CHEMICAL BONDING

Chemical Bond:-

→ It is a force that act between 2 or more atoms to hold them together as a stable state.

→ This process is accompanied by decrease in energy through bond formation

→ Chemical Bond formation ∝ decrease in energy ∝ stability of molecule.

— Hence, molecules are more stable than atoms.

→ Bond formation phenomenon is always exothermic.

→ Bond breaking phenomenon is always endothermic.

Q. When 2 atoms combine to form a molecule?

(a) energy is released (b) energy is absorbed

(c) energy is neither released nor absorbed.

(d) energy may either released or absorbed.

Q. The combination of atoms takes place to that:-

(a) They can gain 2 e^- in the outermost shell

(b) They get 8 e^- in outermost shell

(c) They acquire stability by lowering of energy

(d) They get 16 e^- in outer most shell

* Chemical Bond:- [Bond energy > 42 KJ/mol or 10 kcal/mol]

→ It is a type of force of attraction existing between bonded atoms within the molecules. It's bond energy is greater than 42 KJ/mol.

* chemical force:- [Bond energy ≤ 42 KJ/mol or 10 kcal/mol]

→ It is a weak force of attraction existing between non-bonded molecules or non-bonded atoms (noble gases) & its bond energy is less than or equal to 42 KJ/mol

< 8 KJ/mol | 8 KJ/mol ⟷ 42 KJ/mol | > 42

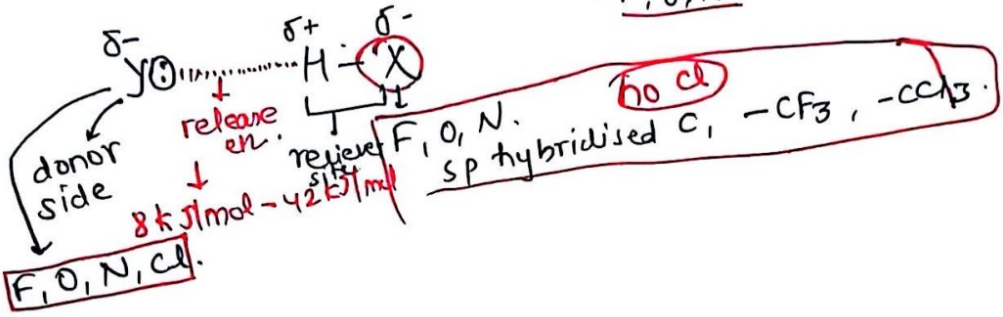
↓ vanderwaal force — H-bond — ↳ Chemical bond

Types of attraction between species

- Strong chemical bond > 42 kJ/mol
  - metallic bond
  - Ionic bond
  - Covalent bond
- Weak chemical force < 42 kJ/mol
  - Vanderwaals force < 8 kJ/mol.
  - H-bond 8 – 42 kJ/mol

H-bond :-

→ H- must be attached to X-atom.
↳ F, O, N.



→ When H-atom is bonded with more E.N. atom, it attract lone pair of adjacent non-bonded polar atom & when release energy in this attraction is > 8 kJ/mol is called H-bond.

Q. Which of them show H-bond?

(a) $H_2O - H_2O$

(b) $O_2 - H_2O$ (non-polar) ✗

(c) HCl – HCl

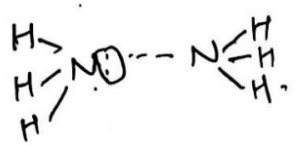
(d) $HCl - H_2O$



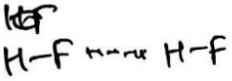
Q. Which of them show H-bonding in ~~pure form~~

pure form

(1) NH_3



(2) HF

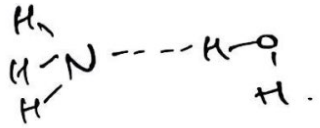


(3) HCl

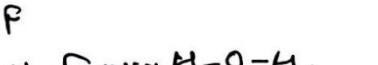
(4) PH_3 ✗

in H_2O

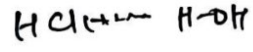
(1) NH_3 -



(2) HF

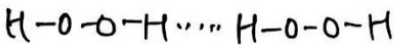


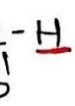
(3) HCl. ✓

↳ 

(5) PH_3 ✗

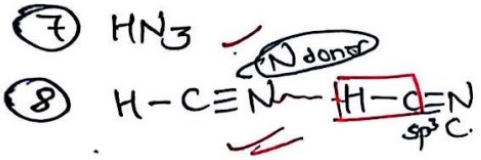
⑤ H_2O_2





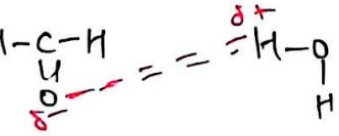
H–O–O–H ····· H–O–O–H

⑥ H–C(=O)–H ✗.



⑦ HN_3

⑧ H–C≡N ~ H–C≡N (N donor; sp^3 C.)



⑨ ethyne ✗

⑤ H_2O_2

⑥ H–C(=O)–H ····· H–O(H) (δ+, δ−)

⑦ HN_3

⑧ H–C≡N

⑨ Ethyne

CH≡CH ····· H–O(H) (sp^3 C.)

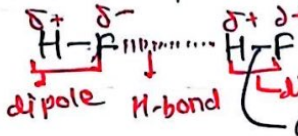


→ H-bond is a special type of dipole-dipole attraction.

δ+ δ− δ+ δ+

H–F ····· H–F

dipole, H-bond, dipole.



covalent bond.
- → stronger than H-bond.
- → bond length less than H-bond.
- → Bond energy ~~of~~ is more than H-bond.

KHF_2 → Fremiz salt

H-bond +nt.

$KHF_2 \longrightarrow K^+ + HF_2^-$

H-bond → ion-dipole



δ+ δ−

F ····· H–F (covalent bond)

H-bond → bond energy almost same

strongest H-bond.

Q. H-bond is :-

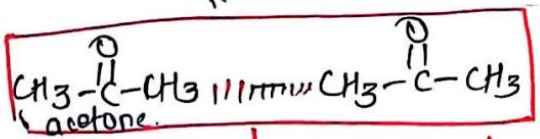
ⓐ dipole-dipole ⓑ ion-dipole

ⓒ both ⓓ none

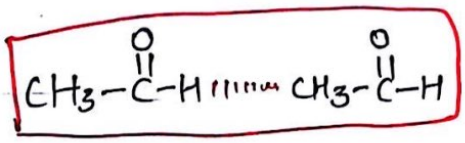
ⓑ ⓒ – ion-ion. → ⓐ.

c > a

$CH_3-C(=O)-CH_3$ ····· $CH_3-C(=O)-CH_3$

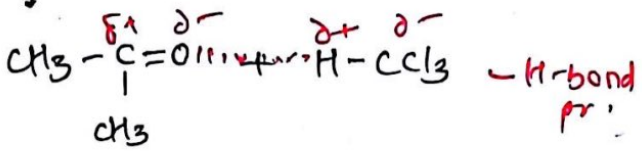


acetone.



no H-bond

$CH_3-C(=O)-H$ ····· $CH_3-C(=O)-H$



→ acetone + $CHCl_3$ →

δ+ δ− δ+ δ−

$CH_3-C(CH_3)=O$ ····· H–CCl_3 – H-bond pr.

Q. Which mixture form H-bond?

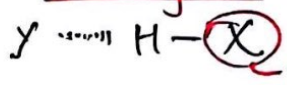
ⓐ HOH & CH_3OH ⓑ HOH & NH_3

ⓒ acetone & $CHCl_3$ ⓓ All

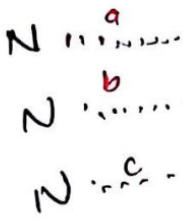
Q. Which acid show H-bonding?

(a) HF (b) HN_3 (c) HCN (d) all

Strength of H-bond

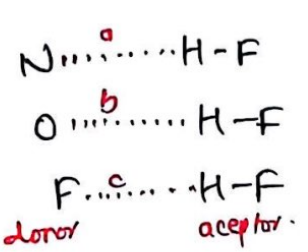


Strength of H-bond | Bond E ∝ EN of X

→ 

a > c > b

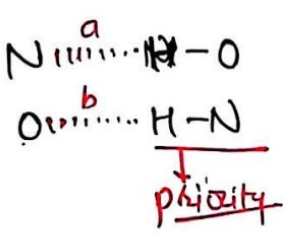
└ H-bond

→ 

H-bond ∝ 1 / EN of donor

a > b > c

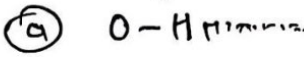
└ H-bond

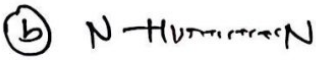
→ 

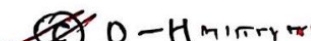
a > b

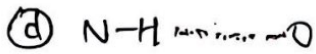
└ H-bond

Q. Strongest H-bond :–

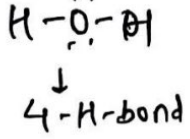
(a) 

(b) 

(c) 

(d) 

Strength of H-bond



4-H-bond



4-H-bond

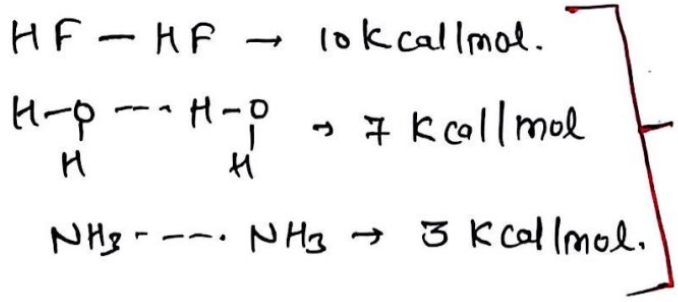


2-H-bond.

Extent of H-bond

↓

no. of H-bond ∝ Strength.



HF – HF → 10 kcal/mol.

→ 7 kcal/mol

NH_3 – – – NH_3 → 3 kcal/mol.

Strength of H-bond.

* Extent of H-bond

$HF-HF \rightarrow 2 \times 10$

$= 20$ K Cal

$H_2O-H_2O \rightarrow 4 \times 7 = 28$ Kcal.

$NH_3-NH_3 \rightarrow 4 \times 3 \rightarrow 12$ Kcal.

$H_2O > NH_3 > HF$

↳ extent of H-bond.

$HF > H_2O > NH_3$

↳ strength of H-bond.

