Chemical Bond

Topics: ① Why atoms combine together?
② How does combine together?
③ Different types of chemical bond
④ Hybridization

⇒ Why atoms combine together?

⇒ Due to intermolecular force of attraction.
⇒ To archieve the electronic configuration of nearest inert gas.
⇒ To follow the octet rule
⇒ To gain stable electronic configuration
⇒ To form new molecular

⇒ How does combine together?

⇒ Transfer of electrons between two atoms (Ionic or electrovalent bond)
⇒ Equal sharing of electrons between two atoms. (covalent bond)
⇒ Sharing of electrons between two atoms by an atom. (Co-ordinate / covalent- coordinate / Dative bond)

Chemical bond: The intermolecular force of attraction due to which two or more atoms combine together to form a new molecule is called chemical bond.

Different types of chemical bond:

Chemical bond are mainly three types.

① Electrovalent or ionic bond:

The chemical bond as result of transfer of electron from one atom (electropositive) to another atom (electronegative).

② Covalent Bond: A covalent bond is a chemical bond that involves the sharing of electrons to form electron pairs between atoms. These electron pairs are known as shared pairs of bonding pairs.

③ Coordinate / covalent coordinate / Dative bond:

The bond formed when one sided sharing of electrons take place is called a coordinate bond.

Besides these there are many other types of chemical bonds such as:

① Hydrogen bond: The bond between the hydrogen atom of one molecule and a more electro negative element of same or another molecule is called as hydrogen bond.

② Metalic bond: This bond force that holds atoms together in a metallic substance.

③ Vandarwals bond

④ Sigma (σ) bond: A covalent bond formed due to the overlapping of orbitals of the two atoms along the line joining the two nuclei is called sigma (σ) bond.

⑤ Pi(π) bond: A covalent bond formed by the side wise overlapping of p – or d- orbitals of two atoms is called as pi(π) bond.

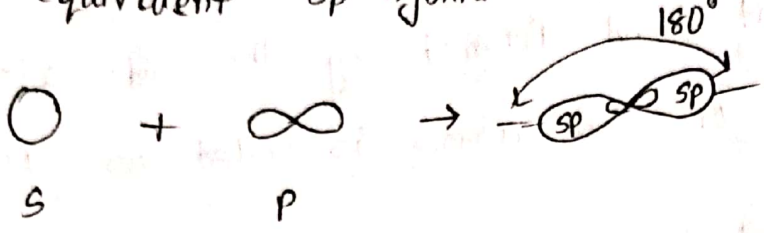
⑥ Polar bond: A polar bond is a bond formed when a shared pair of electrons are not shared equally.

⑦ Non- polar bond: A non polar bond is a type of chemical bond that is formed when electrons are shared equally between two atoms.

Hybridization: Hybridization is defined as the intermixing of atomic orbitals with the same energy levels to give the same number of a new type of hybrid orbitals.

Hybridization: When two or more orbitals combine together then a new types of orbital is forward. The orbitals are called hybrid orbitals and the process is called hybridization.

Sp hybridization: This hybridization involve the mixing of one s and one p orbital resulting in the formation of two equivalent sp hybrid orbitals

