

10/8/17

Chemistry

128

Page No. Date

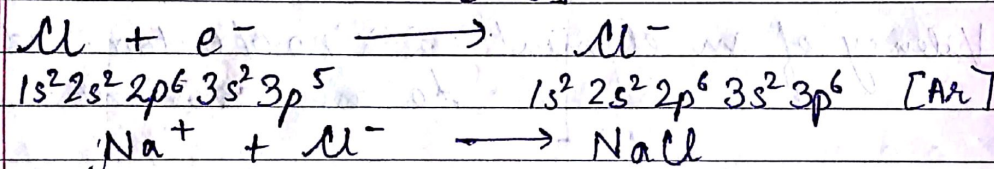
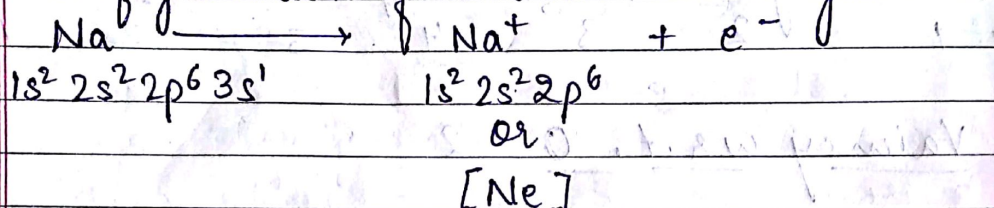
Chemical Bonding

Why do chemical bond is formed?

Chemical Bond : It is force of attraction b/w 2 atoms to form a stable molecule to attain stability : Due to formⁿ of chemical bond overall P.E. ↓ hence stability ↑.

(a)

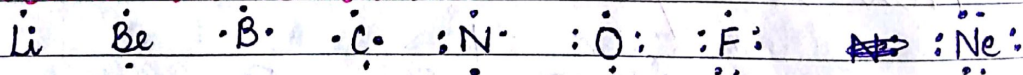
Kossel approach : Every atom tends to attain configuration of nearest noble gas.



(c)

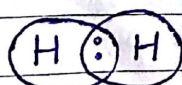
Lewis Octet Rule : Every atom tends to complete its octet i.e. $8e^-$ in its outermost shell.

Lewis dot structure :-



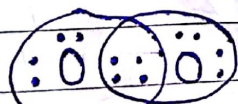
dot $\rightarrow$ valence e^-

H₂



duplet

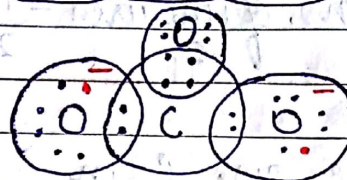
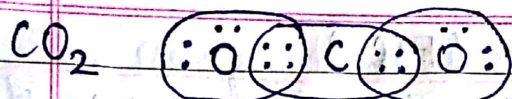
O₂



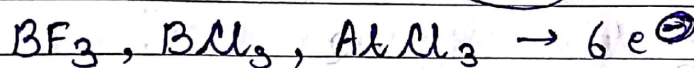
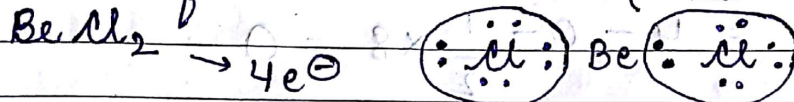
octet

N₂

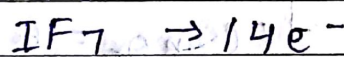
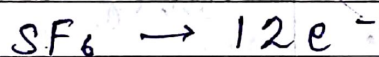
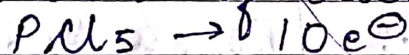




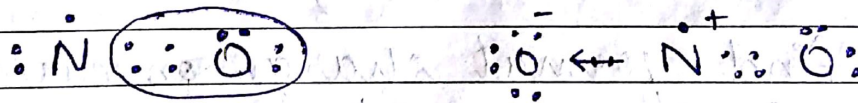
Exceptions to Lewis Octet Rule :-
(1) e^- deficient molecule ($< 8e^-$)



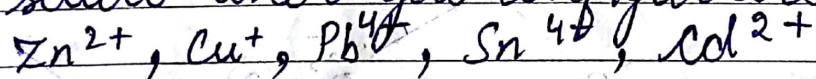
(2) expansion of octet : ($> 8e^-$)



(3) Odd e^- molecule



(4) Pseudo inert gas configuration :- ($18e^-$)



Drawback :-

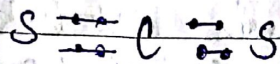
- (1) It could not define stability of molecules.
- (2) It could not define shape of molecules.

Formal Charge :- (F.C.)

$$F.C. = \text{no. of valence } e^- - \text{no. of unpaired } e^- - \frac{1}{2} \times \text{no. of bonds } e^-$$

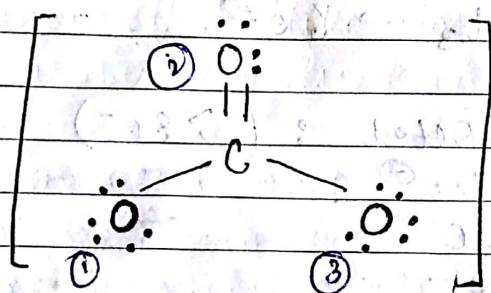
Ques Find formal charge on C in

① CS_2



$$FC_{\text{on C}} = 4 - 0 - \frac{1}{2} \times 8 = 0$$

②



$$FC = 4 - 0 - \frac{1}{2} \times 8 = 0$$

$$FC_{\text{on O}_1} = 6 - 6 - \frac{1}{2} \times 2 = -1$$

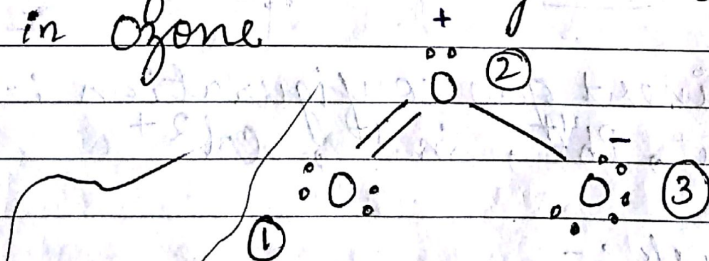
$$FC_{\text{on O}_2} = 6 - 4 - \frac{1}{2} \times 4 = 0$$

$$FC_{\text{on O}_3} = 6 - 6 - \frac{1}{2} \times 2 = -1$$

AIMS-15

Ques Find formal charge on each O-atom in ozone

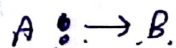
NCERT Pg 101



$$FC_{\text{①}} = 6 - 4 - \frac{1}{2} \times 4 = 0$$

$$FC_{\text{②}} = 6 - 2 - \frac{1}{2} \times 6 = 1$$

$$FC_{\text{③}} = 6 - 6 - \frac{1}{2} \times 2 = -1$$



Page No. 131 Date

Note: Resonant structure which have less formal charge is more stable.

Chemical Bond

Strong Bond

(Interatomic Bond)

- covalent bond
- coordinate bond
- ionic bond
- metallic bond

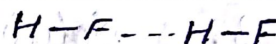


Weak Bond

(Intramolecular bond)

- H-bond
- Vander waal forces

Stability

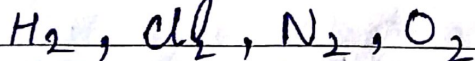


Covalent Bond

:- It is formed by mutual sharing of valence e^- b/w 2 atoms having same or nearly same electronegativity.

Non-polar Covalent Bond :-

- Formed b/w 2 atoms which have same electronegativity.
- mainly non-metals.



Polar Covalent Bond :-

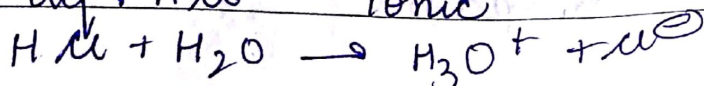
- Formed b/w atoms which have diff. $\Delta E.N.$

$\Delta E.N. < 1.7 \rightarrow$ covalent Ch^+

$\Delta E.N. > 1.7 \rightarrow$ ionic

eg gaseous $HCl \rightarrow$ covalent

aq. $HCl \rightarrow$ ionic



Characteristics of Covalent compd :-

1. Physical state :

Normally $\rightarrow$ gas & liquid

Solid : diamond, SiO_2 , carborandun SiC , AlN

2. Conductivity : They are ~~not~~ non conductor of electricity.

Except Graphite is good conductor of electricity due to mobile πe^- .

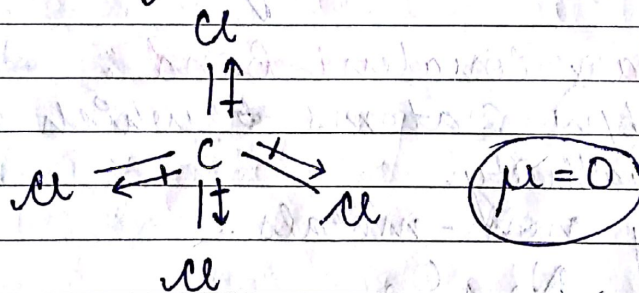
3. Solubility :-

Principle : "like dissolve & like"

polar is dissolved in polar solvent

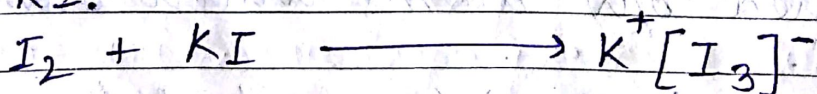
& non polar ————— non polar solvent

Covalent compds are mainly non-polar
so they are dissolved in non polar solvents
like Benzene, CCl_4 , CS_2



Note:

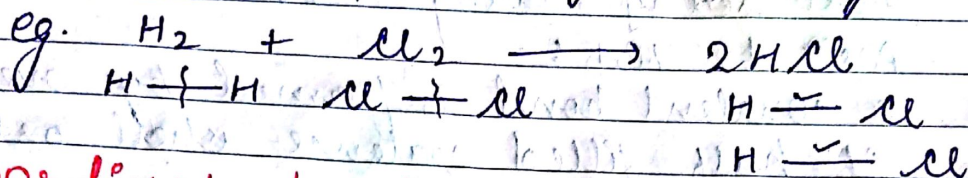
I_2 is non polar solid but its solubility
 $\uparrow$ in water when it is added to
 KI .



4. Isomerism :- They are directional so
they ^{show} exhibit isomerism

eg Organic compds.

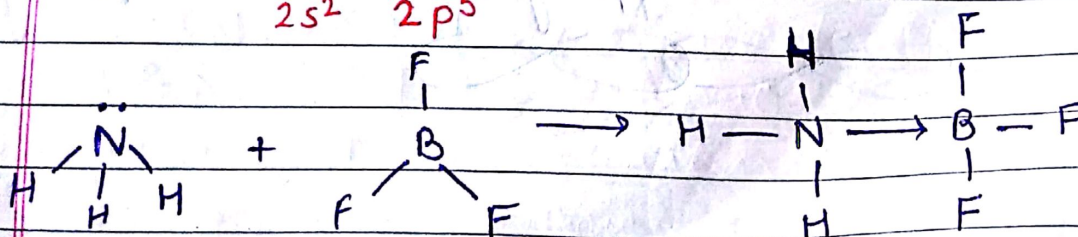
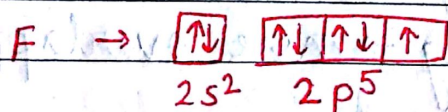
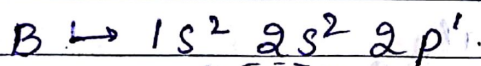
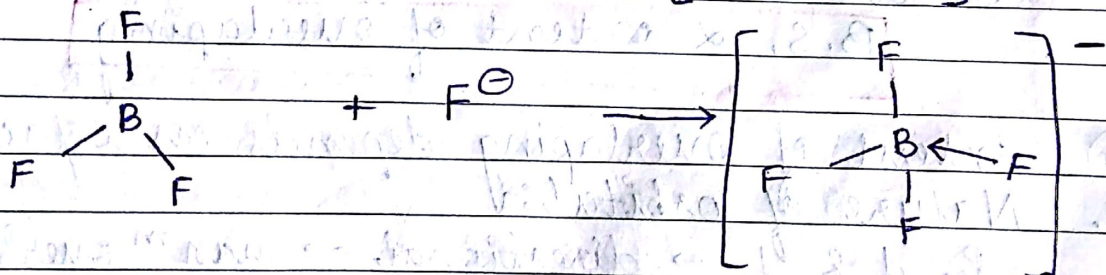
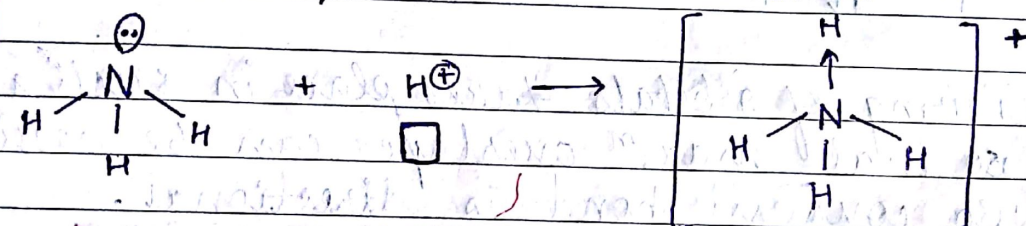
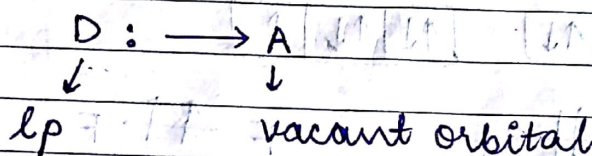
5. Reactivity $\div$ Reacⁿ of c.c. are slow.
becoz bond breaking & making takes place.



