5/11/2024.

Unit - 1

.... Atomic Structure ....

Definition of atom, Fundamental Particle of atom, their mass, charge, Location, Definition of atomic No., Atomic Mass No., Isotopes & Isobars, & their distinction with suitable examples. Bohr's Theory, Definition, Shape of the orbitals & distiction between orbit & orbitals, Hund's Rule, Filling up of the orbitals by Aufau's principle (till atomic no. 30), Definition & types of valency (electrovalency & covalency), Octet Rule, Formation of Electrovalent & covalent compounds e.g. NaCl, $CaCl_2$, MgO, $AlCl_3$, CO_2, H_2O, Cl_2, NH_3, C_2H_4, N_2, C_2H_2 Distinction between electrovalent and covalent compounds.

* Atom :- Atom is a made up of smallest particle of an element it can take part in chemical change is called atom. It can not be further divided.

1. Atomic Structure

Atom :- It is the smallest particle of matter which cannot be further divided.

* Three types of fundamental particle of atom :-

(i) Electron
(ii) Proton
(iii) Neutron

(i) **Electron :-** It is discovered by J.J Thomson.

→ Is has unit negative charge.

→ It's relative mass is equal to the $\frac{1}{1837}$ times mass of 1 hydrogen atom.

→ Absolute mass of electron = 9.1×10^{-31} Kg

→ Absolute charge of electron = -1.6×10^{-19} Coulomb

→ It's location is around the nucleus.

(2) Proton :— It is discovered by 'goldstein'.

→ It has unit positive charge.

→ It's relative mass is equal to the mass of 1 hydrogen atom.

→ Absolute mass of proton = 1.672×10^{-27} Kg

→ It's location is in the nucleus.

(3) Neutron :— It is discovered by James chadwick.

→ It is the sub atomic particle having same mass as that of proton :— It is relative mass is almost equal to the mass of one hydrogen atom.

→ It has no charge.

→ Absolute mass of neutron = 1.675×10^{-27} Kg

→ Absolute charge of neutron is neutral.

→ location - In the nucleus.

* Atomic Number (Z) :—

The number of unit positive charge present in the nucleus of the ion atom of the element.

OR

The number of proton present in the nucleus of an atom of the element.

i.e	Atomic Number = No. of proton Z = P

For any neutral atom,

Atomic number = No. of proton
No. of electron

i.e Z = P = e

If, The number of proton is less than the no. of electron, then the atom should be negatively charged called anion.

eg:- $_{11}Na^{+}$ = No. of proton = 12
No. of electron = 10

And,

If the number of proton is more than the no. of electron the atom should be positively charge, called 'Cation'.

eg:- $_{17}Cl^{-}$ = No. of proton =
No. of electron = 17 + 1
= 18

* **Mass Number (a):-** The sum of the total no. of proton and neutron present in the nucleus of an atom is called mass number.

i.e, Mass number = total no. of proton + total No. of neutron

or $\boxed{a = p + n}$

* **Isotope:-** The element having same atomic number but different mass number is called Isotopes.

for eg : hydrogen have three isotopes :-

$_{1}^{1}H$, $_{1}^{2}H$, $_{1}^{3}H$

Oxygen have three isotopes :-

$_{8}^{12}O$, $_{8}^{16}O$, $_{8}^{18}O$

Carbon have three isotopes :-

$_{6}^{12}6$, $_{6}^{13}C$, $_{6}^{10}C$

* Isobars :- The element having same mass number but different atomic number is called isobars.

for eg :- $_{22}^{210}Pb$, $_{32}^{210}Bi$, $_{6}^{14}C$, $_{7}^{14}N$

$_{18}^{40}Ar$, $_{19}^{40}K$, $_{20}^{40}Ca$

* Difference between Isotopes and Isobars.