Q. KHX_2 exist ; X = ?

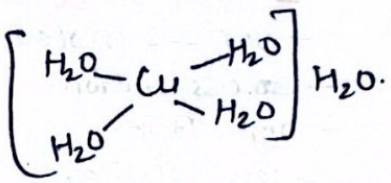
(a) F — due to H-bond → KHF_2.

(b) Cl (c) Br — no H-bond. → $KHCl_2X$, $KHBr_2X$.

(d) All

Q. In $CuSO_4.5H_2O$. No. of H_2O directly linked with Cu?

(a) 0 (b) 4 (c) 3 (d) 5

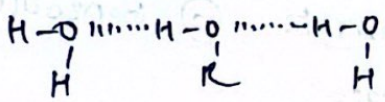


Types of H-bonding

① Intermolecular :-

→ between 2 or more than 2 molecule.

- Homomolecular — e.g. H-F ⋯ H-F
- Heteromolecular — e.g. Alcohol + H_2O.



→ No chelation (Ring formation).

→ Association of molecule.

→

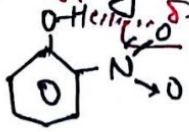
② Intramolecular H-bonding

→ In a single molecule

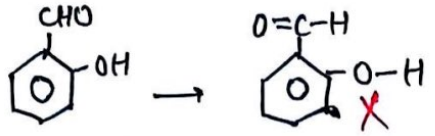
→ Ring like structure. [5 or 6 member ring].

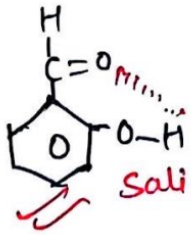
↳ chelation

→ Generally in o- benzene derivative.

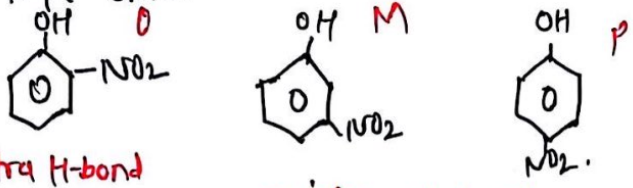


→ No association of molecule.





Q. B.pt order.



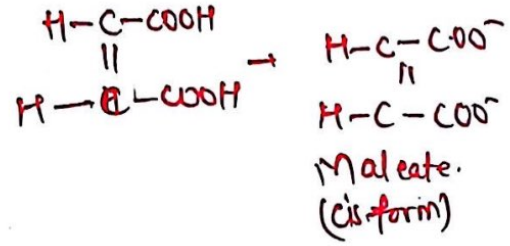
→ intra H-bond	→ inter H-bond.
→ single molecule.	→ various molecule.
→ chelation	→ association.
→ Low Bpt	→ high B.pt.
→ high volatile	→ less volatile
→ less soluble.	→ high soluble.

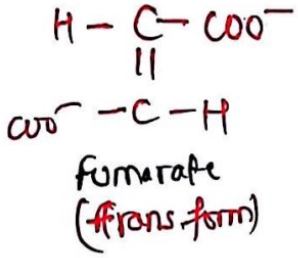
→ ortho-nitrophenol is volatile whereas m & p- nitrophenol is not volatile. so, from mixture o- nitrophenol is separated by distillation (steam distillation).

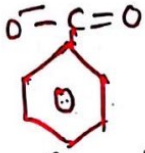
Q. Intra-H bond is present in:-

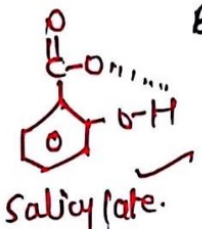
(a) Maleate (b) Fumarate (c) Benzoate (d) Salicylate

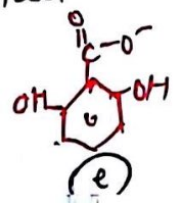
(e) 2,6 – Dihydroxy benzoate.





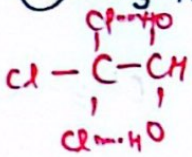






Q. Intra-H bond is present in:-

(a) O-nitrophenol (b) Salicylaldehyde (c) Salicylic acid (d) $CCl_3CH(OH)_2$



(e) enol form of acetyl acetone (f) All

$CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

acetyl acetone ✗ → no H-bond

$CH_3-\overset{O}{\overset{\|}{C}}-CH=\overset{OH}{\overset{\|}{C}}-CH_3$

enol form of acetyl acetone

Application

(1) Physical state:-

NH_3	H_2O	HF
PH_3	H_2S	HCL
⋮	⋮	⋮

HF → Liquid & high B.pt. → H-bond (+nt)

gas & low B.pt → No H-bond → vanderwaal force. (+nt)

(i) Hydride of group 15:-

$BiH_3 > SbH_3 > NH_3 > AsH_3 > PH_3$ → B.pt

NH_3 → weak H-bond.

(ii) Hydride of group 16:-

$H_2O > H_2Te > H_2Se > H_2S$ → B.pt

H_2O → H-bond

B.pt ∝ ⊥ volatile

(iii) Hydride of group 17:-

$HF > HI > HBr > HCl$ → B.pt

HF → H-bond

B.pt
solubility ∝ No. of H-bond ∝ no. of OH-group
viscosity

→ CH_3-CH_2-OH CH_2-CH_2 (OH, OH) $CH_2-CH-CH_2$ (OH, OH, OH)

H-bond ↑es, B.pt ↑es, viscosity ↑es, solubility ↑es.

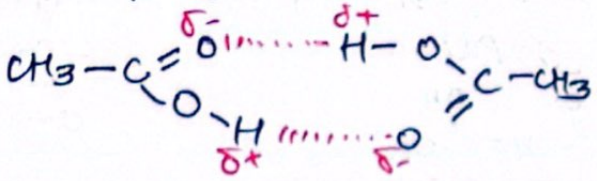
→ H_3PO_4 (3 OH) H_2SO_4 (2 OH) HNO_3 (1 OH)

H-bond ↑es.

V, S, B.pt ↑es.

• Dimer formation

→ Mol. wt of CH_3COOH is 120. because it exist as • dimer by H-bon



CH_3COOH
$HCOOH$
HF → $(HF)_2$

→ Dimer formation by H-bond.

Vanderwaal's forces

→ weakest force.
→ Intermolecular force.
→ 5 types:-

(a) Molecule → Diamagnetic → If ΔEN is zero (Non-polar) → $Cl_2 \rightarrow Cl-Cl \rightarrow 0$.
If ΔEN is non zero (polar). → $HCl \rightarrow H-Cl$
Paramagnetic → net dipole moment (μ) = 0 e.g. CCl_4 → non-polar.
net dipole moment (μ) ≠ 0 → polar. eg $CHCl_3$.

(1) Ion-dipole :-

ion polar molecule.

eg. $Na^+ \cdots H-Cl$ → strongest force.
ion dipole.

F^- & H_2O

(2) Dipole-dipole :- also called (Keesom force).

polar - polar

eg. $H\overset{\delta+}{-}Cl \cdots H\overset{\delta+}{-}Cl$
dipole dipole
Keesom.

→ 2nd strongest.

Q. Which of the following option is an eg of Keeson force.

(a) $CHCl_3 + CHCl_3$ (b) $CCl_4 + CCl_4$

(d) $CCl_4 + CHCl_3$ (d) All
non-polar.

(a) $HCl + HCl$ (b) $CH_3CN + CH_3CN$ (c) $H_2O + H_2O$ (d) All

③ Dipole-induced dipole → also called Debye force.
polar non-polar. — 4th strongest force.

e.g. HCl ⋯ CCl4.
polar non-polar.
Debye force.

eg. $CHCl_3$ ⋯ CCl_4

Q. Which of the following is an eg of debye force?
ⓐ C_6H_6 (non-polar) + H_2O (polar)
ⓑ Xe (non-polar) + H_2O (polar)
ⓒ CCl_4 (non-polar) + HCl (polar)
ⓓ CH_3CN (polar) + CH_4 (non-polar)
ⓔ All

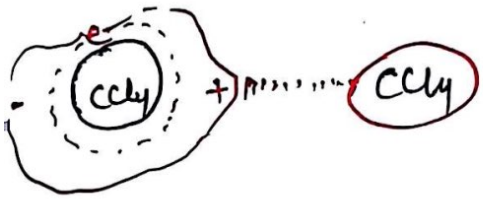
Note:- When size of non-polar molecule increases then dipole-induced dipole ↑es.

H_2O ⋯ He
H_2O ⋯ Ne (b > a)

④ Ion-induced dipole:- 3rd strongest force.
ion non-polar.

eg. Na^+ + CCl_4.
ion non-polar.

⑤ Instantenous dipole-induced dipole:-
→ weakest force.
→ between non-polar molecule.
→ also called london force- / dispersion force.



eg. Cl_2 ⋯ Cl_2
CCl_4 ⋯ CCl_4.
CH_4 ⋯ CH_4.

→ between inert gases. Ne ⋯ Ne.
Ar ⋯ Ar.

Q. Dispersion force is present in:-

(a) Marsh gas (CH_4) (b) Pyrene (CCl_4)

(c) Dry ice (CO_2) (d) C_6H_6 (e) Radon (Rn) ~~(f)~~ All

Note:- In inert gas, dispersion force present.

Q. Weakest force is :-

(a) H- bond (b) Covalent bond ~~(c)~~ Vanderwaal force

(d) Ionic bond

(a) Debye (b) Keesom ~~(c)~~ London Dispersion (d) None

Q. In which mixture, dipole-dipole attraction present?

(a) $KCl + H_2O$ (ion, dipole) (b) C_6H_6 & CCl_4 (non-polar, non-polar) (c) C_6H_6 & C_2H_5OH (non-polar, dipole)

~~(d)~~ Acetonitrile & Acetone

$CH_3-C\equiv N$ (dipole) $CH_3-\underset{\underset{O}{\|}}{C}-CH_3$ (dipole)

Q. $Na^+ \cdots HCl$ (a) $Br^- \cdots CCl_4$ (b) $Cl_2 \cdots Cl_2$ (c)

strength of force → a > b > c.

Q. $F_2 < Cl_2 < Br_2 < I_2$ - London force.

→ Nature of vanderwaals force same अतो अने priority given to molecular weight.

→ He
Ne
Ar
Kr
Xe
Rn

At wt ↑e.
V.W F ↑es.
B.pt ↑es.