12/08/17

Coordinate bond :

It is a simple covalent bond which is formed by contribution of e⁻ pairs from single atom



Covalent bond similar property to coordinate bond

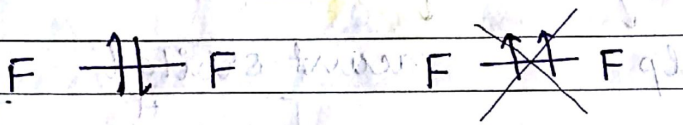
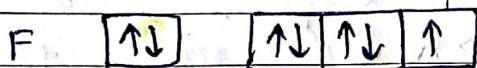
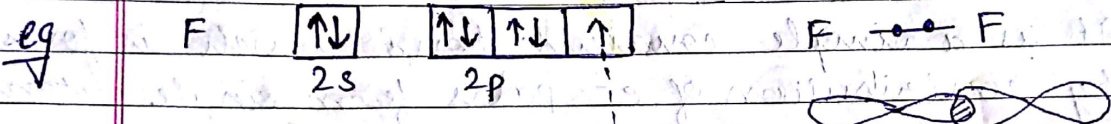
Page No. 134 Date

VBT :-

given by Heitler & London
extended by Pauling & Slater

Accⁿ to VBT :-

- ① a covalent bond is formed by overlapping of half filled valence shell orbital.



- ② Pairing of orbitals takes place in such a dirⁿ so that max^m overlap can be possible -
so covalent bond is directional.

B.S. & extent of overlapping

- ③ Extent of overlapping depends on 2 factors

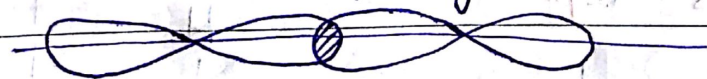
1. Nature of orbital :-

p, d & f $\rightarrow$ directional $\rightarrow$ max^m overlap orbitals

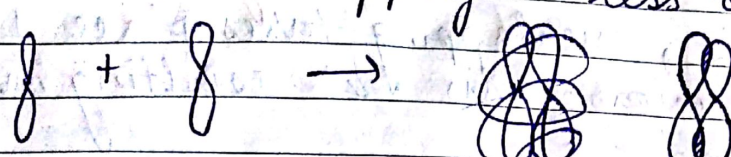
s $\rightarrow$ non directional $\rightarrow$ min^m overlap

2. Nature of overlapping :-

co-axial overlapping $\rightarrow$ more overlapping

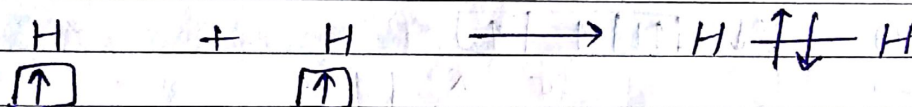
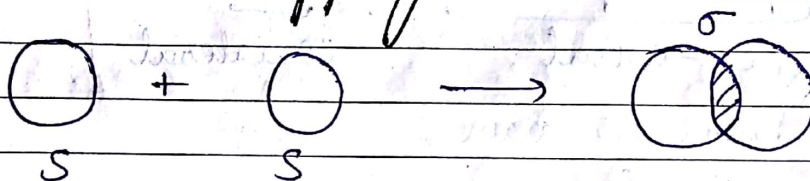


co-lateral overlapping $\rightarrow$ less overlapping

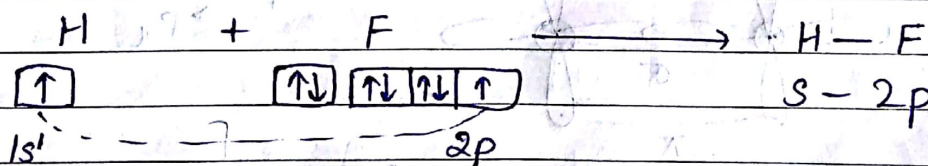
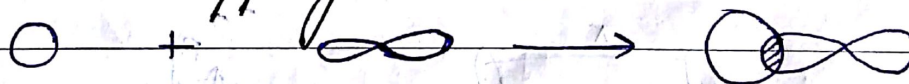


Head-on / **co-axial overlapping** :- In this type of overlapping end to end overlapping takes place resulting in form of σ bond.

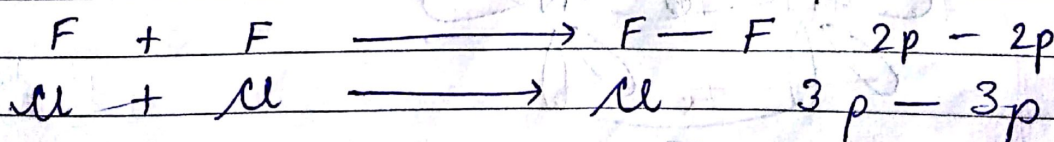
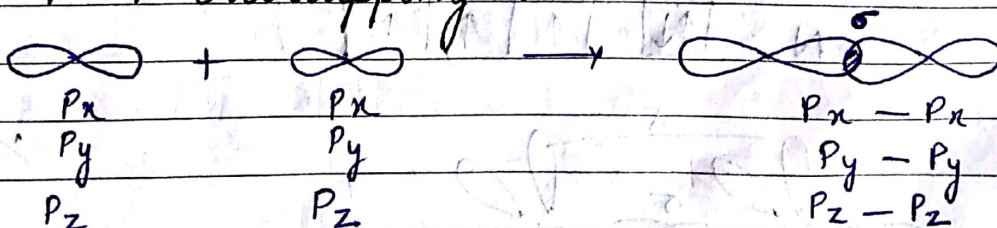
S-S overlapping :-



S-p overlapping :-

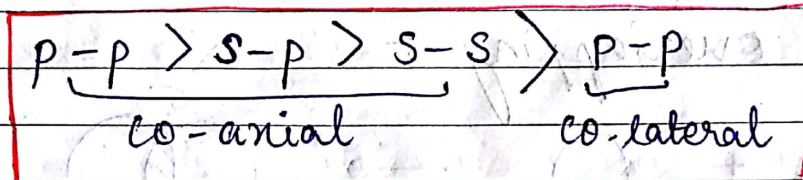
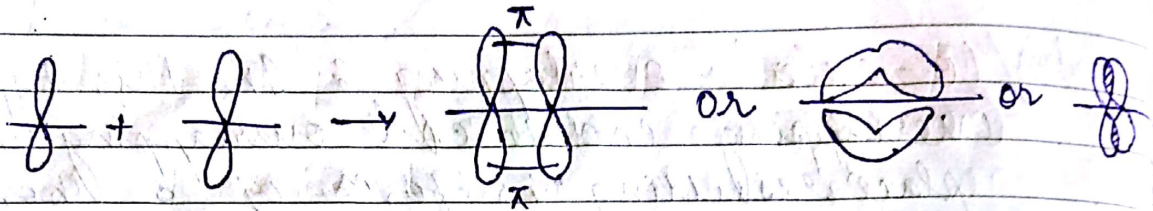


P-P overlapping :-

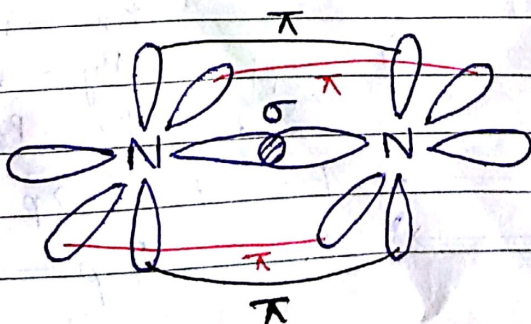
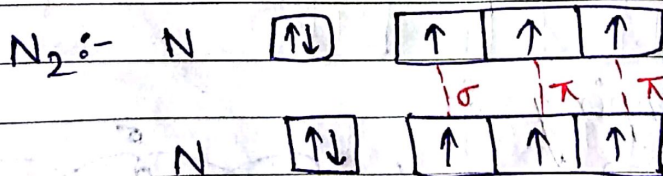
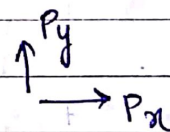
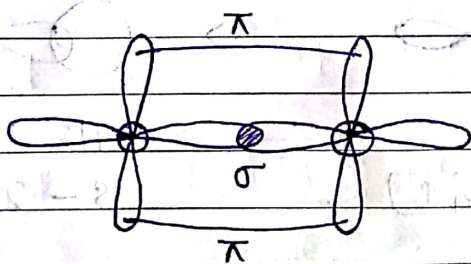
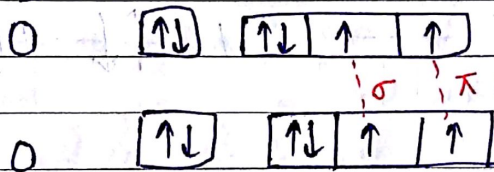


Co-lateral overlapping :-

In this, overlapping takes place $\perp$ to internuclear axis & resulting in form of π -bond.



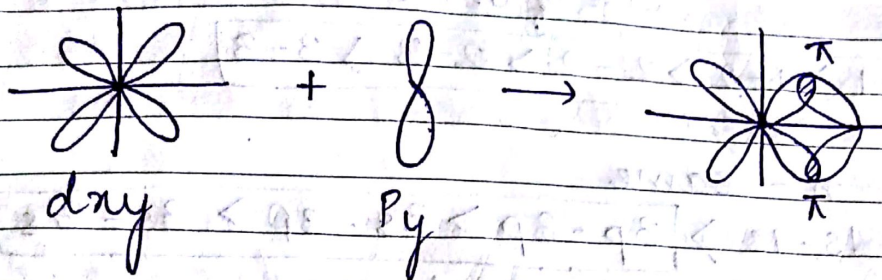
O_2 molecule



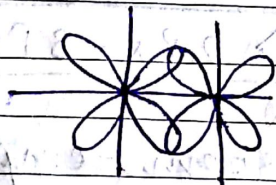
SO₂

Page No. 137 Date

$d\pi - p\pi$ bond :-



$d\pi - d\pi$



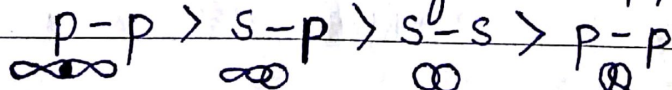
σ

π

- | | |
|---|--|
| • CO-axial overlapping | • colateral overlapping |
| • strong bond | • weak bond |
| • less reactive | • more reactive |
| • exist independently | • exist with σ bond |
| • Free rotation around its own axis possible | • rotation not possible |
| • σ bond does not participate in Resonance | • π bond does participate in resonance |

Bond Strength :- Applicable when orbitals are given :-

1. B.S. $\propto$ Extent of overlapping



co-axial

co-lateral

(2) B.S. $\propto \frac{1}{\text{Size of orbital}}$ as $n \uparrow$ B.S. $\downarrow$

$$1-1 > 1-2 > 2-2 > 2-3 > 3-3$$

If $n = \text{same}$

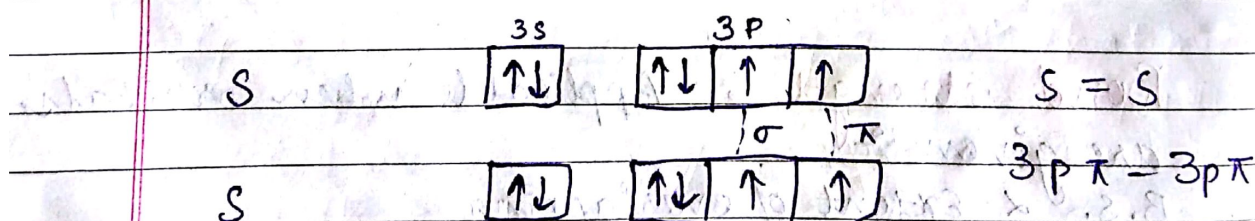
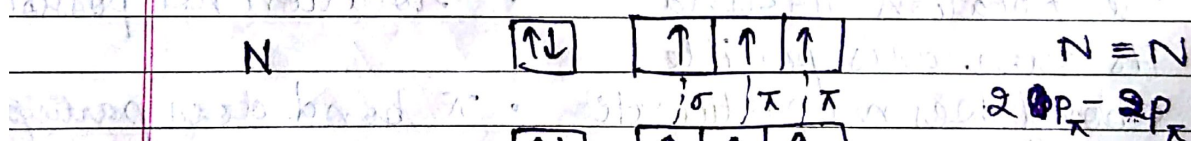
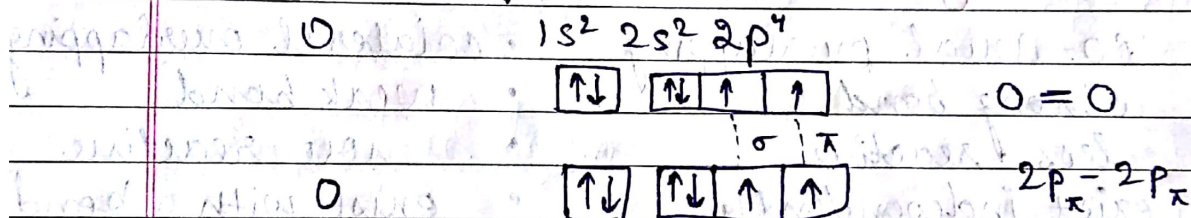
$$1s-1s > 3p-3p > 3s-3p > 3s-3s$$

(3) B.S. of π bond :

$$2p\pi-2p\pi > 2p\pi-3d\pi > 2p\pi-3p\pi > 3p\pi-3p\pi$$

Alms

Ques O_2 & N_2 is stable at room temp. but S_2 not explain why?





