3. CHEMICAL BONDING AND MOLECULAR STRUCTURE

STUDY NOTES

CHEMICAL BONDS [1 LAQ (OR) 1SAQ]

Bonds of 'forces of attraction' between atoms, ions or molecules are called 'Chemical bonds'.

TYPES OF CHEMICAL BONDS

(1) Ionic bond (2) Covalent bond (σ,π bonds)
(3) Co-ordinate covalent bond (Dative bond) (4) Metallic bond (5) Hydrogen bond

MOLECULAR STRUCTURES OF CHEMICAL BONDS

(1) Linear: (sp-CO_2), 180° (2)Trigonal planar: (sp^2-BF_3),120° (3)Tetrahedral: (sp^3-CH_4), 109°28'
(4)Trigonal bi pyramidal: (sp^3d-PCl_5), 90°,120° (5) Octahedral: (sp^3d^2-SF_6), 90°

VARIOUS APPROACHES OF CHEMICAL BONDS

(1) Kossel-Lewis approach (2) VSEPR Theory
(3) Valence Bond Theory (VBT) (4) Molecular Orbital Theory (MOT)

KOSSEL-LEWIS APPROACH

Atoms combine to acquire nearest 'Inert gas configuration'. This is possible in two ways.
(1) By the transfer of valence electrons from one atom to another (proposed by Kossel).
(2) By mutual sharing of electrons (proposed by Lewis).

VSEPR THEORY

VSEPR theory explains the geometrical shapes of simple molecules on the basis of **repulsions** between valence shell electron pairs.

VB THEORY

VB Theory explains the formation of covalent bonds on the basis of **overlapping of atomic orbitals**, hybridisation of orbitals, Electronic configuration of valence electrons.

Molecular Orbital Theory (MOT)

'Atomic orbitals' of the bonded atoms combine to form Molecular Orbitals.
Electrons in the molecule reside in Molecular orbitals instead of atomic orbitals.

IONIC BOND (NaCl, KCl , Sulphuric Acid)

Ionic bond is formed when 'one atom completely **Transfers** electrons' to another atom.

COVALENT BOND (H_2O, O_2, N_2, C_2H_4, Diamond)

Covalent bond is formed when both atoms contribute same number of electrons in the sharing.

SIGMA BOND (σ)

'**Strong** Covalent bond' formed by **axial overlapping** of orbitals.

PI BOND(π)

'Weak Covalent bond' formed by **lateral overlapping** of orbitals.

CO-ORDINATE COVALENT BOND (Dative Bond)

This Dative bond is formed when one & only one atom (Donor) contributes the shared pair of electrons.

METALLIC BOND (Na, Gold, Silver, Fe, CO, Ca, Mg,...)

It's the bond present between 'atoms of **Metallic elements**'

HYDROGEN BOND (HF, H_2O, NH_3)

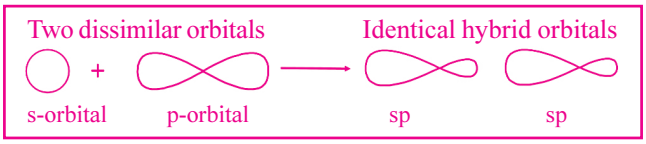
It is a chemical bond' between H atom and more Electronegative atoms like F, O, N .

HYBRIDISATION

Intermixing up of two or more 'different orbitals' of nearly equal energy to form **identical hybrid orbitals** having **same energy.**

sp hybridisation [Ex: $BeCl_2$, C_2H_2]

Intermixing of one s-orbital and one p-orbital to form two new sp-orbitals



Bond angle is 180° and Shape is Linear.

sp^2 hybridisation [Ex: BCl_3, C_2H_4]

Intermixing of one s-orbital and two p-orbitals, to form three new sp^2 orbitals

Bond angle is 120° and Shape is Trigonal Planar.

sp^3 hybridisation [Ex: CH_4, H_2O]

Intermixing of one s-orbital and three p-orbitals, to form four new sp^3 orbitals

Bond angle is 109°28' and Shape is Tetrahedral.

sp^3d hybridisation [Ex: PCl_5]

Intermixing of one s-orbital, three p-orbitals and one d-orbital to form five new sp^3d orbitals.

Bond angles are 90° and 120° and Shape is Trigonal bi Pyramidal.

sp^3d^2hybridisation[Ex: SF_6]

Intermixing of one s-orbital, three p-orbitals and two d-orbitals to form six new sp^3d^2 orbitals.

Bond angle is 90° and Shape is Octahedral.

BULLET MASTER'S

CHEM BEATS!

7 'Basic Questions' of Chemical Bonding and Molecular Structure:

Q1 Why do atoms **combine** to form molecules ? - To get **less energy** and **more stability.**

Q2 How do atoms attain Less Energy? - Energy will be decreased (exo) in chemical bondings.

Q3 How do atoms get **more stability**?- By obtaining **inert gas electronic configuration.**

Q4 How do the atoms acquire **inert gas configuration**?By transferring (or) sharing valence electrons through over lapping of atomic orbitals and **forming chemical bonds**.

Q5 What are different **types** of chemical bonds ?

(i) Ionic bond (ii) Covalent bond (σ,π bonds) (iii) Co-ordinate covalent bond (Dative bond)

Any more bonds ? - Two more bonds (i) Metallic bond (ii) Hydrogen bond

Q6 What are different **shapes** of **chemical bonds** in **molecules** ?

(i)Linear–180^0–CO_2–sp (ii)Trigonal planar–120^0–BF_3–sp^2

(iii)Tetrahedral-109^028^1–CH_4–sp^3 (iv)Trigonal bi pyramidal–90^0, 120^0–PCl_5–sp^3d

(v) Octahedral–90^0–SF_6–sp^3d^2

Q7 What are **various approaches**, regarding the formation of chemical bonds ?

(i) Kossel-Lewis approach (ii) VSEPR (Valence Shell Electron Pair Repulsion) theory

(iii) Valence Bond Theory (VBT) (iv) Molecular Orbital Theory (MOT)

BULLET MASTER'S

CHEM BEATS!

IONIC BOND vs COVALENT BOND vs COORDINATE COVALENT BOND

1) IONIC BOND

Ionic Bond is like **Husband & Wife Relation!**

Reason 1: In NaC*l* Ionic bond formation, Left side Male like Metal atom (Na) **donates its electron** to Right side female like Chlorine atom.

వరుడు కట్నకానుకలు సమర్పించుకొని వధువును వివాహమాడినట్లు!

చట్టబద్ధమైన హెచ్చరిక: కట్నం ఇవ్వడం చట్టరీత్యా నేరం.

Reason 2: Ionic Bond arises due to mutual attraction between oppositely charged ions.

Same is the situation with Married couple.

Reason 3: Ionic bonds are **stronger** than any other bonds.

Generally Marriage relation is stronger which continues for a life time.

2) COVALENT BOND

Covalent Bond is just like a **friendly relation** between two girls of **equal status.**

Reason: Friendship between two girls starts when Girl A offers a chocolate to Girl B.

Their friendship strengthens when Girl B reciprocally offers another chocolate to Girl A.

Thus, **mutual sharing** of two chocolates makes their **friendship covalent.**

3) COORDINATE COVALENT BOND

Coordinate Covalent Bond is just like a **friendly relation** between a **Rich Kid** & a **Poor Baby**.

Reason: Rich Kid donates (sponsors) two Icecreams in the Icecream shop.

They both enjoy eating the Icecreams which establishes a CC Bond between those Two.