Chemical Bonds:

→ to attain stability
→ to have octet
→ to have noble E. configuration

* Octet is not universal.

Don't have octet?
a: BF_3 b: PCl_5
c: SF_6 d: AlI

Types Of Bond:

Ionic Bond

→ complete transfer of $\bar{e}$
→ Metal + Non metal
→ Low I.E High E.A
→ loose $\bar{e}$ Gain $\bar{e}$
→ Ionic bond non directional.
→ No Bond is 100% ionic
  ↳ CsF (92% ionic)
  ↳ NaCl (72% ionic)

Ionic character $\propto \Delta E.N$

Covalent character $\propto \frac{1}{\Delta E.N}$

Q: more Ionic character:
a: NaF → more b: NaCl
c: NaI → min d: NaBr

Coordinate Covalent Bond:

→ Donor
→ $\bar{e}$ pair donate
→ Full orbital
→ Lewis base
→ $\bar{e}$ rich

Acceptor.
→ $\bar{e}$ pair accept
→ Empty orbital
→ Lewis acid
→ $\bar{e}$ deficient

$H_3N: \; BF_3 \rightarrow [H_3N \rightarrow B$

$H_3N: + H^+ \rightarrow NH_4^+$

$H_2O: + H^+ \rightarrow H_3O^+$

% covalent character = $\frac{\text{covalent bond before}}{\text{total bond after}} \times 100 = \frac{2}{3} \times 10$

$= 66\%$

% Coordinat character = $\frac{\text{coordinate Bond}}{\text{total bond}} \times 100 = \frac{1}{3} \times$

$= 33\%$

Covalent Bond:

→ Sharing of $\bar{e}$
→ non metal + non metal

1 ē pair —— single (H-H)
2 ē pair —— double (O=O)
3 ē pair —— Triple (N≡N)

ΔE.N

Polar Covalent Bond (Ionic character)	Non Polar Covalent Bond
→ 0.4 – 1.7	0.00 — 0.4
→ strong	weak
→ Unequal distribution of ē	equal distribution of ē
→ partial charge	no partial charge.
→ High M.pt / B.pt	Low m.pt / B.pt
$H^{+\delta}—Cl^{-\delta}$	H_2, F_2 ΔE.N = 0
$H^{+\delta}—Br^{-\delta}$	Cl_2, I_2

Bond Energy:

↳ E required to breakdown 1 mole of bond.

→ Measure of strength of bond

→ KJ/mol

B.E of polar bond > B.E of non polar.

Factors:

∝ Δ.E.N

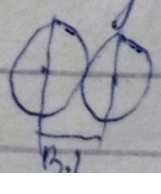
B.E ∝ Bond order (No. of bond)

∝ % s character

∝ $\frac{1}{\text{Bond length/size.}}$

Bond length:

↳ Average distance b/w two bonded atoms



→ Bond length of polar molecules < B.L of nonpolar molecules

→ Units: A°/pm/nm

→ Techniques: to find B.L: → X-ray, e diffraction → spectroscopic.

Factors:

$$\text{Bond length} \propto \frac{1}{\text{B.O / B.E / } \Delta\text{E.N / \% of Schmacter}}$$

Bond length ∝ ~~size~~.

Compounds with Polar bonds but Non Polar:

· CO_2; O=C=O (Bond polar) → dipole moment = 0, so nonpolar

· CS_2; S=C=S (Bond polar) → $\mu = 0$

· BF_3 / CCl_4 / CH_4

WOF has all types of bonds:?

a: $NaBH_4$ b: $LiAlH_4$

c: d: All

$$Na^+BH_4^- \longrightarrow \underbrace{Na^+ + BH_4^-}_{\text{Ionic B}} \longrightarrow \underbrace{BH_3}_{\text{C.B}} + H^- \xrightarrow{\text{C.C.B}}$$

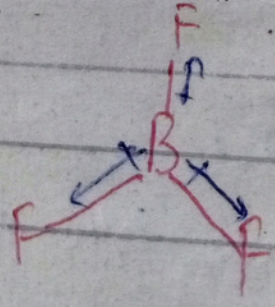
Dipole Moment:

→ $\mu = qr$

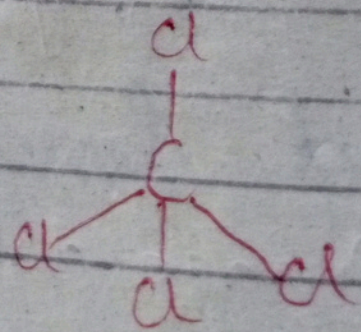
→ Vector

→ Magnitude + Direction. → $+\delta \longrightarrow -\delta$

e.g: $H^{+\delta} \longrightarrow F^{-\delta}$



$\mu = 0$



$\mu = 0$

Applications:
→ Polarity of molecule → μ=0 (non-polar)
→ μ≠0 (polar)

→ % Ionic character: $\frac{\mu_{obs}}{\mu_{ion}} \times 100$ (μobs → given; μion → μ = q×r)
HF → 43% I.C, 57% C.C

Factors:
μ ∝ No. of L.P on central atom
μ ∝ ΔE.N
∝ $\frac{1}{\text{angle}}$

mcq: more μ?
a. HF b. H_2O
c. NH_3 d. same

VBT:

→ "Covalent is formed by overlapping of atomic orbitals."
→ Overlapping → sharing some regions
→ Only half filled orbitals overlap.
→ Number of half filled orbitals = No. of bonds formed
→ Bond strength ∝ extent of overlapping.