	Orbital	INA axis	bond
1.	$S + S$	any axis	σ
2.	$S + P_x$	x	σ
3.	$S + P_y$	y	σ
4.	$S + P_z$	z	σ
5.	$S + P_x$	y or z	no overlap / zero bond
6.	$S + P_y$	x or z	"
7.	$S + P_z$	x & or y	"
8.	$P_x + P_x$	x	σ
9.	$P_y + P_y$	y	σ
10.	$P_z + P_z$	z	σ
11.	$P_x + P_x$	y or z	π
12.	$P_y + P_y$	x & z	π
13.	$P_z + P_z$	x & y	π
14.	$P_x + P_y$	any axis	no overlap
15.	$P_y + P_z$	"	"
16.	$P_z + P_x$	"	"
17.	$P_x + d_{xy}$	y	π
18.	$P_y + d_{xy}$	x	π
19.	$P_z + d_{xz}$	z	π
20.	$P_z + d_{xz}$	x	π
21.	$P_y + d_{yz}$	z	π
22.	$P_z + d_{yz}$	y	π
23.	$d_{xy} + d_{xy}$	x or y	π
24.	$d_{yz} + d_{yz}$	y or z	π
25.	$d_{xz} + d_{xz}$	x or z	π
26.	$d_{xy} + d_{xy}$	z	σ bond
27.	$d_{yz} + d_{yz}$	x	σ bond
28.	$d_{xz} + d_{xz}$	y	σ bond
29.	$d_{x^2-y^2} + d_{x^2-y^2}$	z	σ bond
30.	Hybrid orbital or any orbital	any axis	σ

VSEP

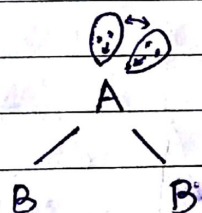
The Valence shell electron pair repulsion theory given by Sidgwick & Powell in 1940
~~ref~~ redefined by Nyholm & Gillespie 1957

- to explain shape and geometry of molecule.
- based on electronic repulsion of e^- pairs in valence shell.

Postulates :-

1. Geometry & shape of a molecule is decided by no. of lone pairs ($lp + bp$) in valence shell.

repulsion :- $lp - lp > lp - bp > bp - bp$
 lp are influenced by only nuclear att. of C.A.
 bp e^- are influenced by nuclear att. of C.A. & S.A.



central atom

- Imp 2. lp & bp tends to occupy ^{such} a posⁿ that minimize e^- repulsion & maximize distance b/w them.
 double bond occupy more space around C.A.
 $db - db > db - sb > sb - sb$

Representation :- AB_mL_n

$A \rightarrow$ C.A. $m \rightarrow$ no. of S.A.

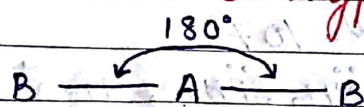
$B \rightarrow$ S.A. $n \rightarrow$ no. of lp

$L \rightarrow lp$

Note

- Steric No. = no. of bp + no. of lp
- geometry of a molecule is decided by steric no.
- shape is obtained by arrangement of lp in geometry.
 e^- pairs (lp+bp) $\rightarrow$ geometry
 bp $\rightarrow$ shape.
- If there is no lp then geometry & shape of molecule are same

1. AB_2LO type :



$$lp = 0$$

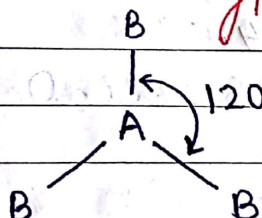
$$S.N. = 2 + 0 = 2$$

geometry $\rightarrow$ linear
shape $\rightarrow$ linear

$$BA = 180^\circ$$

eg : $BeCl_2$, BeH_2 , $HgCl_2$, CO_2

2. AB_3LO type :



$$lp = 0$$

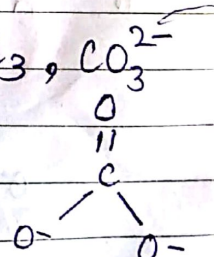
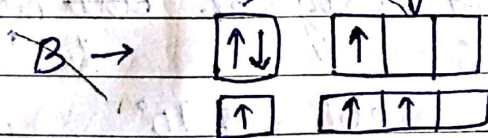
$$S.N. = 3 + 0 = 3$$

G $\rightarrow$ trigonal Planar

S $\rightarrow$ trigonal Planar

$$B.A. = 120^\circ$$

eg : BF_3 , BCl_3 , $AlCl_3$, CO_3^{2-}



3. AB_2L_1

$$lp = 1$$

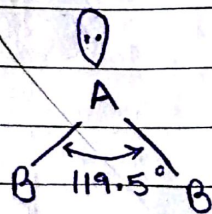
$$SN = 2 + 1 = 3$$

G = Trigonal Planar

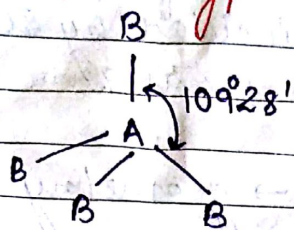
S = Bent / V-shape

$$BA = 119.5^\circ$$

eg : SO_2 , SeO_2 , $SnCl_2$



3. AB_4L_0 type :-



$$lp = 0$$

$$S.No. = 4 + 0 = 4$$

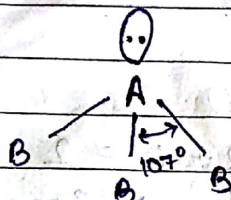
$G = \text{tetrahedral}$

$S = "$

$$B.A. = 109^\circ 28'$$

eg $\rightarrow CH_4, NH_4^+, CCl_4, SiO_4$

Case : I. AB_3L_1



$$S.No. = 3 + 1 = 4$$

$G = \text{tetrahedral}$

$S = \text{Pyramidal}$

$$B.A. = 107^\circ$$

eg $\rightarrow NH_3, PH_3, H_3O^+$

Case - II AB_2L_2



$$lp = 2$$

$$S.No. = 2 + 2 = 4$$

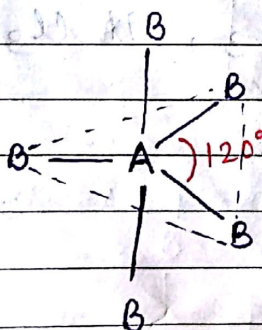
$G = \text{tetrahedral}$

$S = \text{V-Shape / Bent-Shape}$

$$B.A. = 104.5^\circ$$

eg $\rightarrow H_2O, H_2S, Cl_2O$

4. AB_5L_0



$$lp = 0$$

$$S.No. = 5 + 0 = 5$$

$G = \text{trigonal bipyramidal}$

$S = "$

$$B.A. = 120^\circ, 90^\circ, 180^\circ$$

eg PF_5, PCl_5, SbF_5

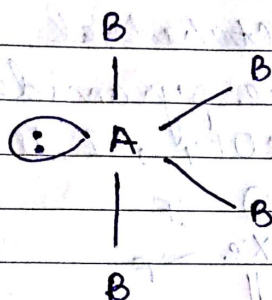
Case AB_4L_1 :-

$$lp = 1$$

$$S.No. = 4 + 1 = 5$$

$$G = TBP$$

$S =$ see-saw, K shape, π -shape



eg SF_4

Case AB_3L_2

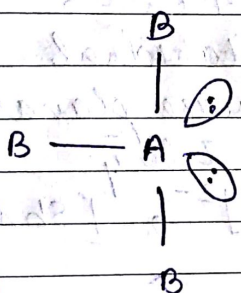
$$lp = 2$$

$$S.No. = 3 + 2 = 5$$

$$G = TBP$$

Shape = T shape

eg $ClF_3, ICl_3, XeOF_2$



Case AB_2L_3

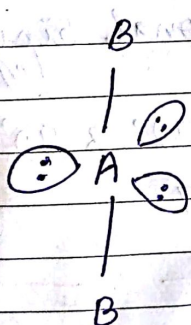
$$lp = 3$$

$$S.No. = 5$$

$$G = TBP$$

$S =$ Linear

eg $\rightarrow XeF_2, ICl_2^-, I_3^-$



5. AB_6L_0 type :-

$$lp = 0$$

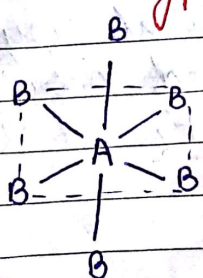
$$S.No. = 6 + 0 = 6$$

$$G = \text{Octahedral}$$

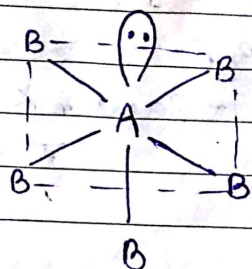
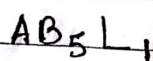
$S =$ " / square bipyramidal

$$B.A = 90^\circ$$

eg: $SF_6, TeCl_6, XeO_2F_4$



Case



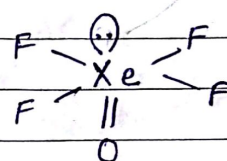
$lp = 1$

$S. No. = 5 + 1 = 6$

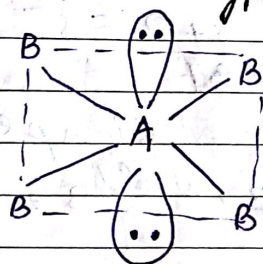
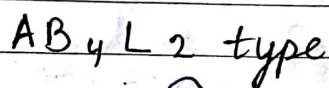
$G = \text{Octahedral}$

$S = \text{Square pyramidal}$

eg : $XeOF_4$, ICl_5 , BrF_5



Case



$lp = 2$

$S. No. = 4 + 2 = 6$

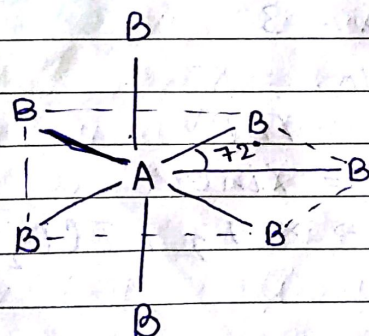
$G = \text{Octahedral}$

$S = \text{Square planar}$

eg : XeF_4 , ICl_4^-

$[TeCl_4]^{2-}$, $[SbCl_4]^{3-}$

6. AB_7L_0 :



$lp = 0$

$S. N. = 7 + 0 = 7$

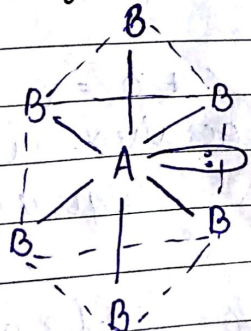
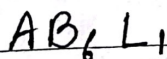
$G = \text{Pentagonal bipyramidal}$

$S = \text{" " " " " "}$

$B. A. = 72^\circ \text{ \& } 90^\circ$

eg IF_7

Case



$lp = 1$

$S. No. = 6 + 1 = 7$

$G = \text{Pentagonal bipyramidal}$

$S = \text{distorted octahedral}$

eg : XeF_6 , ICl_6^-

Case

AB_5L_2 type

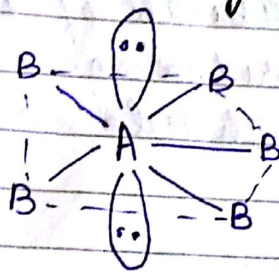
$lp = 2$

S.No. = $5 + 2 = 7$

G = Pentagonal bipyramidal

S = Pentagonal planar

eg $(XeF_5)^-$

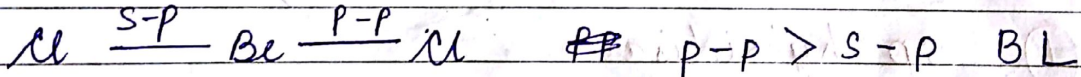
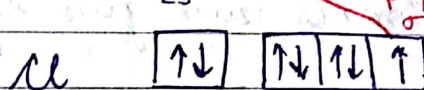
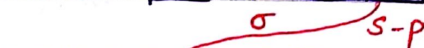
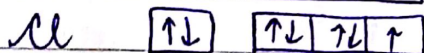
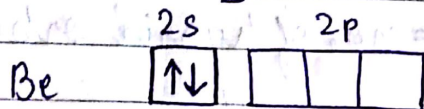


Hybridisation :-

Why?