	Isotopes	Isobars
1.	They have the same atomic number but different mass number.	1. They have the same mass number but different atomic number.
2.	They have identical electronic configuration.	2. They have different electronic configuration
3.	Their chemical properties are identical	3. Their chemical properties are different
4.	They have the same no. of proton and electron but different no. of neutron.	4. They have unequal number of protons, electrons and neutrons.
5.	They occupy the same place in the periodic table. eg:- $^{35}_{17}Cl$, $^{37}_{17}Cl$	5. They occupy different place in the periodic table. eg:- $^{40}_{18}Ar$, $^{40}_{19}K$, $^{40}_{20}Ca$

Bohr's Atomic Model :—

→ Bohr's model of atom was purposed by Neil's Bohr is 1913.

→ Bohr modifyied Rutherford model of an atom by explaining that a nucleus (the charged) is surrounded by negatively charged electron.

→ Bohr modified rutherford Bohr model consist of a small nucleus (+ve charged) surrounded by negatively charged electrons moving around the nucleus.

→ Bohr found that electrons located a ways from the nucleus has more energy and electrons close to the nucleus has less energy.

* Postulates of Bohr's model of an atom :—

→ The electron revolves around the nucleus in certain circular path called orbit. These

Note:- Plank's constant value :-

$h = 6.626 \times 10^{-34} m^2 Kg/s$

$= 6.62 \times 10^{-34} J/s$ (Joule / second)

orbits are associated with fixed energy and also called energy level, these are numbered as 1, 2, 3, 4 ..... or designated as K, L, M, N.

→ Angular momentum of electron is quantised fixed i.e only those orbits are permitted in which the angular momentum of electron is a whole number multiple of $\frac{h}{2\pi}$, where h is 'plank's constant' h or,

Angular momentum of electron :—

$$mvr = \frac{nh}{2\pi}$$

Where, n = No. of electron

V = Velocity of electron

r = radius of orbit

no. of orbit shell 1, 2, 3, 4 ----.

→ As long as the electron remains at a particular orbit, it does not lose or gain energy which means energy of an electron in a particular orbit is constant.

→ When energy from some constant source is supplied to the electron, it may jump

to heighen energy level by observing a fixed amount of energy which is equal to the difference in energy between the two energy level.

$$\Delta E = h\nu^{3}$$
$$E_2 - E_3 = h\nu^{3}$$

$$\nu^{3} = \frac{E_2 - E_1}{h}$$

→ Where ν^{3} = Frequency of the radiation emitted when a jumps from E_1 to E_2.

*Limitation :—

→ It cannot explain the spectrum of multi electron spices.

→ It could not explain the De-Broglie wave matter duality.

→ It couldnot explain Huisenberg's uncertainly principle.

Orbit :- The fixed path on which electron moves or revolves around the atoms.

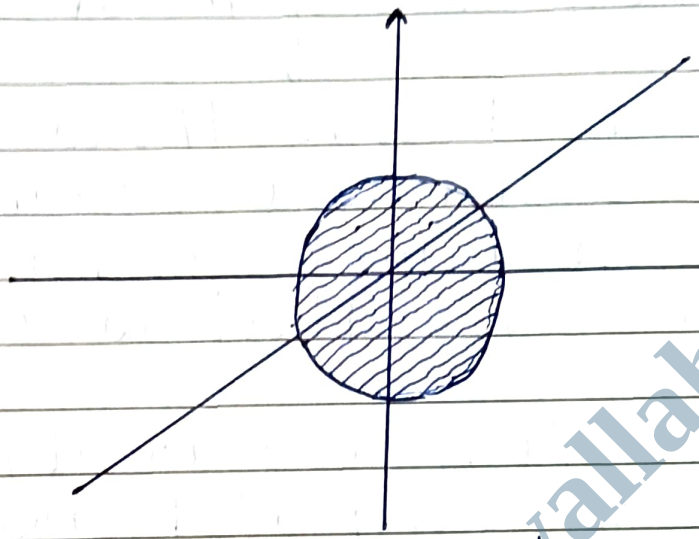
Orbital:- The space around nucleus where probability of finding electron is maximum is called orbital.