Q. LDF works in:—
(a) Polar (b) Non-polar (c) Ionic ~~(d)~~ All. LDF → london force.

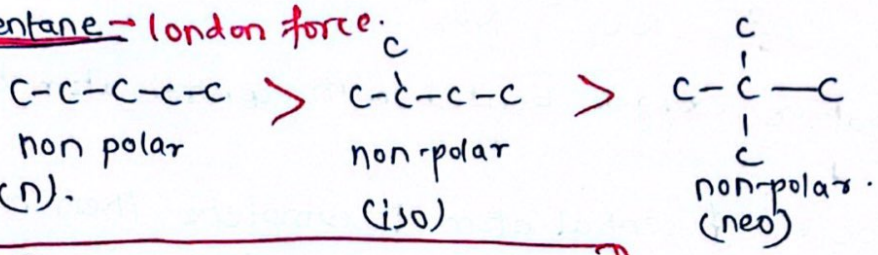
Q. LDF dominant in:—
(a) Polar ~~(b)~~ Non-polar (c) Ionic (d) All

Q. LDF works in:—
(a) only in gas phase (b) only in solid phase
(c) only in liquid phase ~~(d)~~ All

Q. Weakest force?
(a) Keesom (b) Debye ~~(c)~~ London (d) None (a>b>c)

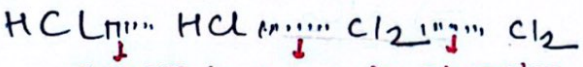
Q. Which of the following force is responsible for solubility of noble gas (non-polar) in polar solvent (H_2O)? (H_2O → dipole.)
(a) dipole-dipole ~~(b)~~ dipole-induced dipole
(c) LDF (d) None

→ n-pentane → london force.

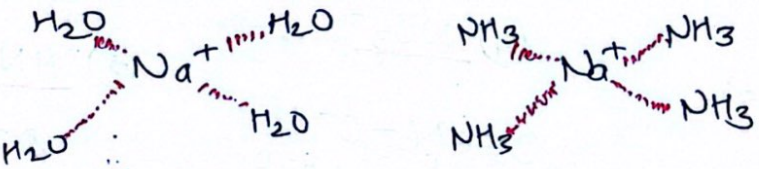


Vanderwaal force ∝ surface area

Trap



→ Hydrated ion & ammoniated ion formed by ion-dipole attraction.



Q (1) Covalent bond (2) Vanderwaal force. (3) H bonding
(4) Ionic

4>1>3>2 → strength

Ionic bond :- also called electrovalent bond.

Polyatomic ion :- SO_4^{2-}, CO_3^{2-}, NO_3^-, NO_2^-

→ Various atom bonded by covalent and coordinate.
100% हुन्छ नहुन नि सक्छ

Q. Bond in KNO_3 are :- Ionic $K^+ \ldots NO_3^-$ covalent.

(a) ionic (b) covalent (c) co-ordinate ~~(d)~~ All

Q. Bond present in NH_4Cl are :- $NH_4^+ \ldots Cl^-$

(a) electrovalent (ionic) (b) covalent (c) coordinate ~~(d)~~ All

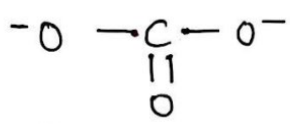
• Polyatomic anion :-

A) Oxo anion :- CO_3^{2-}, NO_3^{2-}, NO_2^-.

$\boxed{\text{Hint}}$ → Negative oxygen bonded with central atom by single bond.

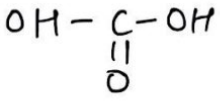
– If octet of central atom is complete then oxygen bonded by co-ordinate bond otherwise oxygen bonded by double bond.

e.g. 1) CO_3^{-2}



$\sigma = 3$
$\pi \Rightarrow 1$. l.p = 0.
bond pair = 4.

② H_2CO_3

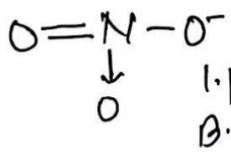


③ NO_2^-



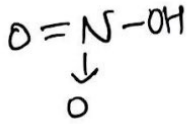
l.p = 1
B. pair = 3.

④ NO_3^-



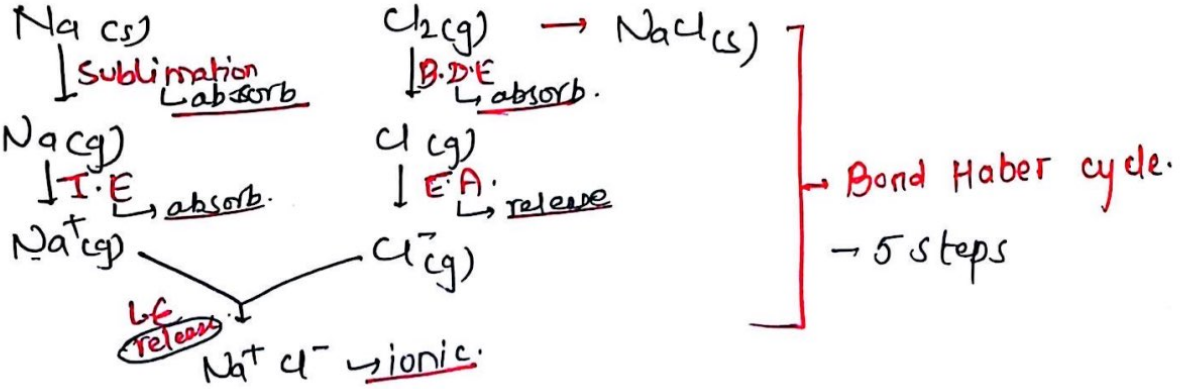
l.p = 0
B. pair = 4.

⑤ HNO_3



* Ionic bond :-

→ Ionic compound को formation मा एउटा cycle चल्छ त्यो cycle Bond haber cycle हो।



Q. Which parameter not involved in Bond Haber cycle.

(a) S.E (b) I.E (c) B.DE (d) Lattice energy ~~(e)~~ EN.

→ $\Delta HF = \underbrace{S.E + I.E + B.D.E}_{\text{absorb}} - \underbrace{E.A - L.E}_{\text{release}}$

ΔHF → enthalpy of formation

for ionic compound. release E > absorb E.

$\boxed{\Delta HF = -ve.}$

→ Bond Haber cycle is used in estimation of lattice energy.

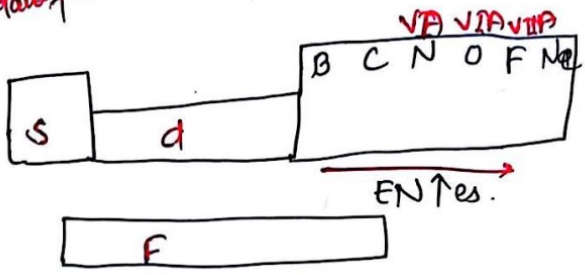
* Ionic bond

→ Between opposite ions.

→ Between metal & non-metal.
S-Block → low E.N. ; high E.N.

$\boxed{\Delta EN > 1.7}$ → Ionic bond.

→ IA, IIA, & sometimes IIIA metals form ionic bond. with VA, VIA, VIIA.
best ; N-fam ; O-fam ; Halo fer.



→ Best group IA & halogen group for ionic bond.

→ CsF is the most ionic compound.

→ No compound is 100% ionic, compound develop some covalent character due to polarization.

→ $\boxed{\% \text{ ionic character} = 16\Delta + 3.5\Delta^2 \quad \Delta = \text{EN difference}}$

→ Na = 0.9

Cl = 3.0

ΔEN = 2.1

% ionic character = $16 \times 2.1 + 3.5 \times (2.1)^2$

$\boxed{\text{Ionic character} \propto \Delta EN}$

→ LiCl < NaCl < KCl < RbCl < CsCl
↳ ΔEN-max.
↳ ionic max.

→ BeO < MgO < CaO < SrO < BaO

→ CaH_2 < SrH_2 < BaH_2

→ AlF_3 > Al_2O_3 > AlN

→ AlF_3 > $AlCl_3$ > $AlBr_3$ > AlI_3

→ NaCl > MgS > AlP
IA IIA IIIA.

→ MF > MCl > MBr > MI

ionic characte

Note:- s-block compound > d-block compound ← ionic.

KCl > CuCl, $CaCl_2$ > $FeCl_2$.

• H–F
2.1 4.
$\boxed{\Delta EN = 1.9.}$
but not ionic
↳ covalent compound.

Trick → No acid is ionic compound.
↳ covalent ইওন /

$H^+NO_3^-$ ← covalent

→ s-block generally ionic except Li Be Mg.

LiH	MgF_2
LiF	MgO
Li_2O	Mg_2C_3
Li_2C	

→ but they are ionic

→ Be_2C is the single compound of Be for ionic.

Q. which is ionic compound?

(a) Be_2C (b) Al_4C_3 (c) Mg_2C_3 (d) CaC_2 ~~(e)~~ All

C^{-4}. C_3^{-4} C_2^{-2}.

→ All acids are covalent in gas or pure form but ionic & conducting in H_2O.

HF HCl HI HNO_3 H_2SO_4 → covalent. (ionic in H_2O.)

→ Anhy. HCl is non-conducting but aq. HCl conducting.

Q. Bond present in HNO_2.
(a) ionic (b) electrovalent (c) covalent (d) Ionic & covalent

• Conditions for ionic bond formation

(1) Large cation & low I.E.
(2) small anion & high E.A.
(3) $\Delta EN > 1.7$.

$Na^+ + Cl^- \rightarrow Na^+Cl^-$ ✗

Lattice Energy:- Energy release during formation of one mole of ionic compound from their component gaseous ion.

$$M^+_{(g)} + X^-_{(g)} \underset{\text{LE}}{\overset{\text{LE release}}{\rightleftharpoons}} MX_{(s)}$$

→ Also, one mole of ionic compound को separate करने में चाहिए energy is L.E.

$$M^{2+}_{(g)} + 2X^-_{(g)} \xrightarrow{\text{L.E}} MX_{2(s)}$$

Q. Which reaction represent L.E of magnesium fluoride (MgF_2).

(a) $Mg_{(g)} + 2F_{(g)} \rightarrow$
(b) $Mg^{+2}_{(g)} + F^-_{(g)} \rightarrow$
(c) $Mg_{(g)} + 2F^-_{(g)} \rightarrow$
(d) $Mg^{+2}_{(g)} + 2F^-_{(g)} \rightarrow$

Factors affecting lattice energy

→ $L.E \propto \frac{\text{charge}}{\text{size}}$ priority

L.E → $Li^+H^- > Na^+H^- > K^+H^- > Rb^+H^- > Cs^+H^-$
(size ↓es, L.E ↑es.)

→ $NaF > NaCl > NaBr > NaI$
(size ↓es. L.E ↑es.)