If Hybridisation is not considered

For eg :- $BeCl_2$



but exp. both B.L. are equal

explained by Pauling
by the concept of Hybridisation

→ It is intermingling of atomic orbitals of same or nearly same energy to form new set of orbitals i.e. hybrid orbitals which give definite geometry to a molecule.

geometry $\rightarrow$ lp + bp location
shape $\rightarrow$ position of terminal atoms

Page No. 146 Date

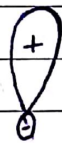
Postulates :-

1. Valence shell atomic orbitals of central atom take part in Hybridisation.
2. Energy of ^{every} orbitals are should be same or nearly same.

- ☒ ① 3s, 3p, 3d
☒ ② 3d, 4s, 4p
☒ ③ 4p, 3p, 3d & 4s
☐ ④ None of these

3. No. of atomic orbitals = no. of hybrid orbitals formed

4. H.O. shape :-



5. Hybrid orbitals are directional hence give definite geometry to orbital.

① sp hybridisation

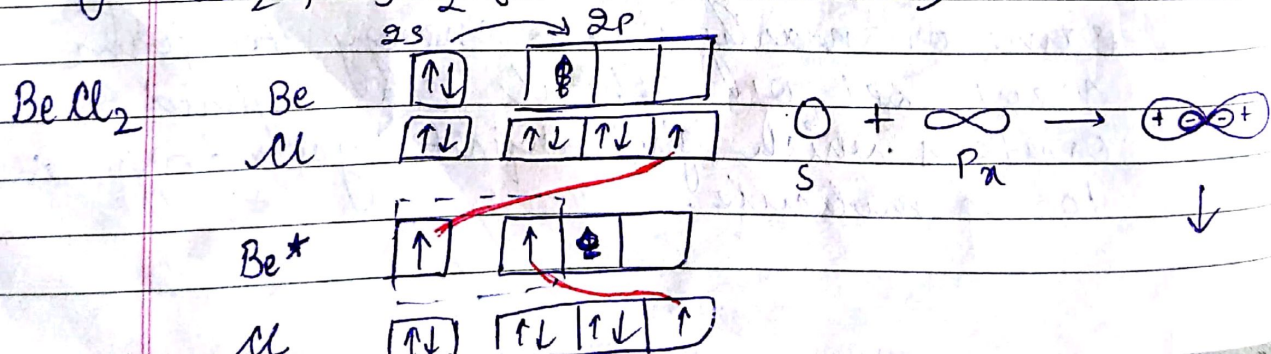
one s + one p = sp + sp
 $p_x / p_y / p_z$

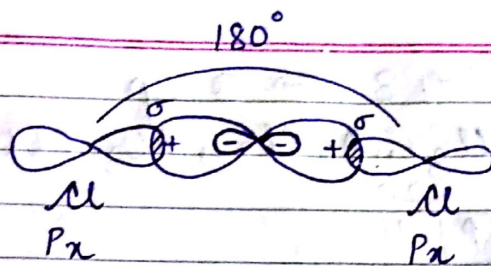
Geometry $\rightarrow$ linear

B.A. = 180°

Shape $\rightarrow$ linear

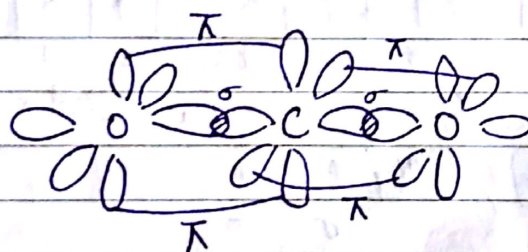
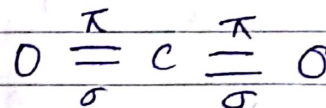
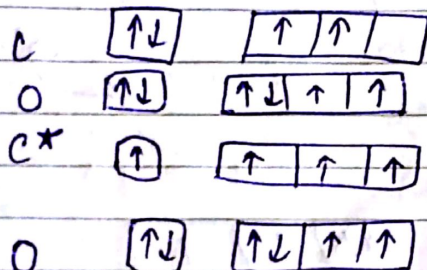
eg $\text{BeF}_2, \text{BeCl}_2, \text{BeH}_2, \text{HgCl}_2, \text{ZnCl}_2, \text{C}_2\text{H}_2, \text{CO}_2, \text{C}_3\text{O}_2$ (carbon suboxide)



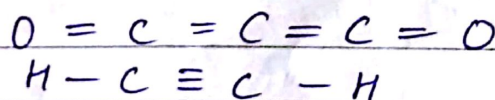


Note : only hybrid orbital form σ bond while π bond is formed by unhybrid orbital

CO₂



C₃O₂
C₂H₂



②

sp^2 :

$s + 2p = 3 \text{ } sp^2$

$s + p_x, p_y \rightarrow xy \text{ plane}$

$s + p_y, p_z \rightarrow yz \text{ plane}$

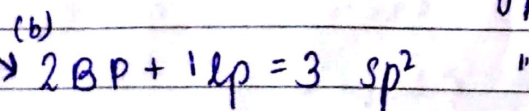
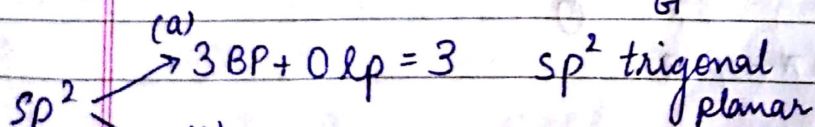
$s + p_x, p_z \rightarrow xz \text{ plane}$

G

S

B.A.

120

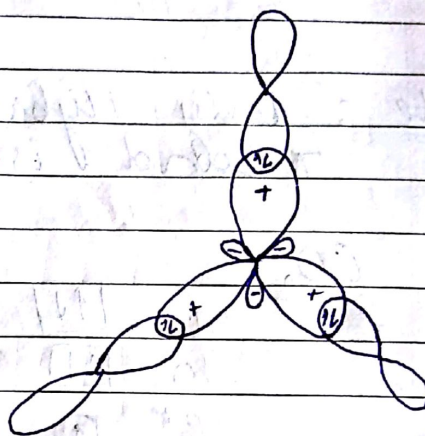
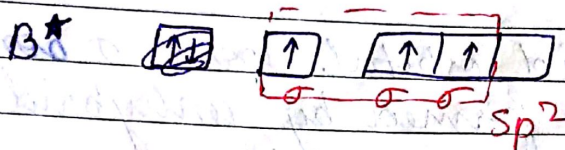


Bent / V
shape

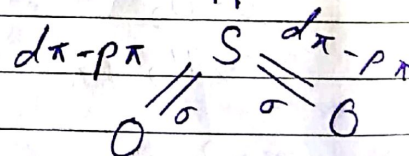
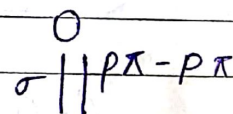
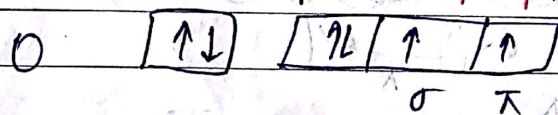
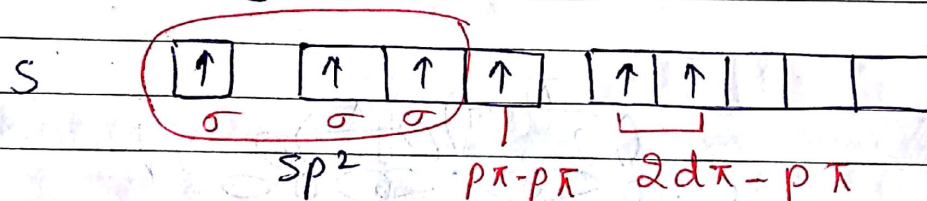
119.5°

(a) $3BP + 0lp = 3 \rightarrow sp^2$

eg : $BF_3, BCl_3, AlCl_3, SO_3, CO_3^{2-}, NO_3^-$

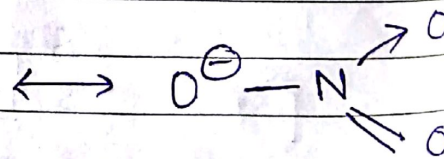
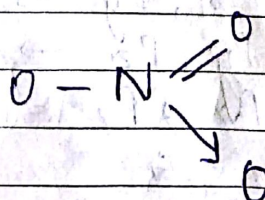
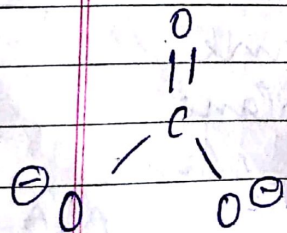


$SO_3 \rightarrow$



CO_3^{2-}

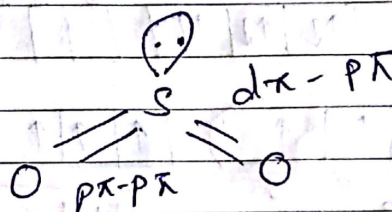
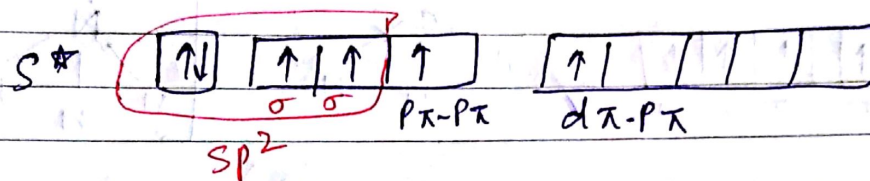
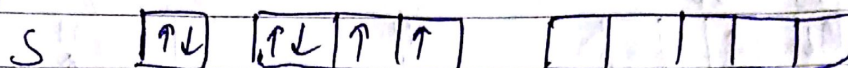
NO_3^-



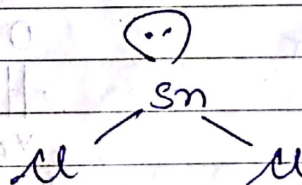
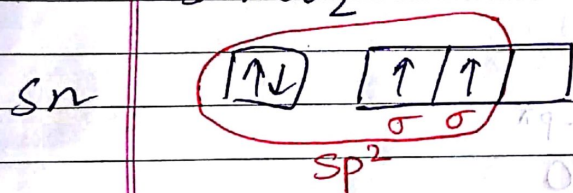
$1p\pi-p\pi$

$1p\pi-p\pi$

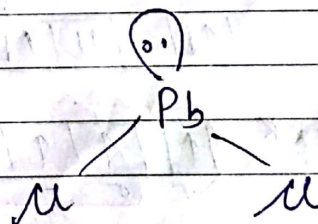
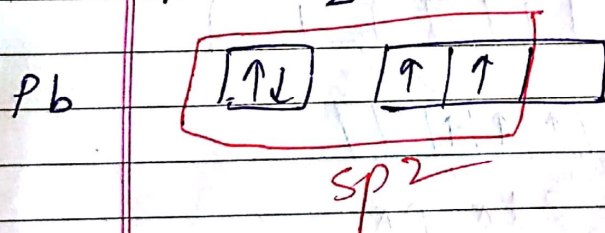
(b) 2 B.P. + 1 lp = 3 sp^2
eg SO_2 , $SnCl_2$, $PbCl_2$