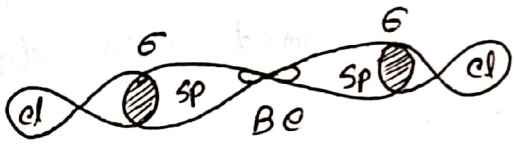


Example: ⊛ $BeCl_2$

$Be(4) - 1s^2 2s^2$

$Be^*(4) - 1s^2 2s^2 2p_x^0 2p_y^0 2p_z^0$

$Be^{**}(4) - 1s^2 \underbrace{2s^1 2p_x^1}_{sp} 2p_y^0 2p_z^0$



$BeCl_2$

$Cl(17) - 1s^2 2s^2 2p^6 3s^2 3p^5$

$Cl^*(17) - 1s^2 2s^2 2p^6 3s^2 3p_x^2 3p_y^2 3p_z^1$

⊛ $CH \equiv CH$

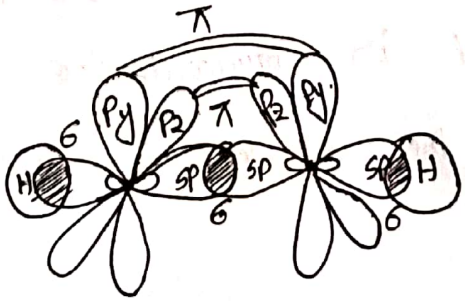
$C(6) - 1s^2 2s^2 2p^2$

$C^*(6) - 1s^2 2s^2 2p_x^1 2p_y^1 2p_z^0$

$C^{**}(6) - 1s^2 \underbrace{2s^1 2p_x^1}_{sp} 2p_y^1 2p_z^1$

$HC \overset{2\pi}{\underset{6}{\equiv}} C\text{-}H$

$H(1) - 1s^1$



$CH \equiv CH$

Characteristics

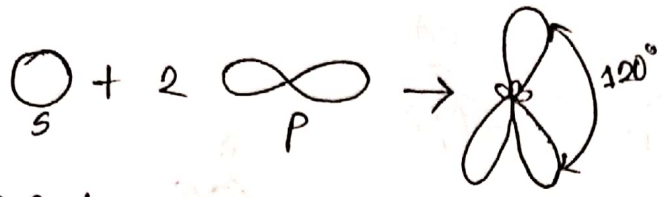
Structure - Linear

Bond Angle - 180°

s-character - 50%

p - character - 50%

sp^2 hybridization: In this hybridization there is involvement of one s and two p orbitals in order to form three equivalent sp^2 hybridised orbitals.

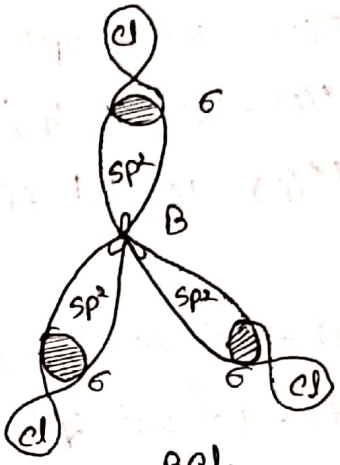


Example: ⊛ BCl_3

$B(5) - 1s^2 2s^2 2p^1$

$B^*(5) - 1s^2 2s^2 2p_x^1 2p_y^0 2p_z^0$

$B^*(5) - 1s^2 \underbrace{2s^1 2p_x^1 2p_y^1}_{sp^2} 2p_z^0$



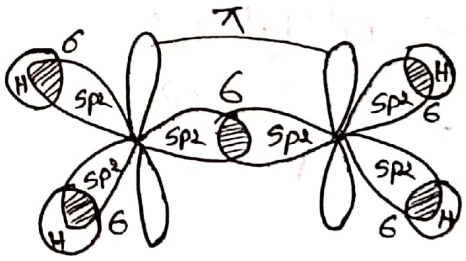
BCl_3

$Cl(17) - 1s^2 2s^2 2p^6 3s^2 3p^5$

$Cl^*(17) - 1s^2 2s^2 2p^6 3s^2 3p_x^2 3p_y^2 3p_z^1$

⊛ इथिलिन ($CH_2 = CH_2$)

$H-C \overset{\pi}{\underset{\sigma}{=}} C-H$



$CH_2 = CH_2$

$C(6) - 1s^2 2s^2 2p^2$

$C^*(6) - 1s^2 2s^2 2p_x^1 2p_y^1 2p_z^0$

$C^{**}(6) - 1s^2 \underbrace{2s^1 2p_x^1 2p_y^1}_{sp^2} 2p_z^1$

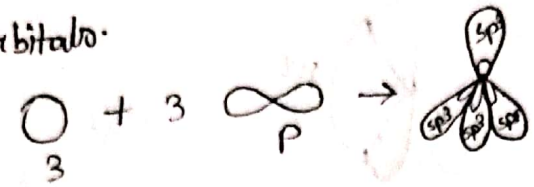
Structure: Triangular

Bond Angle: 120°

S- Character – 33.33%

P- character – 66.66%

sp3 hybridization: In hybridization there is involvement of one s and 3p orbitals in order to form their equivalent sp3 hybridised orbitals.



Example: CCl_4

$C(6) - 1s^2\ 2s^2\ 2p^2$

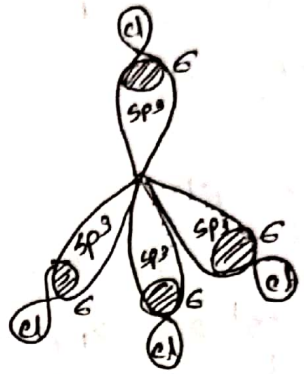
$C^*(6) - 1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^0$

$C^{**}(6) - 1s^2\ 2s^1\ 2p_x^1\ 2p_y^1\ 2p_z^1$

sp^3

$Cl(17) - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

$Cl^*(17) - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p_x^2\ 3p_y^2\ 3p_z^1$



(*) CH_4

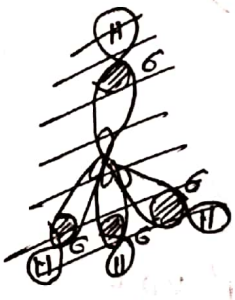
$C(6) \rightarrow 1s^2\ 2s^2\ 2p^1$

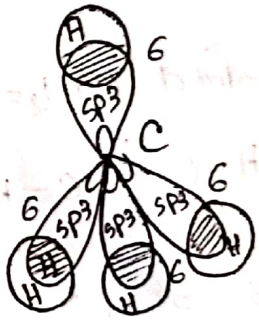
$C^*(6) - 1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^0$

$C^{**}(6) - 1s^2\ 2s^1\ 2p_x^1\ 2p_y^1\ 2p_z^1$

sp^3

$H(1) - 1s^1$





Structure - Tetrahedral

Bond angle - 109°28'

S - 25%,

P - 75%.