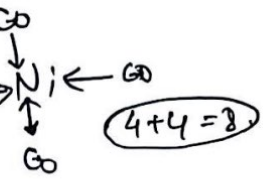
• $Na^+F^- < Mg^{+2}F_2^- < Al^{+3}F_3^-$
(charge ↑es, L.E ↑es)

→ $Li^+F^- < Mg^{+2}F_2^- < Mg^{+2}O^{-2} < Al^{+3}_2O^{-2}_3$
(charge ↑es. L.E ↑es.)

→ Hardness, M.pt, thermal stability and solubility of ionic compound decided by lattice energy.

→ $[Ni(CO)_4]$ → Nickel tetra carbonyl.

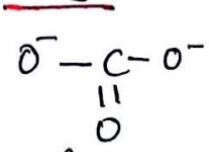
Co-ordinate bond = 4



P, S & Cl → never form co-ordinate bond.

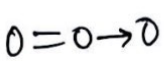
· Polyatomic anion:-

① CO_3^{-2}

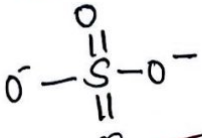


② N_2O

③ O_3

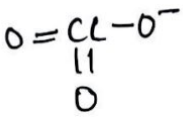


④ SO_4^{-2}

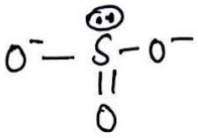


pπ-dπ bonding

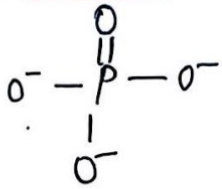
⑤ ClO_3^-



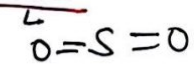
⑥ SO_3^{-2}



⑦ PO_4^{-3}



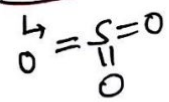
⑧ SO_2



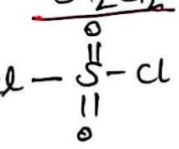
· SO_4^{-2}	H_2SO_4	SO_3	SO_2Cl_2
oxoanion	oxyacid	oxide	oxychloride.
PO_4^{-2}	H_3PO_4	P_4O_{10}	$POCl_3$.

Note:- Due to pπ-dπ bonding in oxoanion, oxyacid, oxide & oxychloride of P, S, Cl. 'O' bonded with central atom by double bond instead of co-ordinate bond.

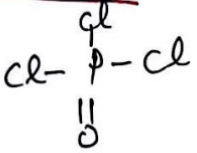
⑨ SO_3



⑩ SO_2Cl_2



⑪ $POCl_3$



→ ① B C N O F → consider octet

↳ central atom & π

P S Cl → 'O' bonded with central atom by double bond.

② Other anion (-ve charge not on side atom)

(a) BF_4^- → $F^- \rightarrow BF_3$.

(b) ICl_4^- → $Cl_3I \leftarrow Cl^-$

(c) $SnCl_3^-$ → $Cl^- \rightarrow SnCl_2$

(d) SiF_6^{2-} → $F^- \rightarrow SiF_4$.

(e) ICl_2^- → Cl^- → ICl.

(f) I_3^- → I^- — I_2 — total $\boxed{3+3+3=9}$
lone pair → 9.
Bond pair →

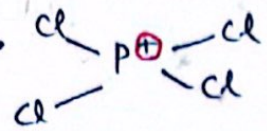
(g) PCl_6^- → Cl^- → PCl_5

(h) SbF_5^{-2} → F^- → SbF_3, F^- → SbF_3

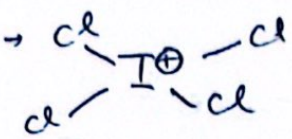
(i) IF_6^- → F^- → IF_5

(j) BrF_4^- → F^- → BrF_3

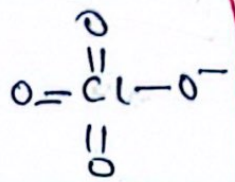
(3) Other cation → +ve charge +nt at central atom.

(a) $P^{\oplus}Cl_4$ → 
l.p = 0
B.p = 4.

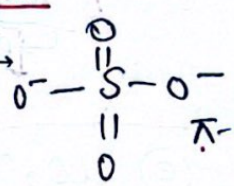
(c) $I^{\oplus}Cl_2$ → Cl — $I^{\oplus}$ — Cl
l.p = 2
B.p = 2.

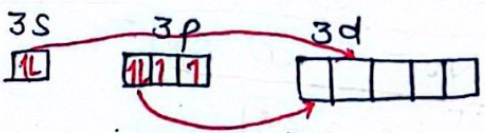
(b) $I^{\oplus}Cl_4$ → 
l.p = 1
B.p = 4.

(d) I_3^+ → I — $I^{\oplus}$ — I
l.p = 2.
B.p = 2.

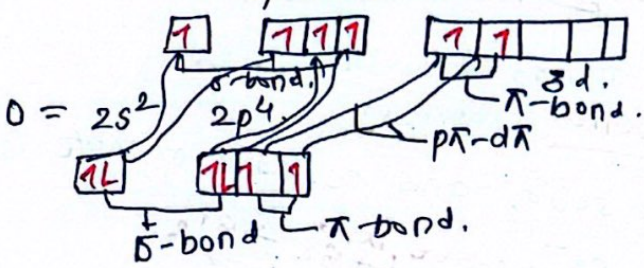
(e) ClO_4^- → 

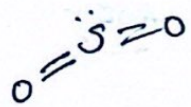
pπ-dπ

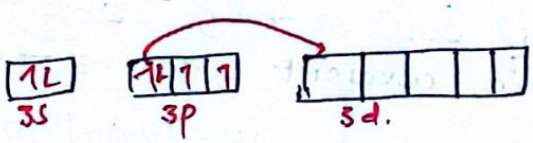
(1) SO_4^{-2} → 
π-bond formed by pπ-dπ overlapping.

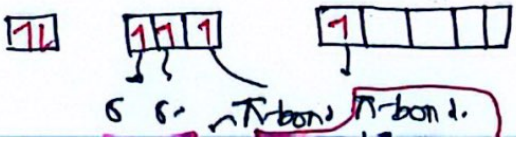
S ⇒ 
→ G.state configuration

after excitation.

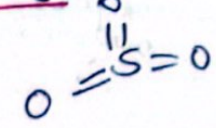

→ E.state.

(2) SO_2 → 

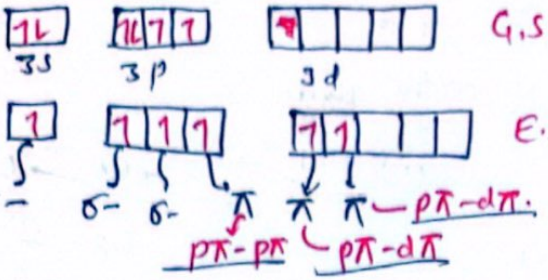
S = 
G.S.



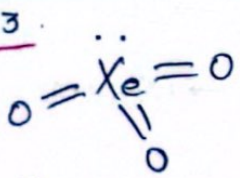
③ SO_3



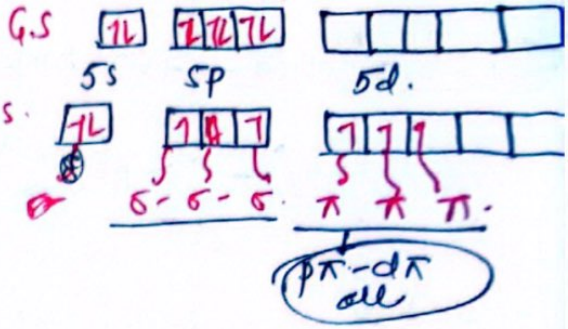
$S = 3s^2\ 3p^4$.



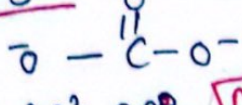
③ XeO_3



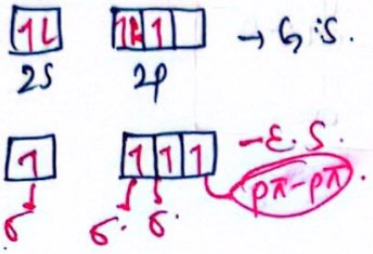
$Xe = 5s^2\ 5p^6$



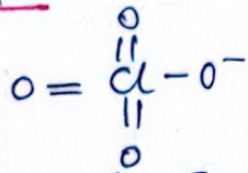
④ CO_3^{-2}.



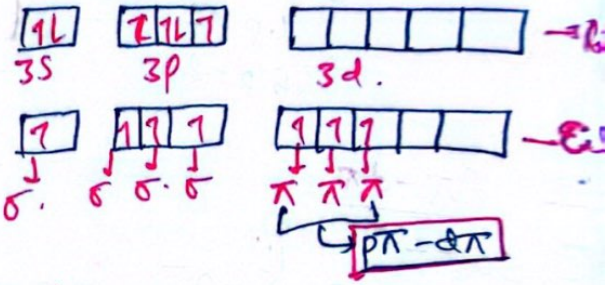
$C = 2s^2\ 2p^2$ — no dπ-pπ



⑤ ClO_4^-



$Cl \rightarrow 3s^2\ 3p^5$



Q. pπ-dπ bonding present in:-

(a) SO_4^{-2} (b) PO_4^{-3} (c) ClO_4^- (d) ClO_3^- (e) ClO_2^-

(f) SO_3^{-2} (g) CO_3^{-2} (h) NO_3^- (i) NO_2^-

pπ-dπ

P, S, Cl @ Pascal.

pπ-pπ → 2nd period

Properties of ionic compound

① Physical state:- crystalline solid, and contain opposite ion.

e.g. $NaCl_{(s)} \rightarrow Na^+ Cl^-$

Q. $CsBr_3$ (s) contain → Cs^+ + Br_3^- (dative bond, $Br^- \rightarrow Br_2$; covalent bond)

↳ ionic, covalent & dative — all bond +nt.

② Ionic bond is non-directional in nature.

$\boxed{B.S \propto \frac{1}{size} \propto p\text{-character}}$
↳ 1st ग्रा.

$\boxed{2p-2p > 2s-2p > 2s-2s}$
↳ size same है.

Q. $1s-2s < 1s-2p$ → $1s-2s > 2p-2p$
size less. ↳ size more

Q. $1s-1s$ (a), $1s-2s$ (b), $1s-2p$ (c), $2s-2s$ (d), $2s-2p$ (e), $2p-2p$ (f), $2s-3s$ (g), $2s-3p$ (h), $3s-3s$ (i), $3s-3p$ (j), $3p-3p$ (k).

Bond strength → $1s-1s > 1s-2p > 1s-2s > 2p-2p > 2s-2p > 2s-2s > 2s-3p > 2s-3s > 3p-3p > 3s-3p > 3s-3s$.