$SnCl_2$



$PbCl_2$

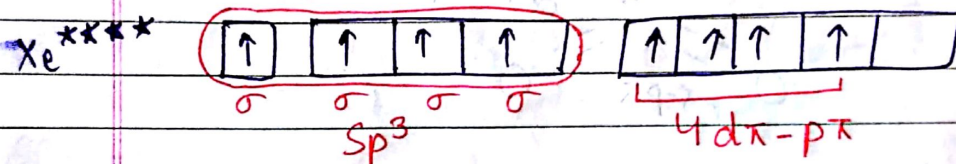
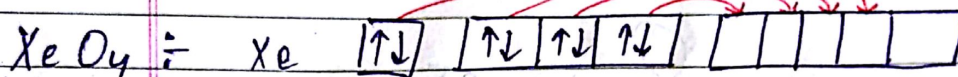
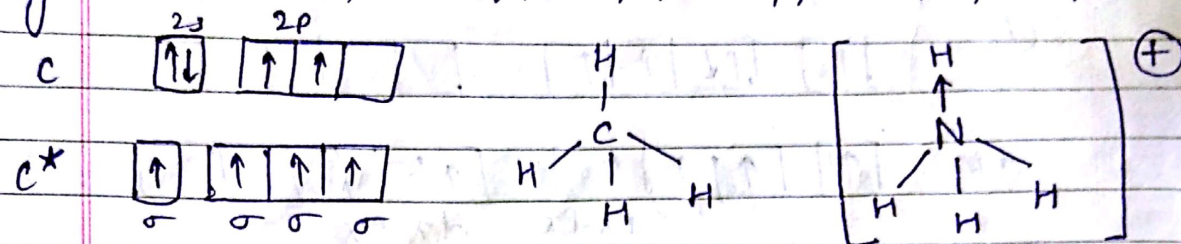


(3) sp^3 :-
 $S + 3p \rightarrow sp^3$ 4
 Px, Py, Pz

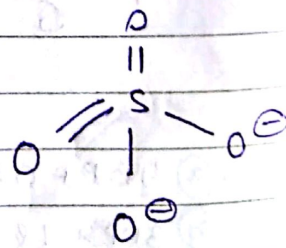
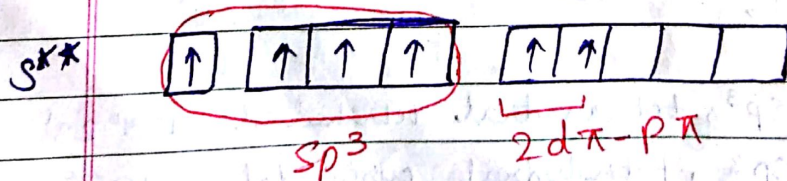
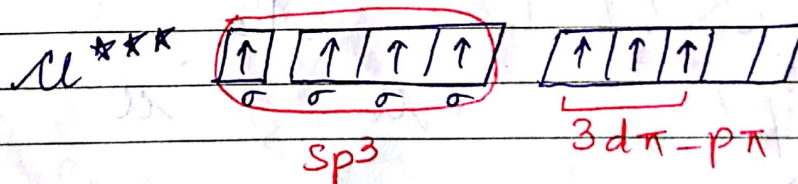
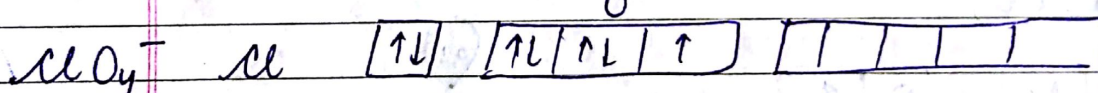
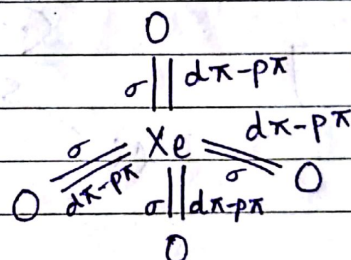
sp^3 $\rightarrow$ (a) 4BP + 0lp = 4, sp^3 , tetrahedral tetrahedral $109^\circ 28'$
(b) 3BP + 1lp = 4, sp^3 , tetrahedral pyramidal 107°
(c) 2BP + 2lp = 4, sp^3 , " Bent/V shape 104.5°

(a) $4BP + 0LP = 4 sp^3$

eg $CH_4, CCl_4, SiCl_4, NH_4^+, XeO_4, ClO_4^-, SO_4^{2-}$



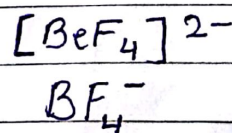
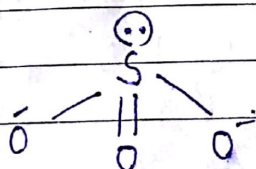
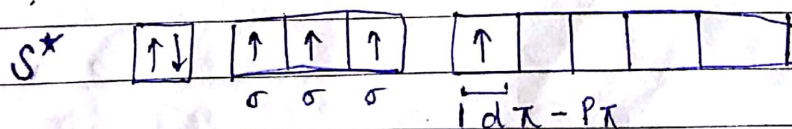
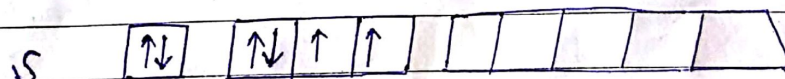
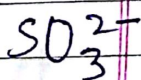
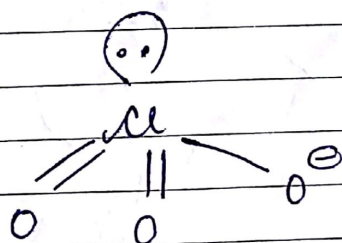
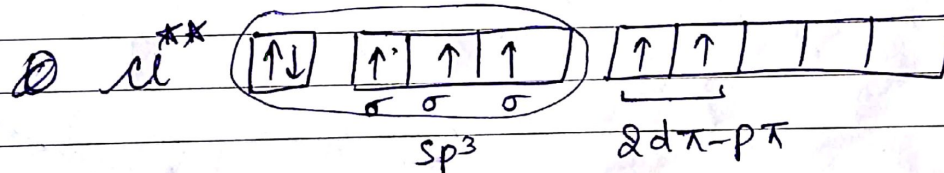
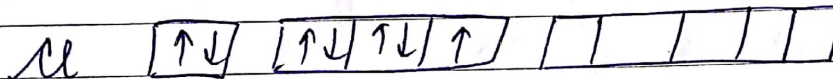
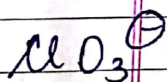
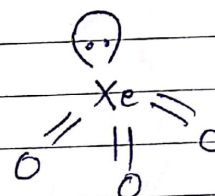
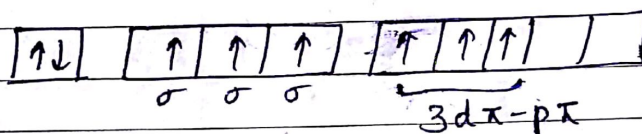
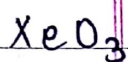
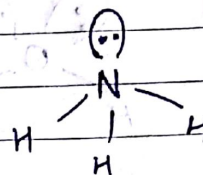
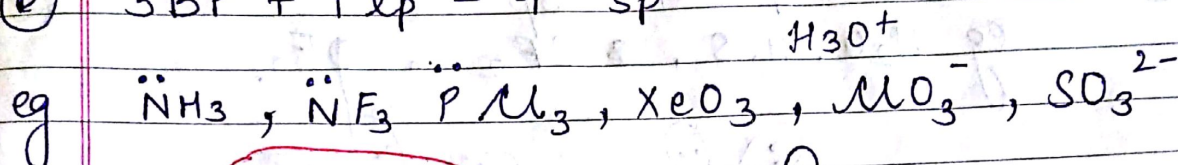
IIT





Page No. 151 Date

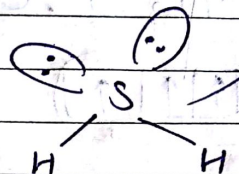
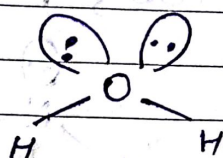
(b) $3BP + 1lp = 4 sp^3$



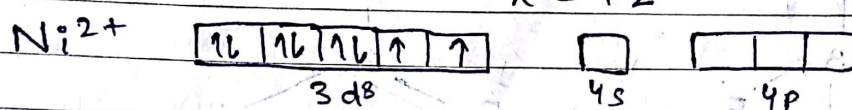
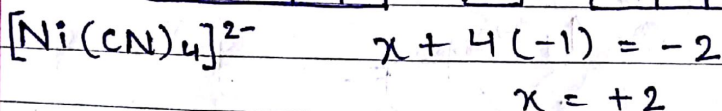
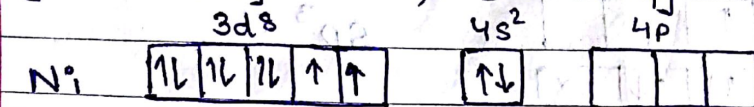
(c)

$$2BP + 2lp = 4 \therefore sp^3$$

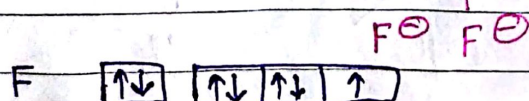
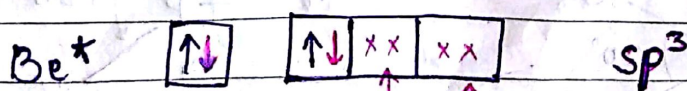
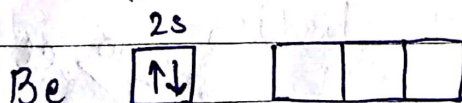
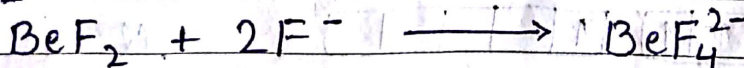
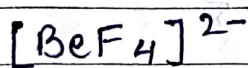
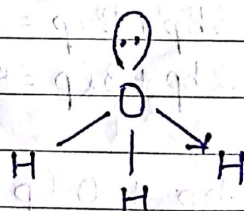
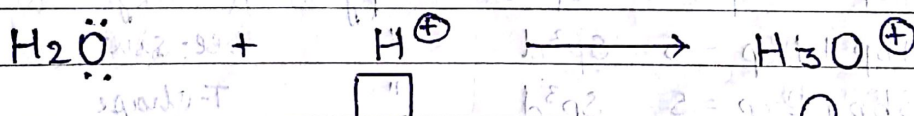
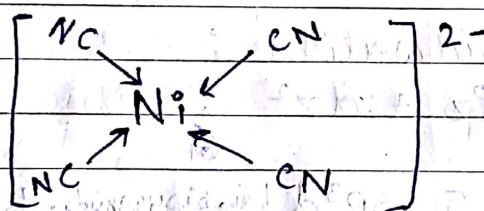
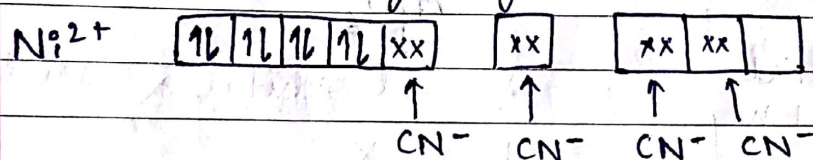
eg H_2O , H_2S , SF_2 , OF_2



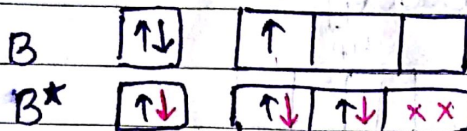
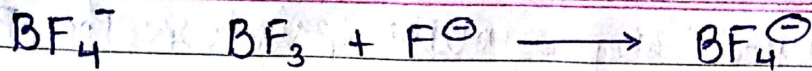
eg dsp^3 hybridisation $\rightarrow dx^2-y^2 + s + P_x, P_y$
 $[Ni(CN)_4]^{2-}$, $[PtCl_4]^{2-}$



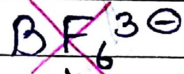
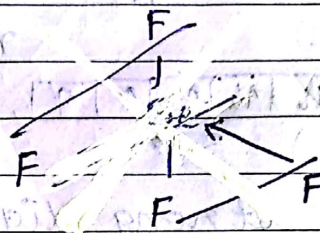
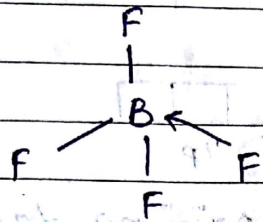
CN^- is a strong ligand, so pairing takes place



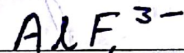
Hyb. occurs in atomic orbitals



sp^3



2d orbital
is not +nt



3d orbital Present

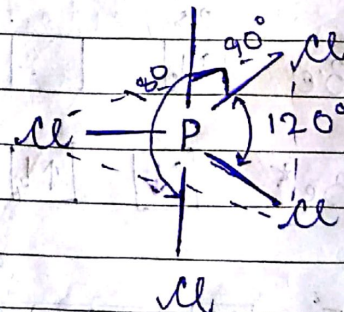
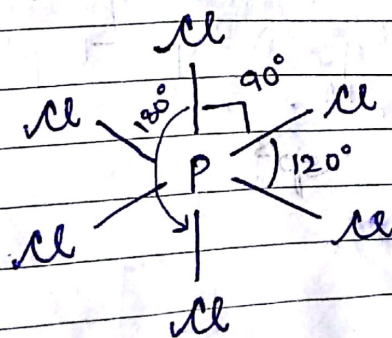
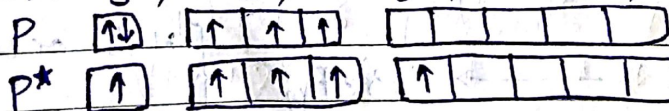
sp^3d hybridisation :-

$\text{S} + \text{P}_x, \text{P}_y, \text{P}_z + \text{d}_{z^2}$

	G	S	B.A.
$\rightarrow 5\text{bp} + 0\text{lp} = 5$	sp^3d tri. bipyramidal	tri. bipy.	$120^\circ \& 90^\circ$
$\rightarrow 4\text{bp} + 1\text{lp} = 5$	sp^3d	"	see-saw
$\rightarrow 3\text{bp} + 2\text{lp} = 5$	sp^3d	"	T-shape
$\rightarrow 2\text{bp} + 3\text{lp} = 5$	sp^3d	"	linear 180°

(a) $5\text{bp} + 0\text{lp} = 5$, sp^3d

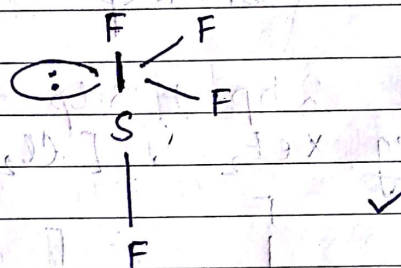
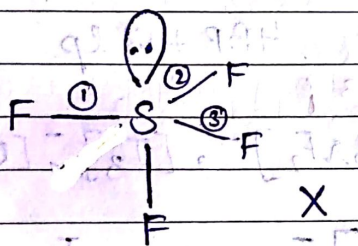
eg $\text{PCl}_5, \text{PF}_5, \text{AsF}_5, \text{SbF}_5, \text{SbCl}_5$



Note : Axial B.L. > eq. B.L.
due to 3 bp-bp repulsion
Axial bond < eq. bond B.s.