Orbit and Orbital

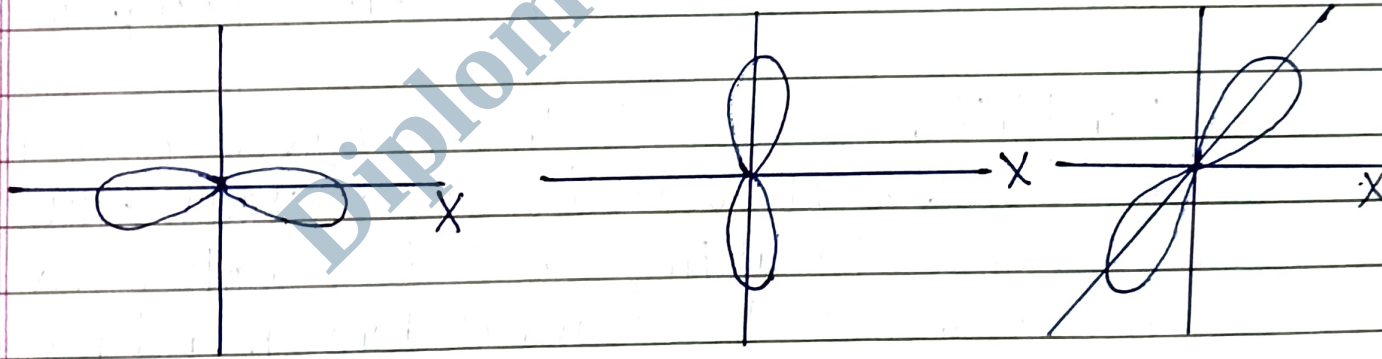
Orbit	Orbital
(i) An orbit is well defined circular path around nucleus in which e^- revolve.	(i) Orbital is space around nucleus where probability of finding e^- is maximum.
(ii) It gives 2D motion of e^-	(ii) It gives 3D motion of e^-
(iii) Shape of orbits are circular	(iii) Orbital having different shape. s - spherical p - Dumbel d - double dumbel f - Complecated
(iv) No directional properties.	(iv) Except s-orbitals all orbitals having directional properties.

Shape of orbitals :—

s. orbital :— Spherical.



p. orbital :— Dumbed shaped.



p_x p_y

d. Orbital :— Double dumbed shaped.

22/1/25.

Metals :-

* Mechanical Properties of metals :-

(1) Hardness :- Hardness is the ability of the metal to resist wear or abrasion. For ex :- Tungsten metal is hardest and Potassium is softest among metals.

(2) Toughness :- It is the property of a metal to resist repeated shocks or vibration without breaking.
Ex :- Gold & Silver are tough metals.

(3) Ductility :- It is the property of metals by which it can be stretched in length without breaking. Ex :- Gold, Silver, Platinum can be easily drawn into wires.

(4) Malleability :- It is the property by virtue of which a metal can be rolled into thin sheets without breaking.

Ex :- Gold, Silver, Aluminium etc.

5. Tensile strength :— The tensile strength of a metal is the cability to carry a load without breaking.

6. Machinability :— It is the property of metal which allows it to give the required shape with the help of machine.

7. Weldability :— It is the process of uniting two piece of metal by means of heat by bringing their ends in the molten state.

8. Soldering :— A method of joining the metal surface by introducing a molten non ferrous alloy with melting point 400° C between them is known as soldering.

9. Costability :— It is the ability of a molten material to take exact dimensions of the mould.

* Flux :— The acidic substances like SiO_2, P_2O_5 etc or basic substance like CaO, MgO etc. Which are mixed with the ore to remove acidic or basic impurities are called flux.

⟶ Flux combines with the impurities and form a fused mass which is seperated from the metal from time to time.

- Fluxes are of two types :—

(a) Acidic flux :— It is used to remove basic impurities like FeO, CaO, HgO etc.

For Ex :— SiO_2, P_2O_5, TiO_2 etc.

$FeO + SiO_2 \longrightarrow FeSiO_3$
Gangue flux — ferrous silicate slag.

(b) Basic flux :— It is used to remove acidic impurities like SiO_2, P_2O_5 etc.

Ex :— CaO, MgO etc.

