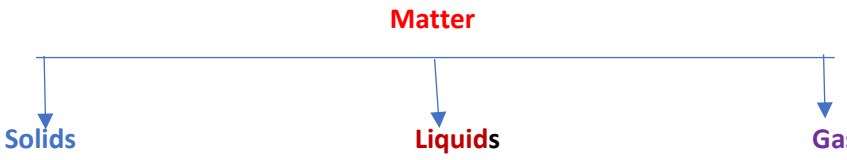
The most fundamental concept of chemistry is **matter.** It consists of large number of tin material particles.

Definition: Anything having some mass and it occupies some space.

Classification: Matters have 02 types of classification

1.Physical Classification **2. Chemical classification**

Physical Classification: It is based on physical state of the matter at the normal conditions of temperature and pressure.



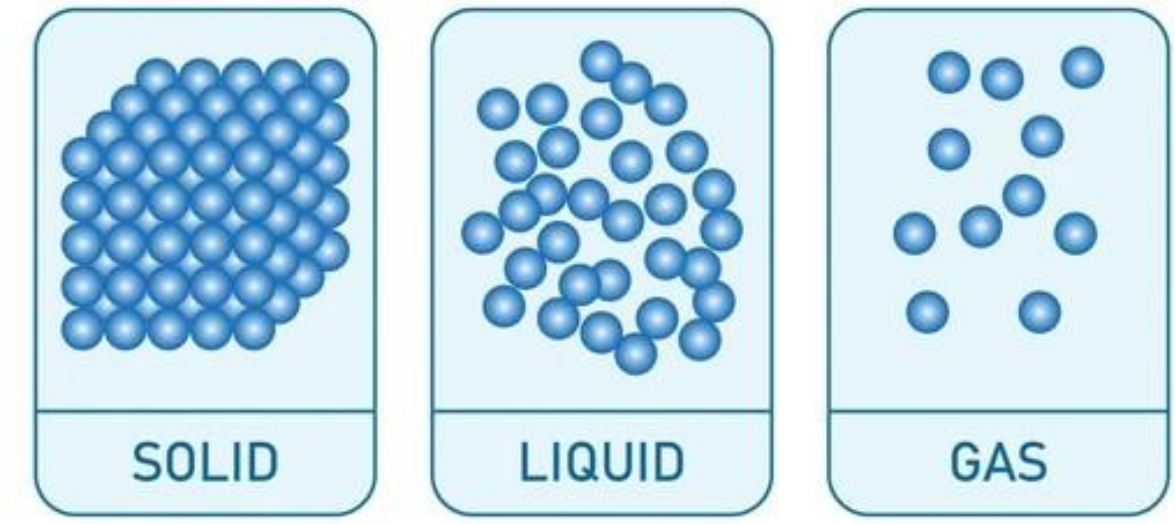
Solids	Liquids	Gases
Generally, the solids are hard and rigid and are available at lower range of temperature of the matter. They have definite shape and and size e.g iron	Liquids have definite volume but no definite shape. They are soft and mobile and take the shape of the container. The at available at comparatively higher range of temperature. e.g water	The gases have no definite shape and size. The particle of the gas are mobile within the bulk of the container. They are available at comparatively higher range of temperature than that in liqid form e.g Oxygen

Solid state

Liquid state

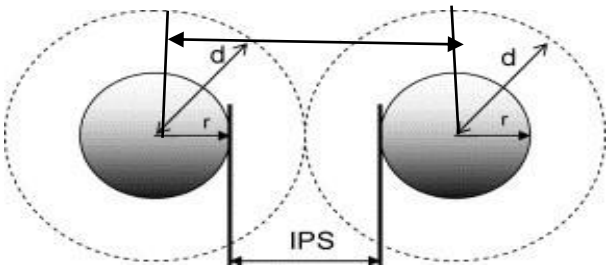
Gaseous state

(Macroscopic view of matter in different states)



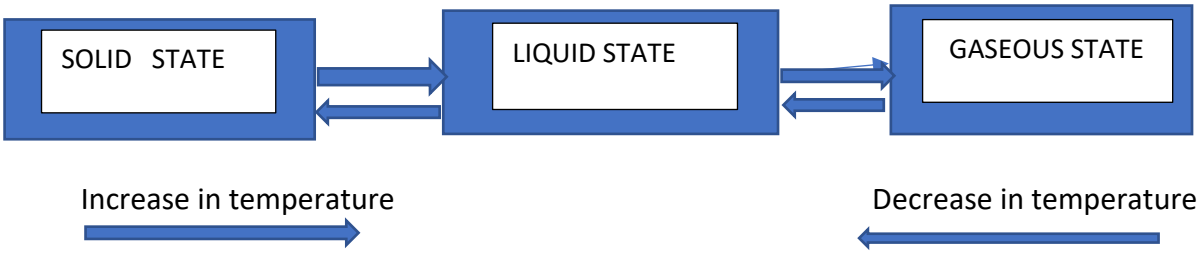
(Microscopic view of matter in different states)

On microscopic study, it is observed that there is an appreciable difference in inter particle distance in case of solid, liquid and gaseous state of a matter. The inter particle distance is the average distance between centres two consecutive material particles which are assumed to be a a tiny rigid spheres. The inter particle distance is the least in case of solid and greatest in case of gaseous state.