Q. $2p_\pi - 2p_\pi > 2p_\pi - 3p_\pi > 3p_\pi - 3p_\pi$ → B.S ↳ size

Q. $3p_\pi - 3p_\pi < 3p_\pi - 3d_\pi < 3d_\pi - 3d_\pi$ → B.S ↳ d-character (size same)

③ Conductivity →
- $NaCl_{(s)}$ → non-conducting
- NaCl → fused or molten or aq. NaCl → conducting

J.I
Q. Which is conducting? ★★★
(a) $NaCl_{(s)}$ (b) Fused $AlBr_3$ ↳ not ionic (c) Molten sulphur (non-metal) (d) $Na_{(s)}$ (metal)
AlF_3 only ionic.

(a) graphite (b) Fused AlF_3 (c) aq. NaCl (d) aq. HCl (ionic) (e) All

Q. Conducting in water?
(a) NaCl (b) HCl (c) $AlCl_3$ (d) All.

Note: Anhy. $AlCl_3$ is covalent & non-conducting but ionic & conducting in water due to high hydration energy of Al^{+3}.

$AlCl_3 \xrightarrow{H_2O} [Al(H_2O)_6]^{+3}$.
non-conducting ↳ conducting.

Q. Conducting in water?
(a) NaCl (b) $AlCl_3$ (c) $AlBr_3$ (d) AlF_3 (e) All
ionic in H_2O.

→ $\boxed{\text{conductivity} \propto \text{mobility of ions} \propto \frac{1}{size}}$

Size – $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$

Hydrated size → $Li^+_{(aq)} > Na^+_{(aq)} > K^+_{(aq)} > Rb^+_{(aq)} > Cs^+_{(aq)}$ → $\propto \frac{1}{\text{conductivity}}$.

Note: Smaller cation becomes largest in H_2O because of excess hydration. ∴ Least conducting in H_2O.

Q. Which ion is least conducting in H_2O?

(a) Na^+ (b) K^+ (c) Mg^+ ~~(d)~~ Al^{+3}.

or. ~~(a)~~ F^- (b) Cl^- (c) I^- (d) Br^-

↳ [more size in H_2O ⇒ least conducting.]

→ [Conductivity ∝ no. of ions].

$K_3[Fe(CN)_6]$ < $K_4[Fe(CN)_6]$ → conductivity.

$\downarrow aq.$ $\downarrow aq.$

$3K^+ + [Fe(CN)_6]^{+3}$. $4K^+ + [Fe(CN)_6]^{-4}$.

④ Hard and brittle

→ CaO > BaO (Hard)

→ Hardness of ionic compound ∝ lattice energy.

- CaO > SrO > BaO

  ← size ↓es, L.E ↑es, Hardness ↑es.

- NaF < MgF_2 < AlF_3 → Ca > Sr > Ba

  L.E ↑es, Hardness ↑es. ← size ↓es, M.B.S ↑es. Hardness ↑es.
  ↳ charge ↑es.

- Hardness of metal ∝ metallic bond strength ∝ $\frac{1}{\text{size}}$

⑤ Non-volatile in nature

→ Due to high mpt & B.pt.

Q. Which compound is more volatile?

(a) NaCl (b) HCl (c) HBr (d) HI

Note:- Covalent compound are volatile in nature due to low B.pt because & weak vanderwaal force.

Q. Which is more volatile?

(a) F_2 (b) Br_2 (c) Cl_2 (d) I_2.

B.pt low due to less m.mass.

⑥ Melting point and Boiling point

→ Ionic > ~~covalent~~ > covalent compound.

Strong electrostatic force of attraction

weak vanderwaal force

m.pt → NaCl > CuCl. $CaCl_2 > CuCl_2$. NaCl > HCl.

ionic covalent ionic covalent

→ NaCl > KCl

(LE ↑es)

→ m.pt of ionic compound ∝ L.E ∝ $\frac{\text{charge}}{\text{size}}$.

m.pt → LiH > NaH > KH > RbH > CsH

size ↓es. L.E ↑es. m.pt ↑.

m.pt → LiCl RbCl > KCl > RbCl > CsCl > LiCl.

Covalent

→ mpt of LiCl is minimom in IA chloride due to covalent nature of LiCl.

→ m.pt of metal ∝ metallic bond strength ∝ $\frac{1}{\text{size}}$.

mpt → Li > Na > K > Rb > Cs

size ↓es. m.B.S ↑es. mpt ↑es.

m.pt → BeO < MgO → Be > Mg

coval. ionic

size ↓es. M.B.S ↑es. mpt ↑.

m.pt → $CaO > SrO > BaO$

Size ↓es, LE ↑es. mpt ↑es

m.pt → $Ca > Sr > Ba$

Size ↓es. M.B ↑es. mpt ↑es.

m.pt → $CaF_2 > CaCl_2 > CaBr_2 > CaI_2$

$NaF > NaCl > NaBr > NaI$

Size ↓es. LE ↑es. mpt ↑es.

m.pt → $F_2 < Cl_2 < Br_2 < I_2$ — covalent S ↑

mass ↑es. V.F ↑. mpt ↑

mpt → $Na < Mg < Al$.

size ↓es. mpt ↑es.

$Na^{+1}F < Mg^{+2}F_2 < Al^{+3}F_3$ — ionic — L.E ∝ charge

Q. $Na^{+1}Cl$ $Mg^{+2}Cl_2$ $AlCl_3$ — covalent

(a) (b) (c)

b > a > c — m.pt

* Few covalent compound like diamond, SiC (artificial diamond), BeC, SiO_2 have high m.pt than ionic compound due to three dimensional network macromolecule structure.

· Diamond:- is covalent but m.pt very high due to 3-D network str.

m.pt → CaC_2 < SiC (artificial diamond)

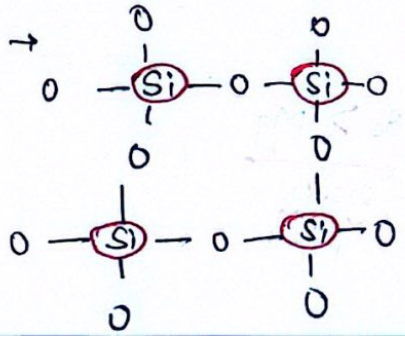
ionic covalent

Q. m.pt → SO_2, CaO, SiO_2, CO_2.

↳ $SiO_2 > CaO > SO_2 > CO_2$

3D-str. ionic covalent. mass होने.

→ SiO_2 →



In SiO_2

→ Each Si bonded by 4 'O' atom.

→ Each 'O' bonded by 2 Si atom.

→ CO_2 is gas & SiO_2 → solid.
↳ 2π-bond. ↳ no π-bond.
↓ solid CO_2 ↳ dry gas. ↓ covalent solid. ↳ 3D network str.

Q. CO_2 (sp) & SO_2 (sp³) molecule resemble in :-
ⓐ physical state ⓑ π-bond ⓒ Hybridization ~~ⓓ~~ Nature of oxide.

Types of solid

① Ionic solid :- यसमा component हरू ions हुन्छ।

e.g. $NaCl_{(s)}$ → $Na^+ Cl^-$; $NH_4Cl_{(s)}$ → $NH_4^+ Cl^-$; $PCl_{5(s)}$ → $PCl_4^{\oplus}$ $PCl_6^{\ominus}$; $CaO_{(s)}$ → Ca^{+2}, O^{-2}.

$CsBr_{3(s)}$ → Cs^+ Br_3^-

Q. Which solid does not contain ion?
ⓐ $NaCl_{(s)}$ ⓑ $NH_4Cl_{(s)}$ ⓒ $PH_4I_{(s)}$ → PH_4^+ I^- ⓓ $PCl_{5(s)}$ → $PCl_4^{\oplus}$ $PCl_6^{\ominus}$ ⓔ $N_2O_{5(s)}$ → NO_2^+ NO_3^-
~~ⓕ~~ $SiO_{2(s)}$ ↳ covalent

② Metallic solid :-
$Na_{(s)}$, $Cu_{(s)}$, $Ca_{(s)}$

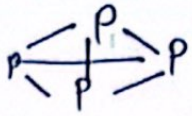
③ Covalent solid :- Atom bonded by covalent bond & 3D network structure form.
e.g. Diamond → max mpt.
↳ hardest substance of chemistry.
graphite, SiC → artificial diamond. ↳ carborandum. , B_4C → Boron carbide.
SiO_2, ...

Note :- In SiO_2 (sp³), each silicon bonded with 4 'O' & each 'O' bonded with 2 Si.

④ Molecular solid :- Molecules are hold by vanderwaal's force.
e.g. ① Dry ice → solid CO_2. $CO_2 \cdots CO_2$
② $I_{2(s)}$ ↳ vander-for. ③ $P_{4(s)}$ ④ $S_{8(s)}$

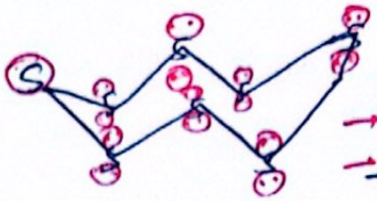
→ N_2 exist but P_2 doesn't exist.
gas. ↳ due to large size π bond convert in P_4.

P_4 → (solid)



N_2, P_4 As_4 Sb_4
gas. ↳ solid.

→ S_8 →



→ 16 lone pair
→ crown shaped.

Covalent Bond

→ Between non-metals. e.g. CO_2, CS_2, CCl_4, SF_4, SO_3.
→ Between less electro +ve metal & non-metal.
e.g. $AlCl_3$, $FeCl_3$. ---

→ Covalent bond Formed by sharing of electron pair.

pair	bond
1	— → single
2	= — Double] Multiple.
3	≡ — Triple.]



$2\pi, 1\sigma$



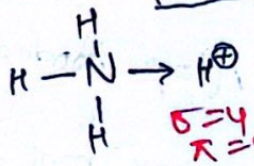
$2\pi, 1\sigma$

e.g. CO → $:C\equiv O$ ← l.p ⇒ 2
↳ l.p = 1 $1\sigma, 2\pi$

O_3 → $O=O\rightarrow O$ ← l.p ⇒ 1
$\sigma = 2$
$\pi \rightarrow 1$

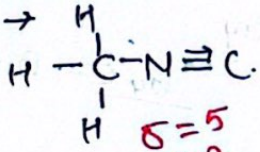
N_2O → $N\equiv N\rightarrow O$
$\sigma = 2$
$\pi \rightarrow 2$

NH_4^+ →



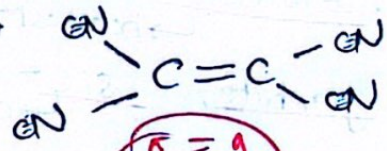
$\sigma = 4$
$\pi = 0$

CH_3NC →



$\sigma = 5$
$\pi = 2$.