$SiO_2 + MgO \longrightarrow MgSiO_3$
Gangue flux slag

- Slag :— The fused mass which is separated from the processes formed by the combination of flux and impurities is called slag.

flux + Matrix ⟶ slag

(1) Example :—
$SiO_2 + CaO \longrightarrow CaSiO_2$
flux Matrix slag
(acidic) (Basic)

(2) $CaO + P_2O_5 \longrightarrow Ca(PO_3)_2$
flux Matrix slag
(Basic) (Acidic)

Q. difference between minerals and ores ?

Ans. -

Minerals	Ores
• All minerals are not ores.	• All ores are minerals.
• For Example :— Salts, solids, matter etc.	• For ex :- Zinc, bauxite, and cinnabar etc.

- They have definite crystalline structure.
- They do not have definite crystalline structure.
- Minerals are all naturally occuring compounds that can be found in the earth's crust.
- Ores are commonly utilized to extract metal at a low cost.
- Minerals are metals compound in their natural state.
- Minerals deposite are known as Ores.

* Physical properties of metal :—

- Metals are malleable and ductile.
- Metal are good conductor of heat and Elasticity.
- Metals are lustrous (shiny) and can be polished.
- Metals are solid at room temp.
- Metals are tough and strong.

(1) Metals :— The element which is hard, dense ductile, malleable, good conductor of heat and electricity, electropositive in nature and possess shining/lustrous and high melting and boiling point are called metals.

Ex :— Copper, iron, gold etc.

(2) Non-metals :— The elements which are soft, brittle, less dense, dull in appearance, poor conductor of heat and electricity, electronegative in nature and possess low melting and boiling point are called non-metal. Ex :— Oxygen, Sulpher etc.

Metalloids For ex :— Antimony, Arsenic, Bismuth etc.

(3) Metalloids :— The elements that show the properties of both metals and non-metals are known as metalloids.

(4) Occurence of metals :—

→ Metals occur in nature in two forms which are given below :—

(1) In free or Native state.

(2) In combined state
(a) As mineral (b) As ores.

(1) Native (or free state):— The metals which are found in nature in the free or elementary state are called native metals.

For ex:— Noble metals with low resitivity like silver, gold, platinum etc, occur in native or free state in nature. Lumps of pure metal found in nature are known as nuggets.

(2) Combined state:— When a metal is found in combination with other elements (mostly non-metals) in nature, it is said to occur in combinated state. Most of the metal occur in the combined state, in the form of their compound as:—

(a) Minerals:— Minerals are naturally occuring materials found in the Earth's crust.

A minerals has a definite chemical composition and structure. It is found in nature by inorganic processes.

(b) Ores :— The minerals from which the metals can be extracted economically and conveniently are called ores.

★ Metallurgy :—

→ The branch of science dealing with the methods of extraction of metals from their respective ores and refining them to the purity required for commercial purpose is called metallurgy.

• Gangue :— The undesired earthy impurities like sand, rocks, limestone etc. associated with the ore are known as gangue.

These impurities can be acidic (eg SiO_2, P_2O_5 etc) or basic (eg, CaO, FeO, $MgCO_3$ etc).

★ Extration of metals from its ores in detail.

→ The process of extraction metals from ore is called metallurgy.

(1) Crushing :— The ore is pulverized to make it easier to process. This increase the surface area for subsequent processes, the mechanical process of crushing the ore to obtain a fine powder.

(2) Concentration :— The ore is seperated from impurities to increase its metal content.

(3) Reducing :— Reduction is a process that uses reducing agents to extract metals from ores.

(4) Refining :— Refining is a process used to purify metals during the extraction process.

Roasting is a process of metallurgy where ore is converted into its oxide by heating it below its melting point in the presence of excess air.

★ Conversion of the concentrated ore to its oxide form.

→ This concentrated ~~ore~~ ore can be converted into its oxide form by the following two methods :-

a) Roasting b) Calcination.

(a) Roasting :— The process of heating the ore in excess of air below the fusion point with the purpose of changing ore into oxide is known as roasting.

$$S + O_2 \longrightarrow SO_2 \uparrow$$
$$P_4 + SO_2 \longrightarrow 2P_2O_5 \uparrow$$

- The sulphide ores undergo oxidation and change into their respective oxides.

$$2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$$
Zinc sulphate

$$2Pb_5 + 3O_2 \longrightarrow 2PbO + 2SO_2$$
Lead sulphate