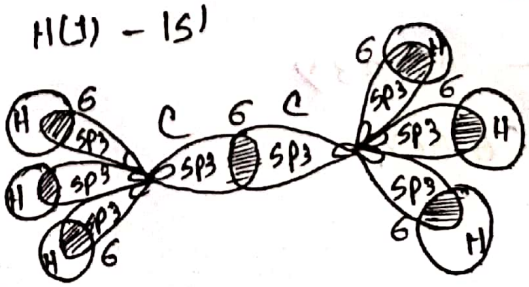
(*) $CH_3 - CH_3$:

$C(6) - 1s^2\ 2s^2\ 2p^2$

$C^*(6) - 1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^0$

$C^{**}(6) - 1s^2\ 2s^1\ 2p_x^1\ 2p_y^1\ 2p_z^1$

$H(1) - 1s^1$



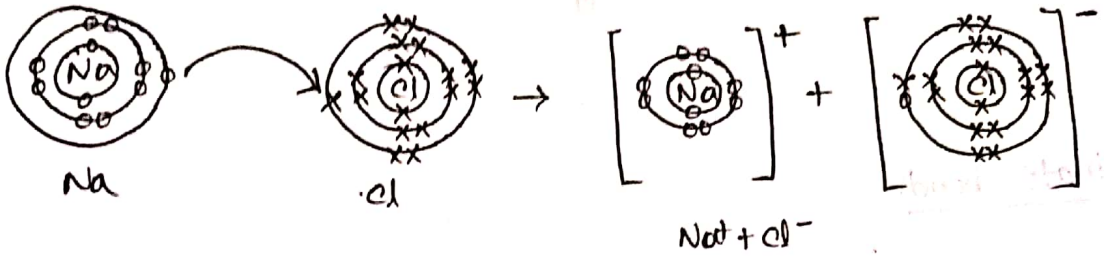
Ionic or electrovalent bond

Discuss the Ionic bond with suitable example.

Let us consider, (NaCl, KCl, $CaCl_2$, $HgCl_2$)

Na(11) – $1s^2$ $2s^2$ $2p^6$ $3s^1$
2 8 1

Cl (17) – $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^5$
2 8 7

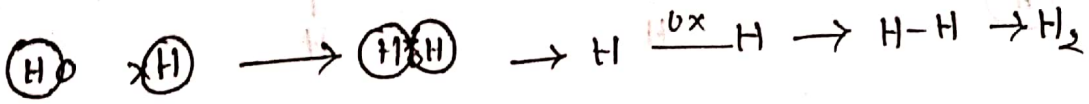


$Na^+ + Cl^-$

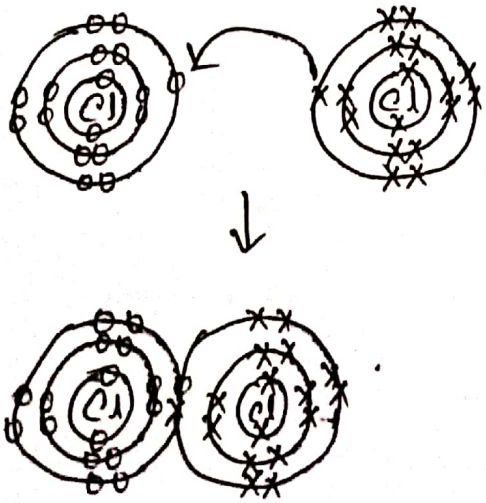
Covalent bond: The chemical bond which is formed by equal sharing of electrons between two atoms is called covalent bond.

Example: H_2, Cl_2 HCl, NH_3 etc

H(1)



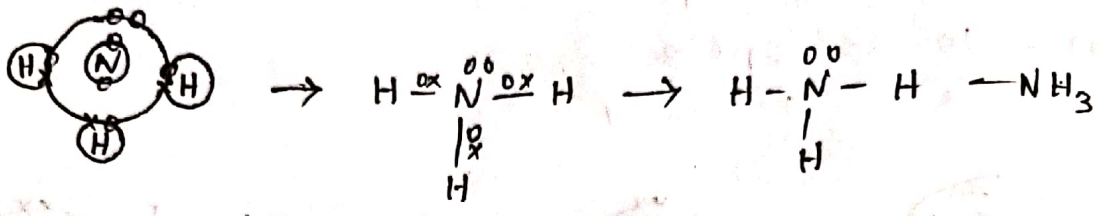
Cl(17) – $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^5$



Cl_2

$NH_3 \rightarrow$ N (7) – $1s^2\ 2s^2\ 2p3$

H (1) – $1s^1$



Coordinate bond:

$NH_4^+ \rightarrow NH_3 + H^+$

H^+ (0) – $1s^0$