$C_2(CN)_4$ →



$\sigma = 9$
$\pi = 9$

$C_2(CN)_2$ →
$N\equiv C-C\equiv C-C\equiv N$
$\sigma \rightarrow 5$
$\pi \rightarrow 6$

CO_2 → $O=C=O$
$\sigma = 2$, $\pi = 2$.

→ carbon suboxide (C_3O_2)

$O=C=C=C=O$

$\sigma = 4$ $\pi = 4$ $\sigma : \pi = 1:1$

* **Covalency** :- No. of unpaired e^- in ground state or excited state.

$S \Rightarrow 3s^2\ 3p^4 \rightarrow$ G.S.

G.S. → [↑↓] [↑|↑|↑] [| | | |] → SF_2
3s 3p 3d.
↓
2

1st excited state → [↑↓] [↑|↑|↑] [↑| | | |] → 4 → SF_4

2nd excited state → [↑] [↑|↑|↑] [↑|↑| | |] → 6 → SF_6

→ $\boxed{\text{Maximum covalency = valance } e^-}$

→ $N \Rightarrow 2s^2\ 2p^3$

G.S → [↑↓] [↑|↑|↑] → 3
2s 2p.

2d ✗ ↳ हुन.

$\boxed{\text{No exictation}}$

→ $P \Rightarrow 3s^2\ 3p^3$

G.S → [↑↓] [↑|↑|↑] [| | | |] → 3 PCl_3

1st excited state → [↑] [↑|↑|↑] [↑| | | |] → 5 PCl_5.

→ Difference between covalency is 2.
→ Excitation of paired e^- within same shell.

e.g. $Cl \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

G.S → [↑↓] [↑↓|↑|↑] [| | | |] → 1
3s 3p 3d.

1st excited state → [↑↓] [↑↓|↑|↑] [↑| | | |] → 3

2nd excited state → [↑↓] [↑|↑|↑] [↑|↑| | |] → 5

3rd excited state → [↑] [↑|↑|↑] [↑|↑|↑| |] → 7

covalency

IF → G.S.
IF_3 → 1st ex.
IF_5 → 2nd E.S.
IF_7 → 3rd. E.S.

$S \rightarrow 3s^2\ 3p^4$.

G.S → [↑↓] [↑↓|↑|↑] → covalency → $\boxed{2, 4, 6}$

(3d) वाली छ.

→ SF_3 not exist but SO_3 exist.
↳ Form in 2nd excited state.
↳ covalency → 6.

Q. Which compound does not exist?
(a) SF_6 (2nd E.S.) (b) SF_4 (1st E.S.) (c) SO_3 (2nd E.S.) ~~(d) SF_7~~
SF_6 → 6. SF_4 → 4. SO_3 → 6.

I → $5s^2\ 5p^5$

G.S → [1L] [1L|1L|1] (5s, 5p)

covalency → 1
1st E.S → 3
2nd E.S → 5
3rd E.S → 7.

Q. Which compound does not exist?
(a) XeF_2 (1st E.S.) (b) XeF_4 (2nd E.S) ~~(c) XeF_5~~ (d) XeF_6 (3rd E.S.)

Xe → $ns^2\ np^6$
G.S → [1L] [1L|1L|1L] [|||||]
↳ no compound (s) (p) (d)
1st ex.st → 2. 2nd → 4. 3rd → 6. 4th → 8.

- Note:- No any compound of Xe form in ground state.

→ Be → $1s^2\ 2s^2$
[XX] [1L] [| |] → G.S.
2s 2p. ↳ no compound.
1st E.S → [1] [1|1|] → 2. ↳ BeF_2

→ N → $2s^2\ 2p^3$
G.S → [1L] [1|1|1] → (3) only NCl_3 no NCl_5
~~1st ex.st~~ [ ] [ ] No excitation

→ O → $2s^2\ 2p^4$.
G.S → [1L] [1L|1|1] → (2) only.
no excitation. ↳ G.S मा मात्र.

→ F → $2s^2 2p^5$
G.S → [1L] [1L|1L|1] → (1) only.

→ N, O र F जाहिले पनि G.S. मा compound बनाउँछ ।
3 2 1

→ P, S & Cl → +nce of vacant d.

→ G.S & excited state दुवै मा बनाउछ।.

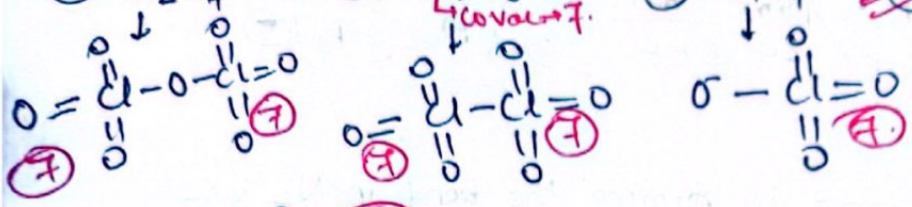
→ C → $2s^2\ 2p^2$.

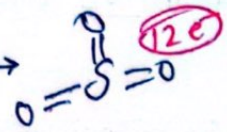
G.S → [↑↓] [↑|↑|]

E.S → [↑] [↑|↑|↑] → only form compound in excited state.

Q. 'Cl' shows 7 covalency in:-

(a) $\overset{+7}{Cl_2}O_7$ (b) $\overset{+6}{Cl_2}O_6$ ↳ covalency → 7. (c) $\overset{+7}{Cl}O_4^-$ (d) All



Q. SO_3 →  correct statement:-

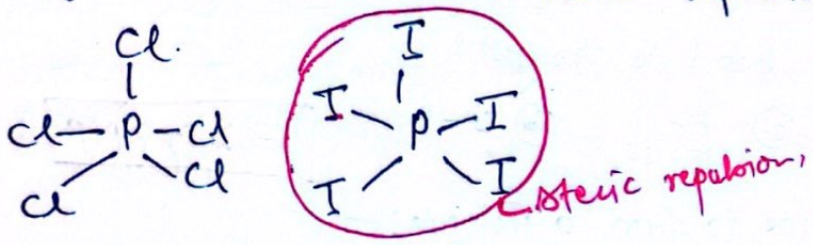
(a) super octet ↳ 8e⁻ भन्दा धेरै (b) All pπ-dπ (1pπ-pπ, 2pπ-dπ) (c) 2nd E.S. (d) 1 & 3.

→ OF_2 (2) (cov) O_2F_2 (2) OF_4 ✗ . which compound doesn't exist.

→ OF_2 ✗ OF_4 ✗ OF_6] absence of d-orbital.

SF_2 SF_4 SF_6] due to +ne of d-orbital.

→ PCl_5 exist but PI_5 doesnot exist due to large size of side halogen atom which create steric repulsion.



→ PF_5 exist but PH_5 doesnot exist.

Q. Which of the following is required for the formation of an ionic bond?
→ Total energy of the resulting molecule should be less than the total energy of reactant.

Q. Which of the following oxyacids of phosphorous are monoprotic?
(a) H_3PO_4 (tri) (b) H_3PO_3 (di) (c) H_3PO_2 (d) $H_4P_2O_7$

Q. Which has max. ionic mobility?
(a) Li^+ (b) Na^+ (c) K^+ (d) Cs^+

Q. Which type of bond is not present in HNO_2 molecule? H-O-N=O
(a) covalent (b) co-ordinate (c) Ionic (d) both b & c.

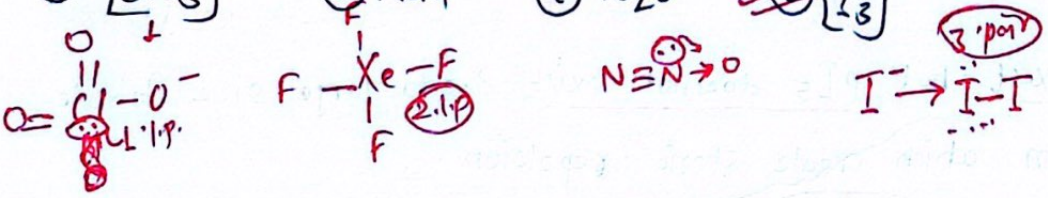
Q. KF combines with HF to form KHF_2. The compound contains the species:-
Fremiz salt.
(a) K^+, F^- & H^+ (b) K^+, F^- & HF (c) K^+ & $[HF_2]^-$
(d) $[KHF]^+$ & F_2

Q. Total no. of e^- take part in forming the bond in N_2 is:-
(a) 2 (b) 4 (c) 6 (d) 10

Q. The bond between two identical non-metal atoms has a pair of e^-:-
(a) usually shared between the two
(b) Transferred fully from one atom to another
(c) with identical spins
(d) equally shared between them

Q. The number & type of bonds between two C-atoms in $Sr C_2$ are:-
Sr^{++} C_2^- → $C \equiv C^-$
(a) 1σ, 1π (b) 1σ, 2π (c) 1σ, 2 1.5π (d) 1σ

Q. Which species has the maximum no. of lone pair on the central atom?
(a) $[ClO_3]^-$ (b) XeF_4 (c) N_2O (d) $[I_3]^-$



Q. Which of the following bond is strongest?
(a) I-I (b) F-f (c) H-H (d) O-O
1s 1s
s-s > s-p > p-p

Q. When two atoms combine to form a molecule:-
(a) Energy is released (b) Energy is absorbed
(c) Energy is neither released nor absorbed
(d) Energy may either be absorbed or released

Q. Most favorable condition for ionic bonding are →
↳ Low charge on ions, large cation, small anion.

Q. Which of the following is not correct statement?
(a) Ionic compounds are electrically neutral.
(b) Boiling point of an ionic compound is more than a covalent compound.
(c) Melting point of a covalent compound is more than ionic compound.
(d) Ionic compounds are soluble in polar solvent.

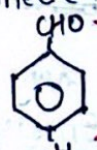
Q. The pair of elements which form ionic bond is:-
(a) C + Cl (b) H + F (c) Na + Br (d) O + H.