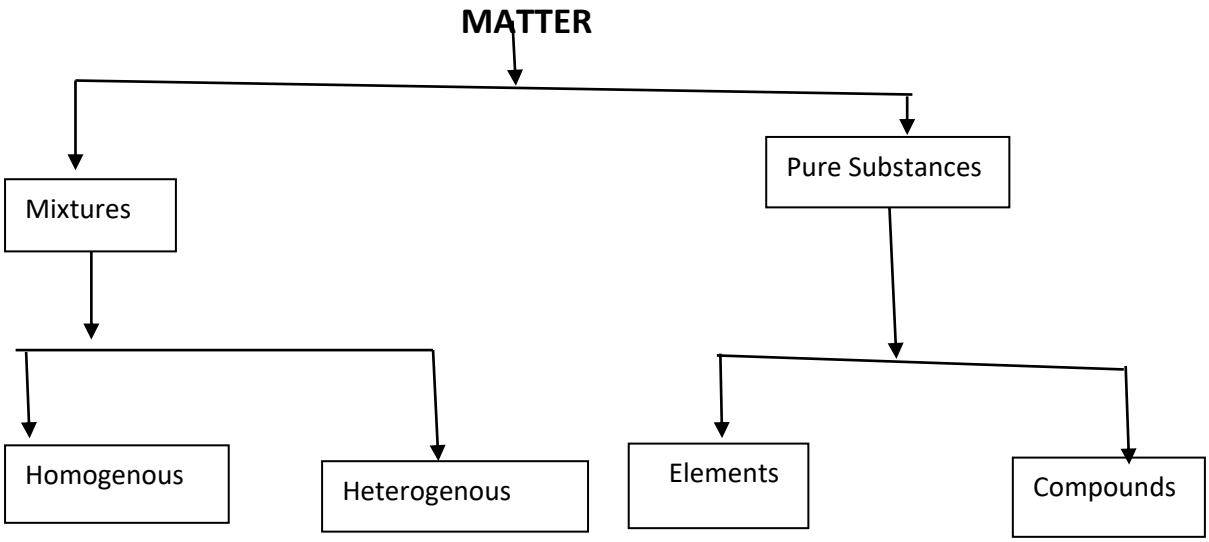
Interparticle distance and interparticle spacing (IPS)

Effect of temperature on the state of a matter: The state of a matter is interconvertible. At certain condition of temperature and a pressure the matter exists in solid state. When the temperature of matter increased gradually, at certain temperature it is converted into liquid state . That temperature is called **melting point** of that matter. If then the temperature is increased further again a situation arises when the liquid state is converted into its gaseous state. This temperature is called **boiling point** of the matter.



The above figure shows the change of state of the matter with gradual increase and the gradual decrease of temperature.

Chemical Classification of Matter: It is classified broadly into two types.



Mixture: It is obtained by mixing two or more elements or compounds in any ratio such that their properties never changes**.**

Homogenous Mixtures: Those are the mixtures which have uniform composition and identical properties through out the bulk of it.

Heterogenous Mixtures; Those are the mixtures which have no uniform properties or identical properties through out the bulk of it

Pure Substances: Those are either elements or compounds.

Elements: It is the simplest form of the matter which cannot be broken into further simpler forms. It is made of similar types of tiny particles called **atoms.** It is the smallest particle of an element which may or may not have independent existence.

Compounds: Those are formed by chemical combination of two or more elements in a fixed ratio by weight**.** It is composed of large number of tiniest particles called molecules.

Molecules: It is the smallest particles of an element or compound which has the independent existence. It is composed of two or more atoms of elements in a fixed ratio by weight.

ATOMIC MASS: We know the atom is the smallest particle of an element which may or may not have independent existence. The mass of an atom of an element is known as atomic mass. The atomic mass of an element cannot be determined directly even by the most sensitive balance. It is determined by applying Avogadro's Law. In case of hydrogen it has been observed that Avogadro's number atoms($6.022x10^{23}$) weighs 1.008 gms. Then the

$$\text{Mass of 1 hydrogen atom} = \frac{1.008}{6.022X10^{23}}\text{ gms} = 1.67X10^{-24}\text{gms.}$$

The hydrogen being the lightest atom among the atoms of all other elements, it was taken as reference standard. The atomic mass of all other elements were expressed in terms relative atomic mass. e.g atomic mass of oxygen is 16.It means Oxygen is 16 times heavier than Hydrogen .

Later on, the International Union of chemists accepted stable isotope of carbon having mass number 12(C^{12}) as standard for atomic mass and molecular mass for all the elements and compounds. In this standard $\frac{1}{12}$ th of an atom of C12 carbon isotope is taken as 1 unit and is written as 1 atomic mass unit(amu). 1 amu= mass of $1/12^{th}$ part of a carbon atom=$\frac{12}{12X6.022X10^{23}}$=$1.66056X10^{-24}$grams

On the basis of this new standard, the atomic mass of any element is expressed as follows,

$$\text{Atomic mass of an element} = \frac{Mass\ of\ one\ atom\ of\ an\ element}{\frac{1}{12}th\ mass\ of\ atom\ of\ C^{12}\ carbon\ isotope}$$

Atomic Mass is simply a number.