(b) $4 \text{ bp} + 1 \text{ lp} = 5 \text{ } sp^3d$ $\rightarrow$ trigonal bipyramidal
 $\therefore S \rightarrow$ see saw.

eg SF_4 , SeF_4 , $TeCl_4$, PF_4^- .
 $lp-lp > lp-bp > bp-bp$

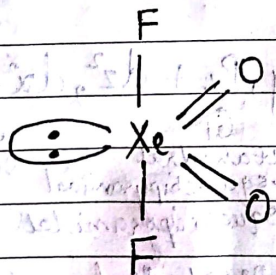


lone pair repulsion

①, ②, ③ so
this structure is not
possible.

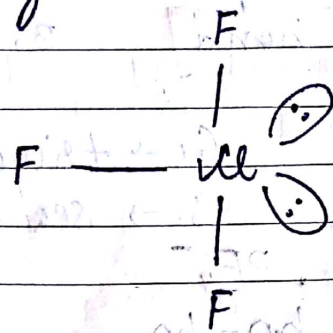
(lp-bp) repulsion

Ques

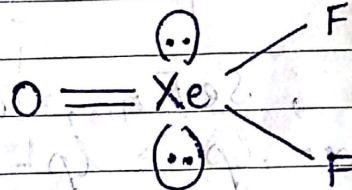
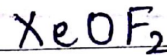


which excited state & how many $d\pi-p\pi$
are present?

Lone Pair : Always goes to equatorial posⁿ becoz there is min repulsion in eq. posⁿ

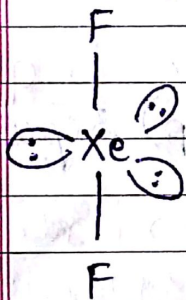


3 BP + 2 lp

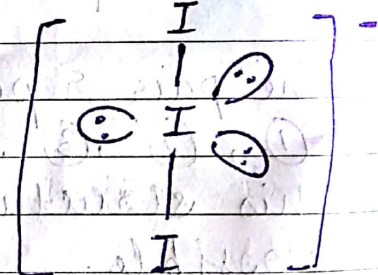
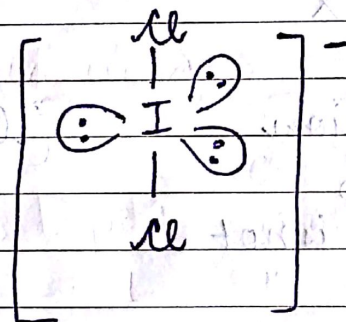


4 BP + 2 lp

(d) $2 \text{ bp} + 3 \text{ lp} = 5 \text{ } sp^3d$
eg XeF2, [Cl2]^-, [BrF2]^-, [I3]^-, [Br3]^-



Linear

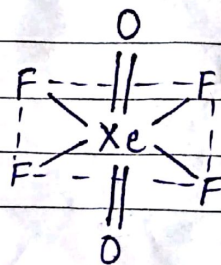
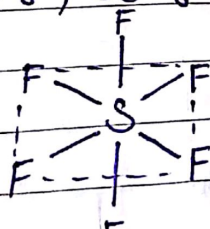


$sp^3d^2 \div S + P_x, P_y, P_z + d_{z^2}, d_{x^2-y^2}$

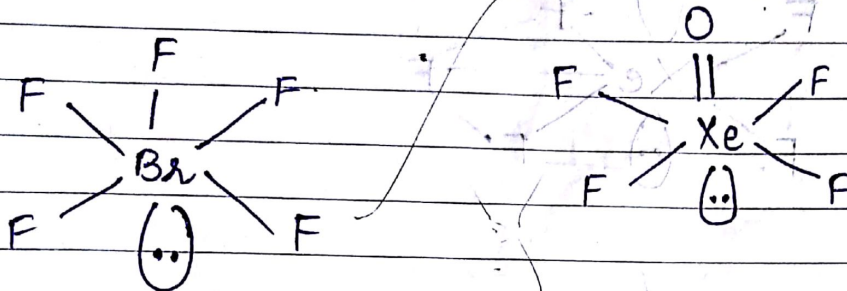
BA.

sp^3d^2 → (a) $6 \text{ BP} + 0 \text{ lp} = 6 \text{ } sp^3d^2$ Octahedral or square bipyramidal Octahedral 90°
(b) $5 \text{ BP} + 1 \text{ lp} = 6 \text{ } sp^3d^2$ Square bipyramidal square pyramidal
(c) $4 \text{ BP} + 2 \text{ lp} = 6 \text{ } sp^3d^2$ Octahedral square planar

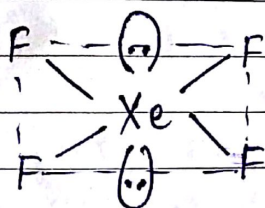
(a) $6 \text{ bp} + 0 \text{ lp} = 6 \text{ } sp^3d^2$
SF6, SeF6, TeF6



(b) $5 \text{ bp} + 1 \text{ lp} = 6$ sp^3d^2
eg IF_5 , BrF_5 , IF_5



(c) $4 \text{ Bp} + 2 \text{ lp} = 6$ sp^3d^2

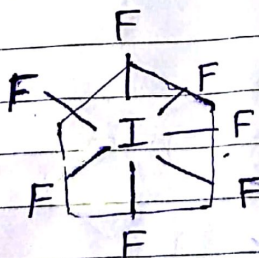


XeF_4 , $[XeF_4]^-$

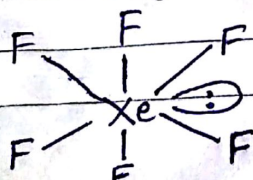
sp^3d^3

	G	S	B.A.
sp^3d^3 → $7 \text{ bp} + 0 \text{ lp} = 7$ sp^3d^3	Pentagonal bipyramidal	Pentagonal bipyramidal	$72^\circ \& 90^\circ$
sp^3d^3 → $6 \text{ bp} + 1 \text{ lp} = 7$ sp^3d^3	Pentagonal bipyramidal	Square bipyramidal	
sp^3d^3 → $5 \text{ bp} + 2 \text{ lp} = 7$ sp^3d^3	Pentagonal bipyramidal	Pentagonal Planar	

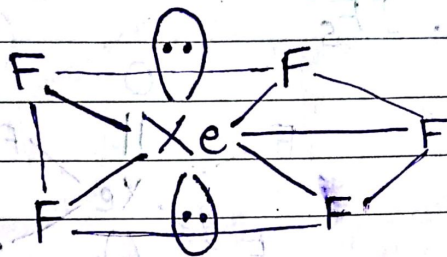
(a) $7 \text{ bp} + 0 \text{ lp} = 7$ sp^3d^3
eg IF_7



(b) $6 \text{ bp} + 1 \text{ lp} = 7$ sp^3d^3
 XeF_6 , $[XeF_6]^-$



(c) $5 \text{ bp} + 2 \text{ lp} = 7 \quad \text{sp}^3\text{d}^3$

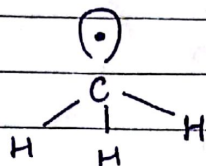


Hybridisation of odd odd electron species:

Case-I If E.N. of C.A. > E.N. of S.A.

odd e^- is not counted in hybridisation

eg

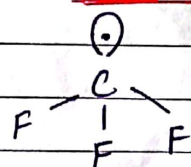


$$\begin{aligned} \text{S.No.} &= \text{no. of bp} + \text{no. of lp} \\ &= 3 + 0 \\ &= 3 \\ &sp^2 \end{aligned}$$

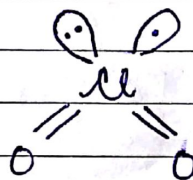
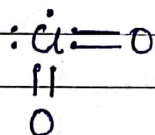
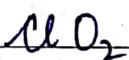
Case-II If E.N. of C.A. < E.N. of S.A.

odd e^- is counted as lp in hybridisation

eg

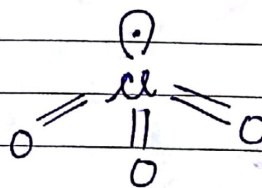
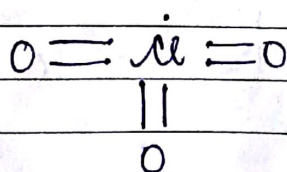
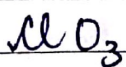


$$\begin{aligned} \text{S.No.} &= 3 + 1 = 4 \\ &sp^3 \end{aligned}$$



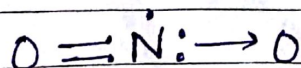
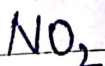
$$\text{S.No.} = 2 + 2 = 4 \rightarrow sp^3$$

V-shape

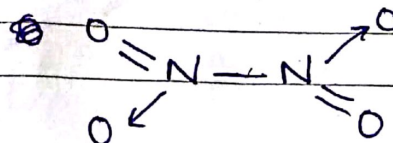
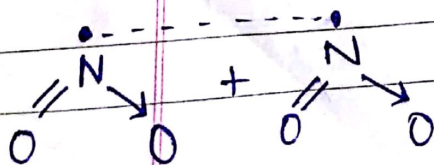
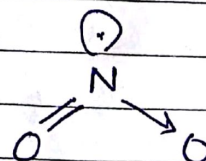


$$\text{S.No.} = 3 + 1 = 4 \rightarrow sp^3$$

Pyramidal

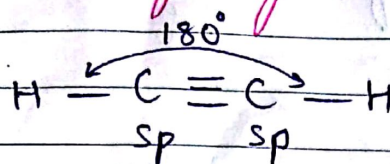


$$\text{S.No.} = 2 + 1 = 3 \quad sp^2$$



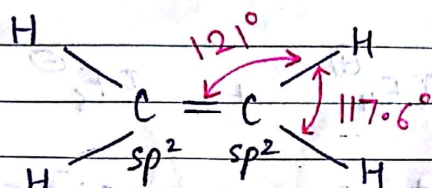
Hybridisation of Hydrocarbon :-

C_2H_2



linear

C_2H_4

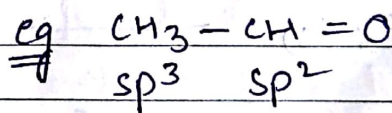
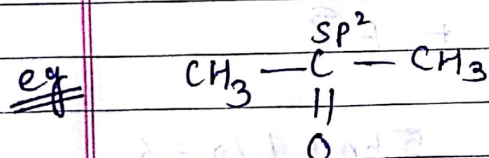
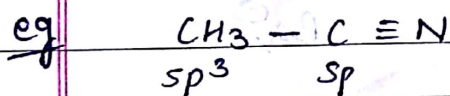
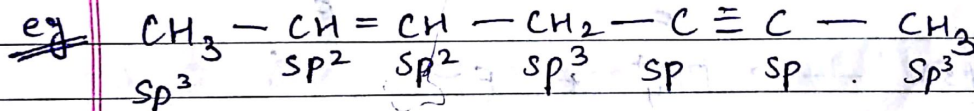
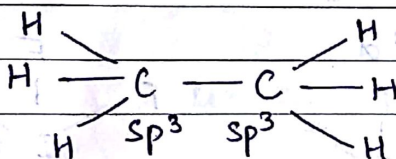


NCERT

C—H
108 pm

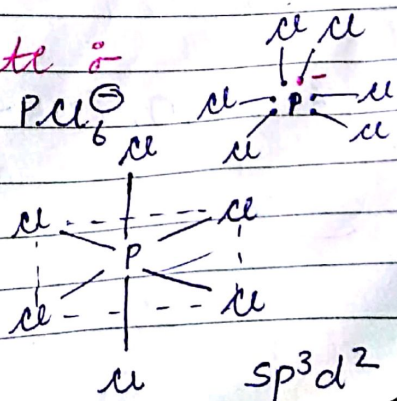
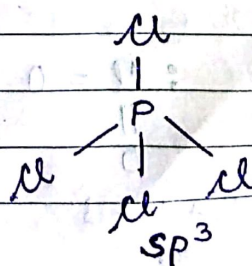
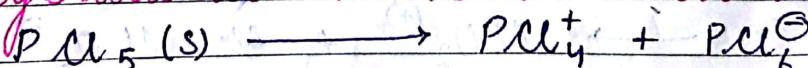
C—C
134 pm

C_2H_6



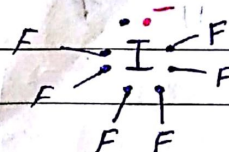
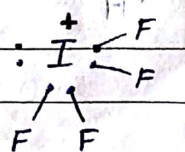
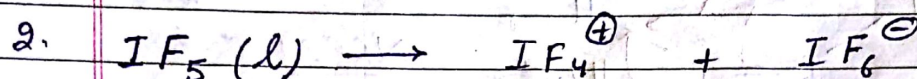
Hybridisation in solid state :-

★ 1.