Q. Lattice energy of an ionic compound depends upon:-
↳ $\propto \frac{\text{Charge}}{\text{size}}$
(a) charge on the ion & size of ion
(b) Packing of ions only
(c) Size of ion only
(d) charge on the ion only

Q. The strength of bond formed by overlapping of atomic orbitals in order:-
(a) s-s > s-p > p-p (b) s-s < p-p < s-p
(c) s-p < s-s < p-p (d) p-p < s-s < s-p

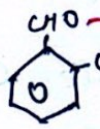
Q. Out of the two compounds shown below, the vapour pressure of II of at a particular temperature is connected to be:-

I. p-Hydroxy benzaldehyde →



Intermol. → B.P ↑ → V.P ↓es

II O-Hydroxy benzaldehyde →



Intramolar → B.P ↓ → V.P ↑es.

(a) Higher than that of I (b) lower than that of I
(c) Same as I (d) can be higher or lower depending upon size of vessel

Q. Among the following ions, the $p\pi - d\pi$ Overlap is present in:-
(a) NO_3^- (b) $PO_4^{\ominus}$ (c) CO_3^{2-} (d) $NO_2^{\ominus}$

Q. Which one or more among the following involve $p\pi - d\pi$ bonding?
(a) $(SiH_3)N:$ → Vacant (d) → Silane (b) $(CH_3)_3N:$ (c) $:\overset{\ominus}{C}Cl_3$ → Vacant (d) (d) $:\overset{\ominus}{C}F_3$

Q. The compound which contains both ionic & covalent bond is:-
(a) CH_4 (b) H_2 (c) KCN (d) KCl

Q. The total no. of e^- that takes part in forming the bond in N_2 is:-
(a) 2 (b) 4 (c) 6 (d) 100

Q. Element X is strongly electropositive & element Y is strongly electronegative. Both are univalent. The compound would be:-
(a) $X^+ Y^-$ (b) $X^- Y^+$ (c) X-Y (d) X→Y

Q. Which of the following compound is covalent?
(a) H_2 (b) CaO (c) KCl (d) Na_2S

Q. Which of the following has O-O linkage?
(a) $H_2S_2O_6$ (b) $H_2S_2O_8$ (c) $H_2S_2O_3$ (d) $H_2S_4O_6$

Q. There is no S-S bond in:-
(a) $S_2O_6^{2-}$ (b) $S_4O_6^{2-}$ (c) $S_2O_3^{2-}$ (d) $S_2O_7^{2-}$

Q. Chemical bond formation takes place when:-
(a) Force of attraction & forces of repulsion are equal
(b) Force of attraction are greater than repulsion.
(c) Force of repulsion are greater then attraction
(d) energy is absorbed

Q. Which of the following is correct for the process of a chemical bond?
(a) electron-electron repulsion ~~before~~ becomes more than nucleus-electron attraction.
(b) Energy of system does not change.
(c) Energy ↑es (d) Energy ↓es

Q. The correct statement for molecule, C_sI_3 is:-
(a) It is covalent molecule.
(b) It contains Cs^+ & I_3^- ions
(c) It contains Cs^{3+} & I_3^- ions
(d) It contains Cs^+, I^- & lattice I_2 molecule

Q. The low solubility of $BaSO_4$ in water is due to:-
(a) Dissociation energy (b) low lattice-energy
(c) High lattice energy (d) Ionic bond.

Q. Stability of ionic compounds is due to:-
(a) electronegativity (b) Lattice energy
(c) Sublimation energy (d) Electron affinity

Q. Which of the following is not a correct statement about an ionic compd?
(a) Higher the temp, more the solubility.
(b) Higher the dielectric constant of solvent, more the solubility
(c) Higher the dipole moment of solvent, more the solubility
(d) Higher the lattice ∈, more the solubility

Q. In a crystals, cations and anions are held together by:-
(a) electrons (b) electrostatic forces (c) Nuclear Forces (d) covalent bond

Q. fused ionic compounds :-
(a) are insulators (b) are used as semi-conductors
(c) conduct electricity (d) donot conduct electricity

Q. As compared to covalent compound, electrovalent compounds generally have:-
(a) low melting point & low boiling point
(b) low melting point & high B pt.
(c) high m.pt & low B.pt
(d) high mpt & high B.pt.

Q. Which of the Following Factors donot favour electro valency?
(a) low charge on ions (b) High charge on ions
(c) Large cation & small anion (d) All

Q. The strongest bond is:-
(a) Ionic (b) covalent (c) Hydrogen (d) Metallic.

Q. KCl easily dissolves in water because:-
(a) is a salt of K. (b) It react with water
(c) is an electrovalent compound (d) Its ion are easily solveted.

Q. Types of force between C_6H_6 (non-polar) are:-
(a) dipole-dipole Interaction (b) dispersive force (id-id)
(c) H-bonding (d) vanderwaals Force

Q. Ozone has:-
(a) $1\sigma, 2\pi$ (b) $2\sigma, 2\pi$ (c) $2\sigma, 1\pi$ (d) 2σ, 1π & 1 lone pair

O=O→O

Q. The low density of ice compared to water is due to:-
(a) H-bonding Interaction (b) dipole-dipole interaction
(c) dipole-induced dipole (d) Induced dipole-induced dipole

Q. The correct order of decreasing polarizable ion is:—

(a) Cl^-, Br^-, I^-, F^- (b) F^-, I^-, Br^-, Cl^-

(c) I^-, Br^-, Cl^-, F^- (d) F^-, Cl^-, Br^-, I^-

Cation $\propto \frac{1}{\text{anion}}$

Q. The correct order of O-O bond length ↑es in following:

(a) $O_3 < H_2O_2 < O_2$ (b) $O_2 < O_3 < H_2O_2$

(c) $O_2 < H_2O_2 < O_3$ (d) $H_2O_2 < O_2 < O_3$

Q. Which noble gas is most soluble in H_2O?

(a) He (b) Ne (c) Ar (d) Xe

Q. The force acting between noble gas atoms are:—

(a) Vanderwaals force (b) Ion-dipole force

(c) London force (d) Magnetic force.

Q. The correct order of solubility in H_2O:—

(a) He > Ne > Ar > Kr > Xe (b) Ne > Ar > Kr > He > Xe.

(c) Xe > Kr > Ar > Ne > He (d) All

Dipole Moment (Extra Class)

↳ μ.

→ predict polarity of a molecule.

→ $H_2 \Rightarrow H-H \rightarrow \mu = 0$ (no q) ↳ $\boxed{\text{non-polar}}$

→ $\mu = q \times d$.

→ unit → esu × cm

→ cb × m

→ Debye.

HF → $\overset{\delta+}{H}-\overset{\delta-}{F}$

$\mu \neq 0$ ↳ polar molecule

→ $\boxed{1\,\text{debye} = 10^{-18}\,\text{esu} \times \text{cm} = 3.33 \times 10^{-30}\,\text{Coulumb} \times \text{m}.}$

→ Dipole को लागि deciding factor → charge हो (Distance होइन).

$\overset{\delta+}{H}-\overset{\delta-}{F} > \overset{\delta+}{H}-\overset{\delta-}{I} \rightarrow (\mu)$.

• Diatomic Molecule

A_2: H_2, O_2, F_2, N_2

$q = 0$, $\mu = 0$ ↳ non polar

A-B: CO, NO, ICl, HF.

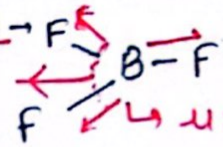
$q \neq 0$, $\mu \neq 0$ ↳ polar compound.

Polyatomic molecule → Resultant dipole is vector addition of all bond moment

e.g. $CO_2 \rightarrow O=C=O$

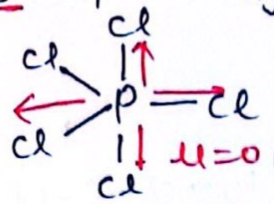
↳ $\mu = 0$. (two vector in op. direction)

$BF_3 \rightarrow$



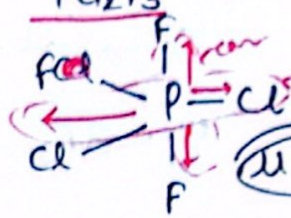
↳ $\mu = 0$ (cancel each other).

$PCl_5 \rightarrow sp^3d \rightarrow$ Trigonal Bipyramidal.



$\mu = 0$ (cancel). दूर.

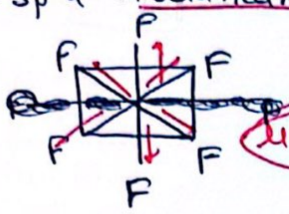
PCl_2F_3



cant cancel.

$\mu \neq 0$

$SF_6 \rightarrow sp^3d^2 \rightarrow$ octahedral



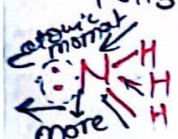
bond → polar.

$\mu = 0$ → non-polar ↳ molecule.

↳ cancel. गई.

→ $\mu \Rightarrow$ vector summation of all bond moment.

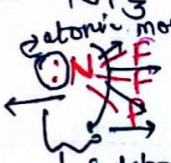
→ $NH_3 > NF_3 \rightarrow \mu$.



atomic moment

more E.N.

additive



atomic moment

↳ Substractive.

↳ can be cancel.

→ In BF_3 → bond is polar but molecule is non-polar.

Q. Compare dipole moment:—

→ $:NH_3$ (a) BF_3 (b) $:NF_3$ (c) $\mu = 0$ $a > c > b$

→ $:NH_3 > :PH_3$ (additive) $P \approx H$ → E.N.

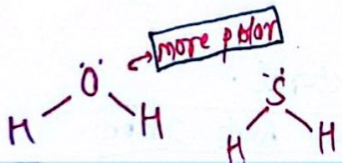
→ $:NCl_3 > :NF_3$ (neutral ↳ no op. fa) ↳ subst.

→ $:NH_3 > :NCl_3$ (adv.) $\mu \approx Cl$ ↳ E.N.

Q. $NH_3 > PH_3 \rightarrow \mu$.

(a) Basic strength ↳ ↓es top to bottom. (b) Thermal stability ↳ ↓es top to bottom. (c) Dipole moment (d) All

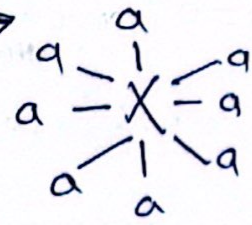
→ $H_2O > H_2S \rightarrow \mu$. → $H_2O_2 > H_2O \rightarrow \mu$.



more polar

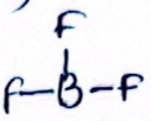
→ Linear compound को dipole moment always zero हुनलाई हुँदै कि same element हुन पर्छ। eg. CO_2, CS_2, etc. (not CSO)

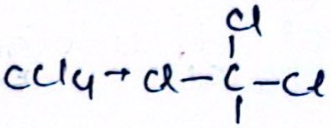
→ H_2O_2 → Open book shape.