The atomic mass of hydrogen in new standard

$=\frac{1.6739X10^{-24}}{1.66056X10^{-24}}$=1.008amu

The atomic mass of some elements are given below.

:Atomic Mass Table:

Name of the Elements	No of time heavier than $1/12^{th}$ of one atom of C^{12} Isotope	Atomic Mass of Elements(amu)
Hydrogen(H)	1.008	1.008
Oxygen(O)	16	16
Nitrogen(N)	14	14
FLORINE(F)	19	19
SULPHUR(S)	32	32
CHLORINE(Cl)	35.5	35.5
POTASSIUM(K)	39	39

More accurately, we take average atomic mass of some elements due to presence of its 2 or more isotopes in nature. The term atomic mass unit is revised as unified mass(u) .Due to presence of 2 or more isotopes of some elements, their atomic masses observed to be fractional. e.g atomic mass of chlorine is 35.5.This is because chlorine occurs in nature in the mixture of $Cl^{35}$and Cl^{37} isotopes in ratio 3:1

$$\frac{3X35+1X37}{3+1}=35.5$$

Gram Atomic Mass(Molar mass of an atom):The gram atomic mass or molar mass of an element is mass of one mole (Avogadro's Number of atoms) of it expressed in Grams or Kilograms and denoted by gm(CGS) or Kgm(SI).

e.g 1 gm of Hydrogen=Mass of 1.008 grams of hydrogen

1 gm of Chlorine=Mass of 35.5 grams of Chlorine

The actual mass of an atom can be determined, it atomic mass of an element is given.

We know from the mole concept that the mass of Avogaro's Number of atoms($6.022X10^{23}$) is equal to its atomic mass expressed in grams.

The actual mass of atom=$\frac{Atomic\ mass\ of\ atom\ in\ grams}{6.022X10^{23}}$ ……(1)

The actual atomic mass of the some of the elements are given below.

e.g Atomic mass of Hydrogen=$\frac{Atomic\ mass\ of\ hydrogen\ in\ grams}{6.022X10^{23}}=\frac{1.008\ grams}{6.022X10^{23}}=1.67X10^{-24}$grams

Atomic mass of Nitrogen=$\frac{Atomic\ mass\ of\ nitrogen\ atom\ in\ grams}{6.022X10^{23}}=\frac{14\ grams}{6.022X10^{23}}$=$2.324X10^{-23}\ grams$

Atomic mass of Oxygen=$\frac{Atomic\ mass\ of\ oxygen\ in\ grams}{6.022X10^{23}}=\frac{16\ grams}{6.022X10^{23}}$=$2.656X10^{-23}$ grams

Atomic mass of Sulphur=$\frac{Atomic\ mass\ of\ Sulphur\ atom\ \ in\ grams}{6.022X10^{23}}=\frac{32\ grams}{6.022X10^{23}}=5.31X10^{-23}$grams

Gram Atomic Mass: Atomic mass of an element expressed in grams is known as gram atomic mass of that element. Alternately, it is also called as one gram atom of that element.

e.g 1.5 gram atom of carbon=1.5X12.011=18.0165 grams of carbon

Molecular Mass: The molecular mass of a substance is defined as the average relative mass of one molecule of it compared to $1/12^{th}$ of one atom of stable C^{12} isotope. It is calculated from the sum of atomic masses of elements multiplied by by the number of atoms present in the molecule.

e.g Molecular mass of sodium carbonate (Na_2CO_3):
2 X atomic mass of sodium+1Xatomic mass of carbon+3Xatomic mass of carbon
=2X23+1X12.011+3X16=46+12.011+48=106.011u
Molecular mass of ethane(C_2H_6): 2Xatomic mass of carbon+6Xatomic mass of hydrogen
=2X12.011+6X1.008=24.022+6.048=30.07u
Molecular mass of sucrose($C_{12}H_{22}O_{11}$):
12Xatomic mass of carbon+22X atomic mass of hydrogen+11Xatomic mass of Oxygen
=12X12.011+22X1.008+11X16.00=144.132+22.176+176=342.308u
Gram Molecular Mass: The molecular mass of a compound or an element expressed in grams is known as gram molecular mass. Alternately, it is also called one gram molecule.
e.g.1 gram molecule Oxygen(O_2)=Molecular mass of oxygen=32 grams

1gram molecule of water (H_2O) =Molecular mass of water=18.016 grams

Mole Concept: One gram atom of any element contains same number of atoms and one gram molecule of any substance contains same number of molecule. This number is experimentally found out to be 6.022137×10^{23} correct upto 7 significant figures. This value generally taken as 6.022×10^{23} and is known as Avogadro's Number and is taken to be a constant. The amount of substance in Avogadro's number of atoms or molecules is known as '**mole**' or mol. It taken as 7^{th} fundamental quantity in SI system of units.