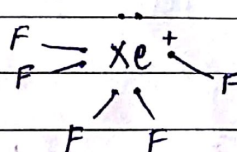
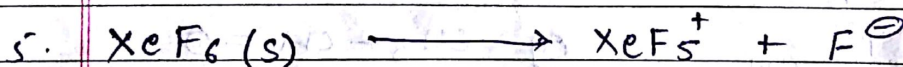
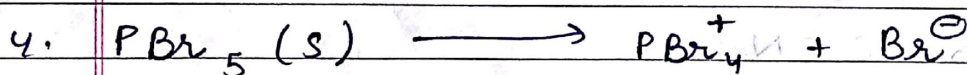
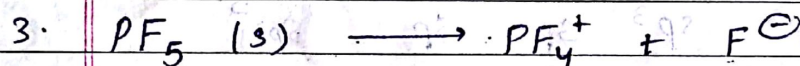
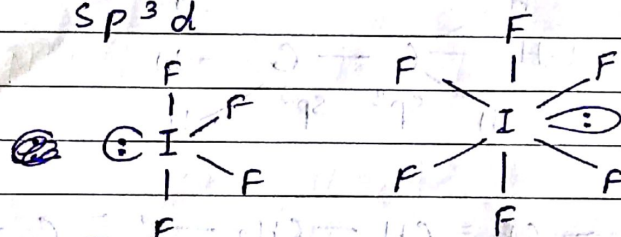
Ques Hybridisation of PCl_5 (s) is

- ① sp^3d
- ② sp^3
- ③ sp^3d^2
- ④ both ② and ③

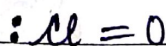
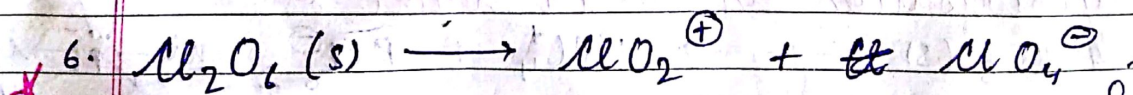


$6bp + 1lp = 7$
 sp^3d^3

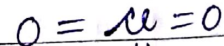
$4bp + 1lp = 5$
 sp^3d



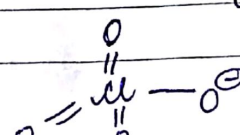
$5bp + 1lp = 6$
 sp^3d^2

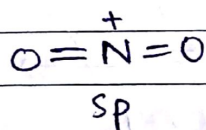
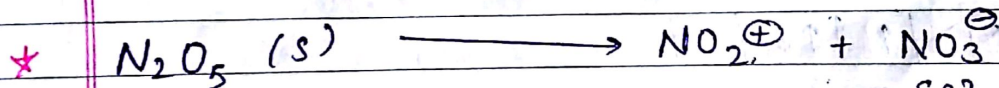
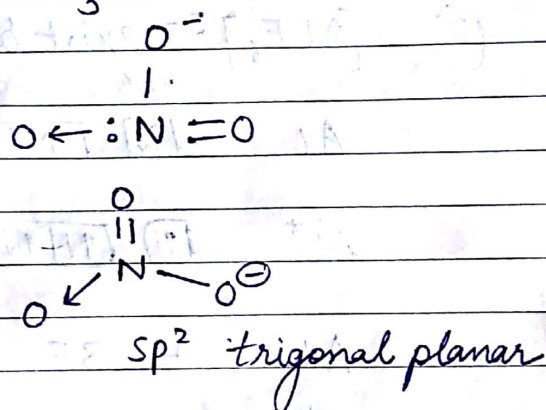
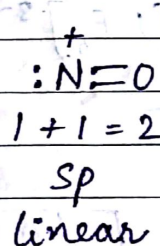
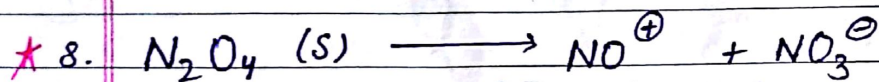
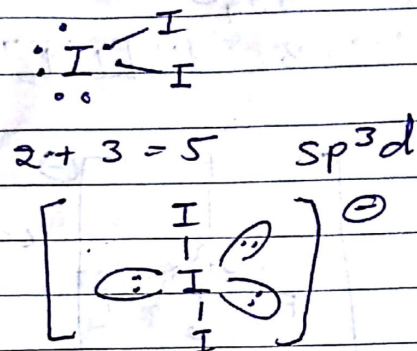
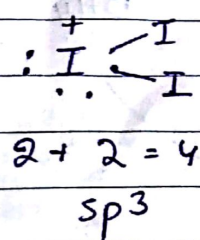
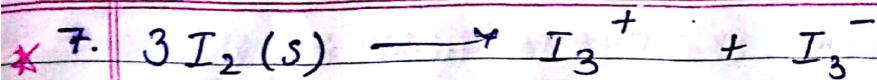


$2+1=3$
 sp^2

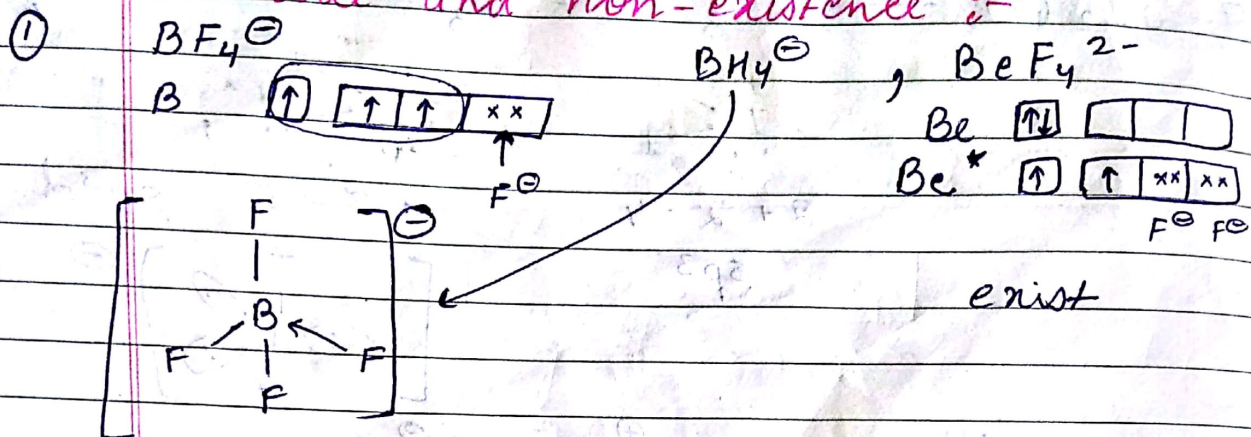


$4+0=sp^3$

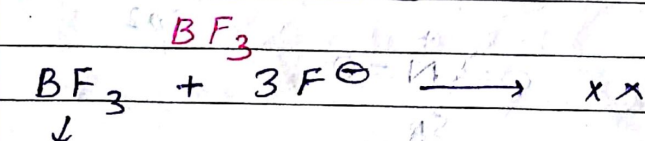
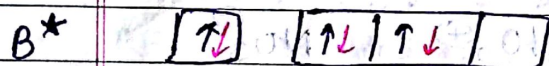
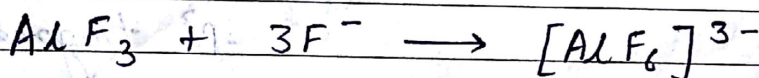
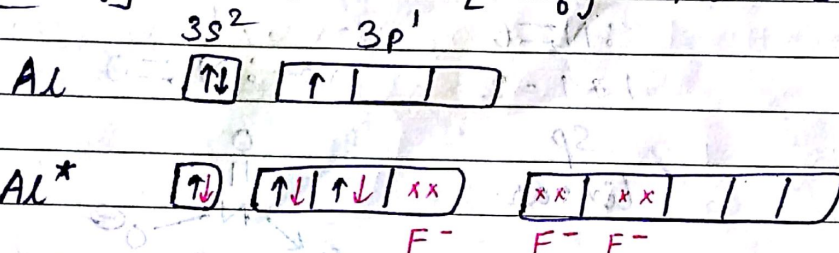




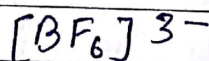
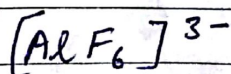
Existence and non-existence :-



② $[AlF_6]^{3-}$ exist but $[BF_6]^{3-}$ not. Explain why?

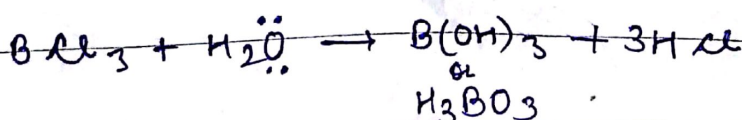
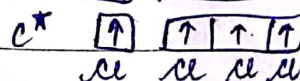
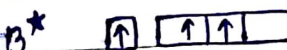
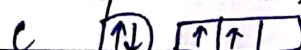
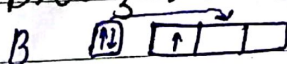


2d x



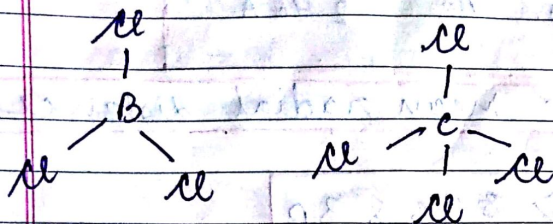
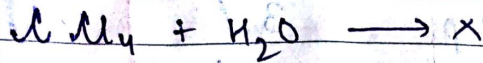
↓ have vacant (3d) does not have vacant d orbital

③ BAl_3 is hydrolysed but $AlCl_3$ not?



B has vacant orbital in which O lone pair is attracted to orbital and energy released & this energy used to break B-Cl bond and form B-OH bond

Page No. 158 Date



CCl_4 does not have vacant orbital so O lone pair can't be attracted.

④ SiF_6^{2-} exist but SiCl_6^{2-} not ?

3d

3d

F size small

Cl → large size

steric hinderance (repulsion)

SiCl_6^{2-} x

⑤ CCl_6^{2-} → not exist



⑥ PF_5 / PCl_5 exist but NF_5 / NCl_5 not ?

3d

2d x

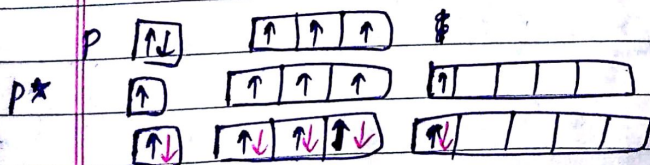
⑦ PCl_6^- ✓

⑧ PI_6^- x

I size & ↑

steric hinderance ↑

Ques PCl_5 & PF_5 exist but PH_5 not ?