→ 

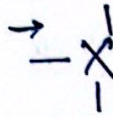
central atom संग lone pair दैन भने

$X \rightarrow (\mu = 0)$

e.g. BF_3 →  $(\mu = 0)$ no l.p.

CCl_4 → 

$\mu = 0$

→  dif-E भने $\mu \neq 0$

but कहिले काहि zero पनि हुन सक्छ.

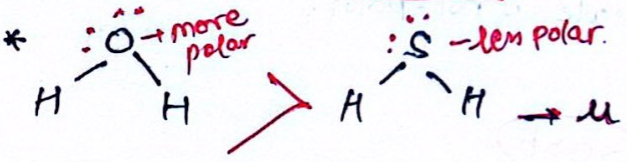
Q. Which molecule polar ($\mu \neq 0$).

(a) CCl_4 (b) CH_2Cl_2 (c) BCl_3 (d) SF_6

but in NH_3 → lone pair (+nt) → $\mu \neq 0$

PCl_3 → lone pair (+nt) → $\mu \neq 0$.

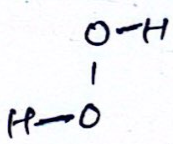
but PCl_5 ⇒ zero. no lone pair → $\mu = 0$.

* 

$H_2O < H_2O_2 \rightarrow \mu$

$H_2O > CH_3OH \rightarrow \mu$

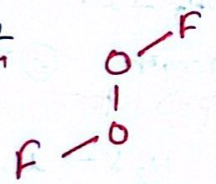
→ $H_2O_2 \Rightarrow \mu \neq 0$.



Q. Molecule isostructural with H_2O_2 :-

(a) C_2H_2 (b) C_2F_2 (c) H_2F_2 (d) O_2F_2

$H-C\equiv C-H$ $F-C\equiv C-F$ $H-F\cdots\cdots H-F$



→ H_2O_2, O_2F_2, H_2S_2, S_2Cl_2, are iso-structural.

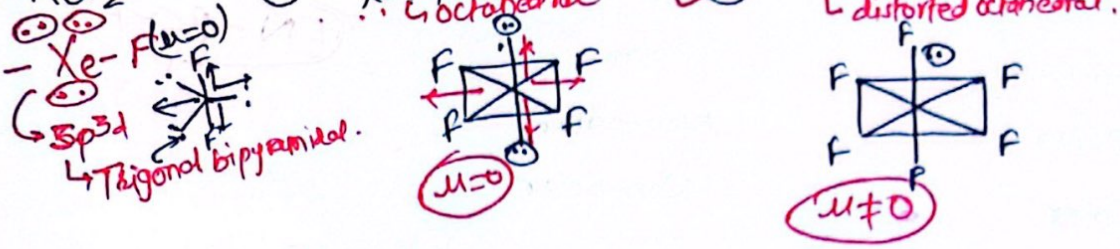
↳ Open book shape.

Q. Which molecule is polar? ($\mu \neq 0$)

(a) PCl_3 (b) SF_4 (c) CH_2Cl_2 ~~(d)~~ All

Q. Which molecule is polar?

(a) XeF_2 (b) XeF_4 ~~(c)~~ XeF_6



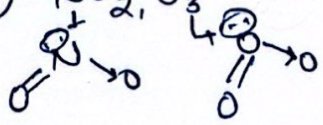
Q. Which has dipole moment?

(a) BF_3 (b) SiF_4 (c) XeF_4 ~~(d)~~ SF_4.

Q. Which pair has dipole moment?

(a) CO_2, NO_2 (b) CO_2, SiF_4

(c) SiF_4, O_3 ~~(d)~~ NO_2, O_3



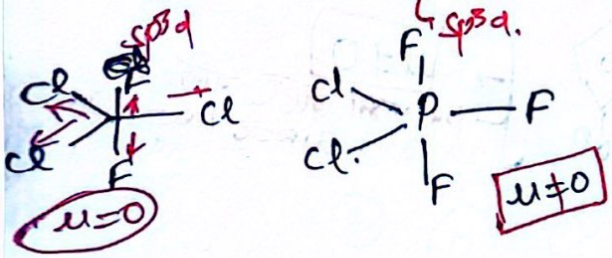
→ $CH_3Cl > CH_2Cl_2 > CHCl_3 > CCl_4$ → μ. ($\mu = 0$)

→ $HF > HCl > HBr > HI$ → μ. μ = charge d.

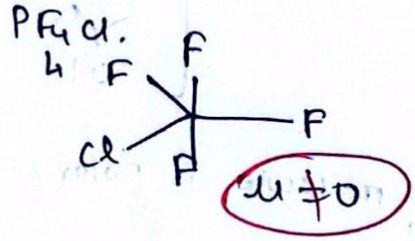
→ $CH_3F < CH_3Cl > CH_3Br > CH_3I$ → μ.

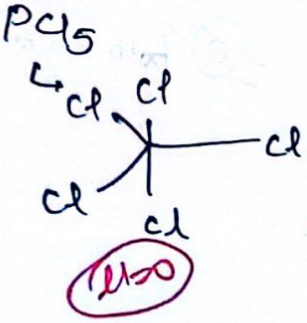
$CH_3Cl > CH_3F$

→ PCl_3F_2 PF_3Cl_2



– more E.N atom → axial position





→ Bond polarity ...

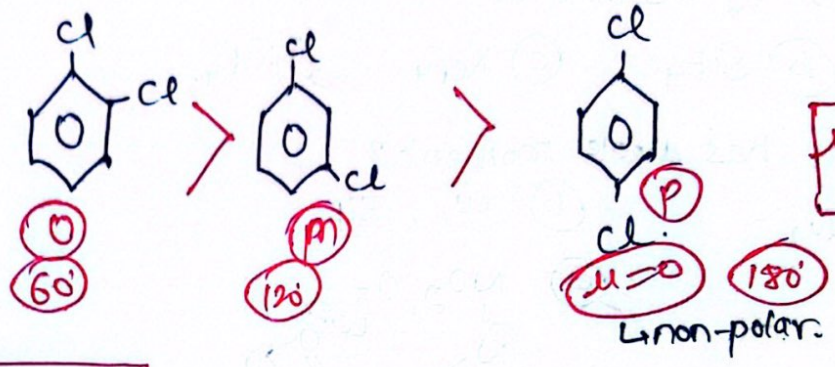
→ ~~Dipole~~ Molecule polarity is determined by dipole moment.

	Bond	Molecule
BF_3	Polar	Non-polar
PH_3	non-polar	polar
XeF_2	Polar	Non-polar
BeH_2	Polar	Non-polar

EN → P ≃ H

→ $C_6H_4Cl_2$ →

$\mu \Rightarrow$



$\mu \propto \frac{1}{\text{angle}}$

B.Pt ∝ polarity

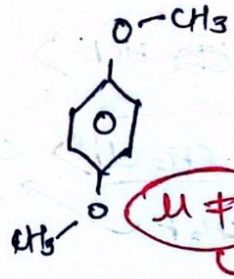
B.pt → para > meta > ortho

Q. Which molecule is polar?

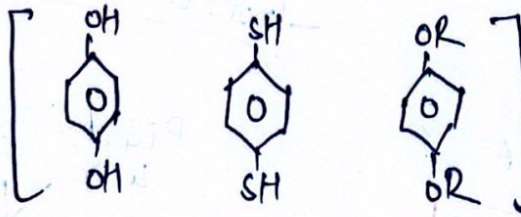
(a) 

(b) 

(c) 

~~(d)~~ 

$\mu \neq 0$ ← polar.



→ $\mu \neq 0$

← para मा भएर पनि dipole mom ≠ 0

Q. Which molecule is polar?

~~(a)~~ 

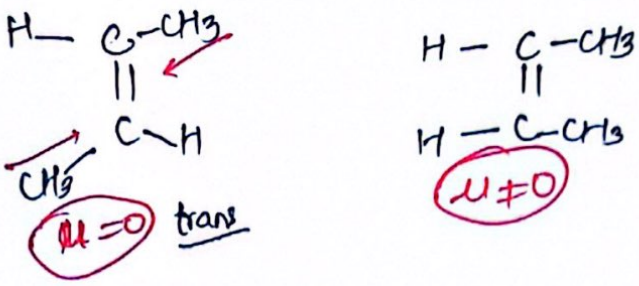
~~(b)~~ 

(c) 

(d) 

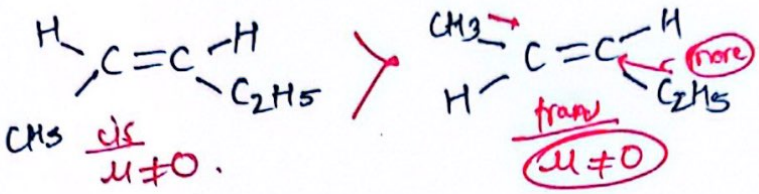
~~(e)~~ both a & b.

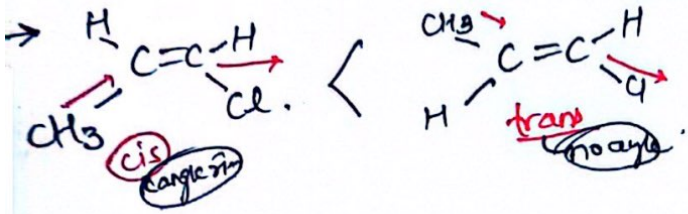
Dipole moment → cis > trans → generally.

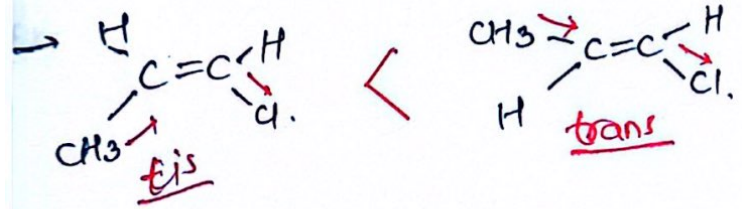


→ pent-2-ene

$CH_3 - CH = CH - C_2H_5$.





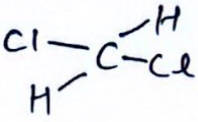


Minimum dipole moment.

(a) $CH_3 - C \equiv C - H$ ($\mu \neq 0$)

(b) $CH_3 - C \equiv C - CH_2 - CH_3$ ($\mu \neq 0$)

(c) $CH_3 - C \equiv C - Me$ ($\mu = 0$)

(d)  → CH_2Cl_2. ($\mu \neq 0$)

Q. Max. dipole moment:—

(a) 

(b) 

(c) 