# **CHAPTER ONE**

#### MATTER AND THE ATOM:

#### MATTER:

- Matter is anything which has weight and occupies space, and examples are stone, wood, sand and air.Mather can exist or be found in three states and these are:

- (i) The solid state.
- (ii) The liquid state.
- (iii) The vapour or the gaseous state.

#### THE SOLID STATE OF MATTER:

- Solids have definite or fixed shape and volume, with examples being stone, iron and wood.- The spaces between the molecules of a solid are very small, and the molecules or particles are tightly packed together. - In the solid state of matter, the molecules are not free to move about since the attractive forces acting between them are very strong.

#### THE LIQUID STATE OF MATTER:

- Even though a liquid has a fixed volume, it does not have a definite shape. - For this reason, a liquid therefore takes the shape of its container. - The spaces between the molecules within a liquid are greater than those between that of a solid. - The force of attraction between the molecules of a liquid is not as strong as that between the molecules of a solid.

#### THE VAPOUR STATE OF MATTER:

- Since a gas has no fixed shape or volume, it always takes the shape of its container.- The spaces between the molecules of a gas are greater than those between the molecules of a liquid or a solid.- Because the attractive forces acting between the molecules of a gas are the weakest, a gas always spreads out to fill its container.

#### CHANGE OF STATE:

- Matter can be changed from one state into another, provided the right conditions are provided - For example water can be changed into the vapour state by heating it, and the vapour can be changed back into water by cooling it.

#### MELTING :

- This the process in which a solid changes into the liquid state.-For example if ice which is water in the solid state is removed from the freezer, it melts into water which is a liquid.

#### VAPORIZATION OR EVAPORATION:

- This is the process in which a liquid changes into the vapour state.- For example if water is heated continuously, it changes into the vapour state.

#### **CONDENSATION:**

- This is the process in which a gas or vapour, is changed into the liquid state.- For example if water is cooled, it changes into water and the vapour is said to have been condensed into water.

#### SUBLIMATION:

This is the process in which a solid changes directly into the vapour state, without passing through the liquid state.
There are certain substances such as solid iodine, sulphur and camphor which changes directly from the sol.id state into the gaseous state, and they are said to have sublimed.
For example if camphor or sulphur is heated, they change directly into the gaseous state.

ELEMENT:- Certain substances such as water are made up of two or more different atoms, i.e. hydrogen and oxygen in the case of water.- Other substances such as aluminum and oxygen, are made up of only one particular type of atom.- A substance which is made up of only one particular type of atom is called an element.- Elements may exist as solids, liquids or gases.

While hydrogen is an example of a gaseous element, that of solid is iron and that of liquid is mercury. - Elements can be represented by one or two letters, and these letters or letter used to represent elements are called chemical symbols.

- Given next are a few or the elements as well as their chemical symbols.

#### **ELEMENTSYMBOL**

Aluminum	.Al
Carbon	C
Calcium	.Ca
Chlorine	.Cl
Gold	.Au
Hydrogen	H

Iodine	l
Iron	Fe
Zinc	Zn
Tin	Sn
Sulphur	S
Silver	Ag
Nitrogen	N
Oxygen	0
Potassium	К
Copper	Cu.
Sodium	Na
Mercury	Hg
Magnesium	Mg

#### ATOM:

- This is the smallest particle of matter, which can exist.- When matter such as a piece of chalk is continuously divided into two portions, a stage will be reached at which we shall get the smallest particle possible, which can no longer be divided. - This smallest particle is what is referred to as the atom.

#### MOLECULE:

- When two or more atoms combine or come together, a molecule is formed.- For example the nitrogen molecule is formed when two nitrogen atoms combine or are brought together.

- Also since the hydrogen molecule is formed when two hydrogen atoms come together, it is represented by the symbol  $H_2$ .

Water molecule is formed by the combination of two atoms of hydrogen, and an atom of oxygen and is represented by the formula  $H_20$ .

#### THE STRUCTURE OF THE ATOM:

- Even though the atom is very small and cannot be seen even with a microscope, scientists have various ways of getting information about the atom.



- The atom is round in shape, and at its central part can be found a structure called the nucleus.
- Surrounding the nucleus are the orbitals or shells, in which the electrons move.
- There are different types of atoms with varying number of electrons and shells.
- Each shell has a certain maximum number of electrons it can hold.
- While the first orbital or shell can hold a maximum of two electrons, the second can hold up to eight electrons and the third can hold up to a maximum of eighteen electrons.
- The electrons are negatively charged and each carry a charge of -1.
- Within the nucleus of an atom can be found two types of sub-atomic particles and these are
  - (i) the protons.
  - (ii) the neutrons.
- Each proton carries or bears a charge of +1.
- Within an atom which is neutral, the number of positive charges (protons) is always equal to that of the negative charges (electrons).
- For this reason, the atom is said to be electrically or electrostatically neutral.
- Therefore if such an atom has two protons, then it will have two electrons and these protons and neutrons will cancel the effect of each other, rendering the atom to become neutral.
- The neutrons are neutral since they bear no electrical charge, and the neutrons and the protons are collectively referred to as the nucleons.

### The atomic number:

- This is also known as the proton number and it is represented by the symbol Z.
- The atomic number of an element is the number of protons or electrons within its atom.
- Therefore if the atom of an element contains 8 electrons, then its atomic number will b 8, and if it contains only 2 electrons then it atomic number will be 2.
- Also if an atom contains 5 protons, then its atomic number is 5, and if there are 3 protons then the atomic will be 3.
- The atomic number can be used to differentiate one element from another, since each element has an atomic number which is different from that of any other element.

## The mass number:

- This is also referred to as the nucleon number, and it is represented by the symbol A.
- The mass number refers to the total number of protons and neutrons found within an atom.
- Since the number of protons and electrons within an atom are the same, the mass number may also be defined as the total number of electrons and protons within the atom.

(Q1) Within an atom, there are 5 electrons and 2 neutrons. Find its mass number.

Soln:

Number of electons = 5.

Number of neutrons = 2.

Mass number = 5 + 2 = 7.

(Q2) There are 2 neutrons and 6 protons within an atom. Determine its mass number.

Soln:

Number of neutrons = 2. Number of proton = 6. Mass number = 2 + 6 = 8. (Q3) An atom has a mass number of 10. If it contains 2 electrons, how many neutrons does it contain?

Soln:

Mass number = 10.

Number of electrons = 2.

Number of neutrons =?

Since mass number = number of neutrons + number of electrons,

=>10 = number of neutrons + 2,

 $\Rightarrow$  10 – 2 = number of neutrons,

=>number of neutrons = 8.

(Q4)An atom which contains 3 electrons has a mass number of 8. Determine the number of neutrons that it contains.

Soln:

Number of electrons = 3.

Mass number = 8.

Number of neutrons =?

Since mass number = number of electrons + number of neutrons,

=>8 = 3 + number of neutrons,

=>number of neutrons = 8 - 3 = 5.