P-P (sigma) > S-P (sigma) > S-S (sigma)

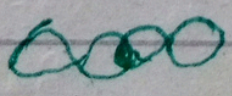
→ Extent of overlaping ∝ $\frac{1}{\text{size of overlaping}}$

1s-1s > 2s-2s > 3s-3s

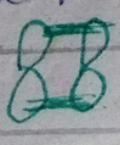
Overlaping

σ-bond:
Head to Head
Linear overlap
1st bond
strong
s-s (H_2)
s-p (HF)
p-p (F_2, Cl_2, Br_2)

a. H-F (1s 2p → strong overlapping)
b. H-Cl (1s 3p)
c. H-Br → weak overlaping (1s-4p, size ↑)



π-bond
→ Sidewise
→ Parallel
→ Lateral
→ 2nd, 3rd
→ Weak



L.P + B.P = hybridization

CO_2 : O ≠ C ≠ O → 0 + 2 = 2 (sp)

SO_2 : O ≠ S → 1 + 2 = 3 (sp^2)

= 4 (sp^3)
= 3 (sp^2)
= 2 (sp)

$SnCl_2$ 1 + 2 = 3 (sp^2)
NH_3 1 + 3 = 4 (sp^3)

C = C : sp^2 sp^2 ; C ≡ N : sp sp

Hybridization
(Modern form of VBT)

Atomic Orbital —mix→ Hybrid Orbital

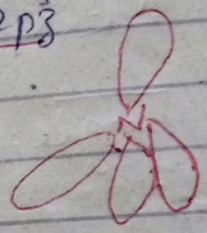
→ Different shape and energy

→ Same shape & Energy.

Ground state: $N_7 = 1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$

Excited state: $= 1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$

Hybrid state: | 1 | 1 | 1 | 1 |
sp^3 sp^3 sp^3 sp^3



Half filled
Empty
Fully filled
} can mix

3s 2p ✗
2s 2p ✓
1s 2p ✗

→ Exothermic process ∴ Bond formation is always exothermic process

→ Valence shell orbital mix.

→ Orbital mix not electron.

→ Number of A.O mix = Number of H.O formed.

Characteristics	sp^3 (CH_4)	sp^2 (C_2H_4)	sp (C_2H_2)
No. of s-orbital	one	one	one
No. of p orbital	three	two	~~two~~ one
No of H. orbital	four	three	two
Mixing ratio	~~25%~~ 1:3	~~33%~~ 1:2	~~50%~~ 1:1
s-character	25%	33%	50%
p character	75%	66%	50%
Type of molecule	AB_4	AB_3	AB_2
Geometry	Tetrahedral	Planer	Linear
Angle	109.5°	120°	180°
Example	CH_4 / H_2O	C_2H_4 / BF_3	C_2H_2 / $BeCl_2$
	NH_3	BH_3 / BCl_3	BeH_2

VESPR:

→ Electron pair
↓ max distance
↓ min repulsion.

→ Electronic geometry
L.P + B.P

→ Shape → B.P
molecular geo

→ L.P > B.P

Repulsion order
L.P - L.P > L.P - B.P > B.P - B.P

= → more space

≡ → no rotation geo.

1 1
O ≠ C ≠ O
not 2-2

Type of molecule	T.E.P	B.P	L.P	E.geometry	M.Geometry	Angle	HB	M
AB_2 B	2	2	0	linear	linear	180° B-A-B	sp	u=0
AB_3E_0	3	3	0	T. planer	T. planer	120°	sp^2	u=0
AB_2E_1	3	2	1	//	Bent	u>0 120°	sp^2	u≠0
AB_4E_0	4	4	0	Tetra	Tetra	109.5	sp^3	u=0
AB_3E_1	4	3	1	tetra	Pyramidal	107.5	sp^3	u≠0
AB_2E_2	4	2	2	//	Bent V-shape angular	104.5	sp^3	u≠0

Total épair = (group of central atom + No. of mono valent atom − magnitude of charge) / 2

$CH_4 = \frac{4+4+0}{2} = \frac{8}{2} = 4$ épair

L.P = T.E.P − B.P = 4 − 4 = 0
AB_4

$BF_4^{-1} = \frac{3+4-(-1)}{2} = \frac{7+1}{2} = \frac{8}{2} = 4$
B.P

L.P = 4 − 4 = 0 AB_4

$NH_3 = \frac{5+3-0}{2} = \frac{8}{2} = 4$
B.P

AB_3E_1

L.P = 4 − 3 = 1

$SO_4^{-2} = \frac{6+0-(-2)}{2} = \frac{6+2}{2} = \frac{8}{2} = 4$

b/c O is divalent not monovalent

L.P = 4 − 4 = 0 AB_4

$NH_3/As H_3/PH_3$
$PCl_3/NF_3 \rightarrow 102°$
$H_2O/H_2S - 92°$

Atoms: BeH_2
$BeCl_2/CS_2/HgCl_2$
$BF_3/BH_3/SO_3$
$AlCl_3/AlH_3$
$SnCl_2/PbCl_4/SO_2$
$CH_4/CCl_4/BF_4^-$
$SiH_4/SiCl_4/NH_4^+$
$SO_4^{-2}/PO_4^{-3}/CrO_4^{-2}$