	3s	3p	3d
mean radial distance	0.47 Å	0.55 Å	2.46 Å

energy $\propto$ mean radial distance

energy $3d \gg 3s \text{ \& } 3p$

so intermixing of 3s, 3p & 3d is not possible

P is attached to highly EN like F, O, Cl
P⁵⁺

as +ve charge on C.A. (P) $\uparrow$ attraction on $e^- \uparrow$
hence 3d orbital contraction comes closer to nucleus

Now energy 3s, 3p & 3d are comparable
mixing of orbital

PF₅, PCl₅

but in case of PH₅ H is less EN.

hence contraction of orbital not possible

so PH₅ does not exist

|| y , SF₆ & SF₄ exist
but SH₆ & SH₄ not

~~MOT~~ : Molecular

18/09/17

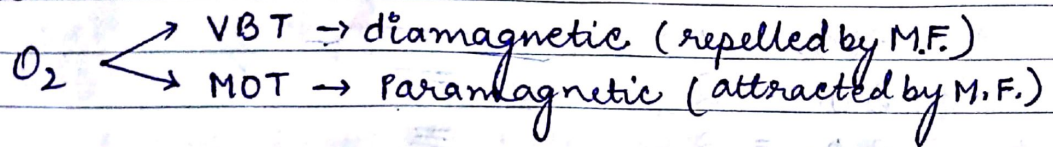
1 Ques NEET/AIIMS

Page No. 160 Date

Molecular Orbital Theory (MOT)

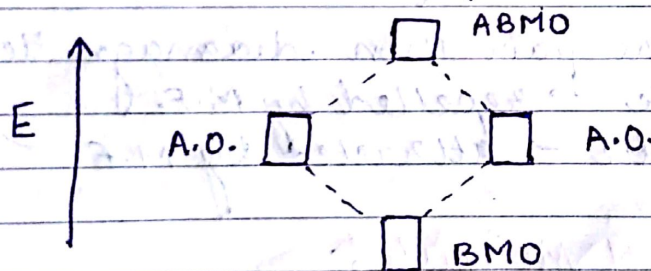
It explains the prop. of molecule which VBT could not.

Accⁿ to



Postulates :-

1. El⁻ in a molecule are +nt in molecular orbitals as e⁻ in atom are +nt in atomic orbitals.
2. MO are formed by overlapping of A.O.
3. no. of M.O. = no. of A.O. overlapping
Half of M.O. have less energy $\rightarrow$ BMO (Bonding M.O.)
more stable $\leftarrow$
Half of M.O. have higher energy $\rightarrow$ ABMO $\rightarrow$ less stable



4. El⁻ are filled^{in M.O.} accⁿ to Aufbau Principle which is based on Hund's Rule and Pauli Exclusion Principle
e⁻ first goes to MO which have less energy i.e. BMO
then e⁻ 1st goes to MO which have high energy i.e. ABMO

* 5. Bond Order (B.O.) = $\frac{N_b - N_a}{2}$

$N_b \rightarrow$ no. of e⁻ in BMO

$N_a \rightarrow$ no. of e⁻ in ABMO

Diamagnetic is repelled by Magnetic Field

Page No. 161 Date

Note: B.O. may be +ve, -ve, zero or fractional
molecule exist if B.O. is +ve
molecule doesn't exist if B.O. is -ve or zero

$$B.O. = 1$$

$$B.O. = 2$$

$$B.O. = 3$$

$$B.L. \propto B.O.$$

$$B.E. \propto B.O.$$

$$B.E. \propto B.D.E. \propto B.O.$$

$$\text{Stability of molecule} \propto B.O.$$

* 6. A molecule is paramagnetic if ^{there is} unpaired e^- in M.O.

- If all e^- are pair then diamagnetic.
- diamagnetic $\rightarrow$ repelled by M.F.
- paramagnetic $\rightarrow$ attracted by M.F.

Formation of Molecule:-

$\rightarrow$ An e^- is influenced by a nucleus in atoms while an e^- is influenced by 2 or more nuclei in a molecule.

- e^- in a atom $\rightarrow$ monocentric
- e^- in a molecule is $\rightarrow$ Polycentric

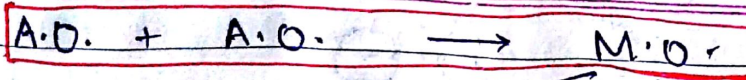
H

H₂



atom

molecule

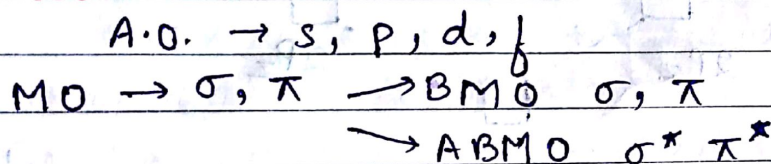


BMO

ABMO

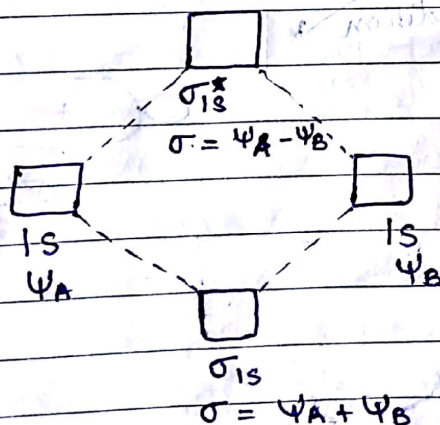
- | | |
|---|---|
| • e^- density is +ve b/w nuclei | • e^- density is present away from nuclei |
| • hence there is less repulsion b/w nuclei in BMO | • repulsion b/w nuclei in ABMO $\uparrow$ |
| • Energy $\downarrow$ | • Energy $\uparrow$ |
| • Stability $\uparrow$ | • Stability $\downarrow$ |

Linear Combination of Atomic Orbitals (LCAO) method :-

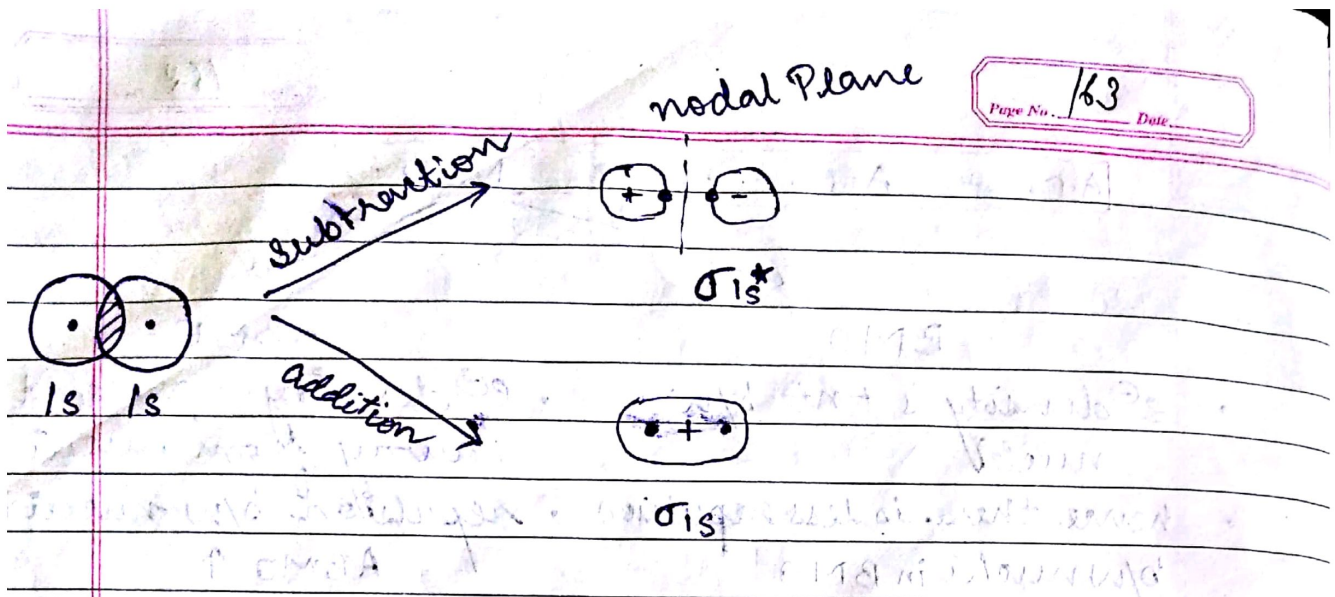


σ MO :-

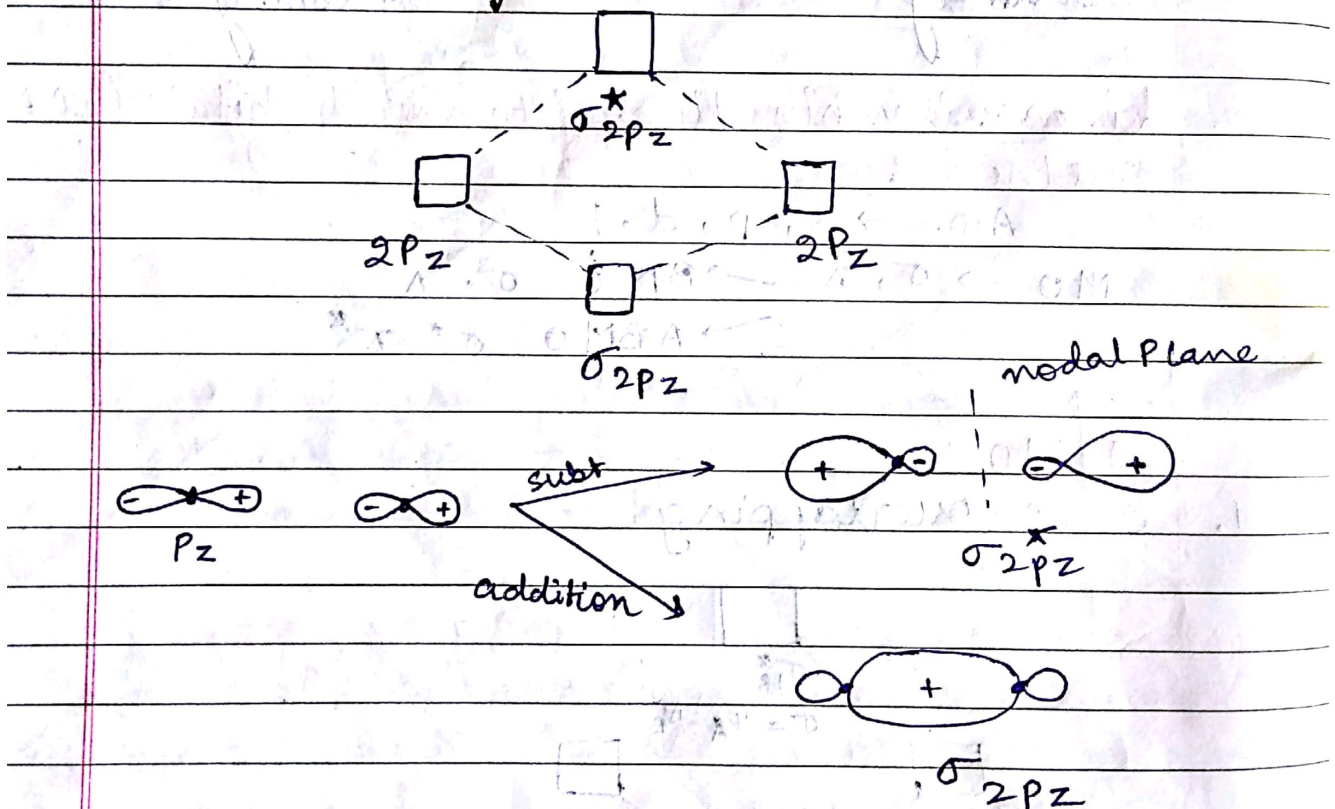
1. s-s overlapping



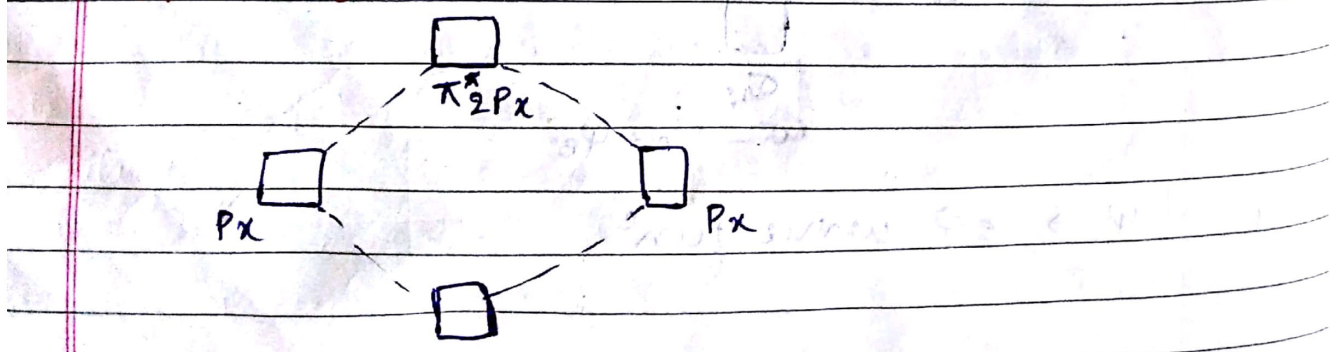
$\Psi \rightarrow e^-$ wave func

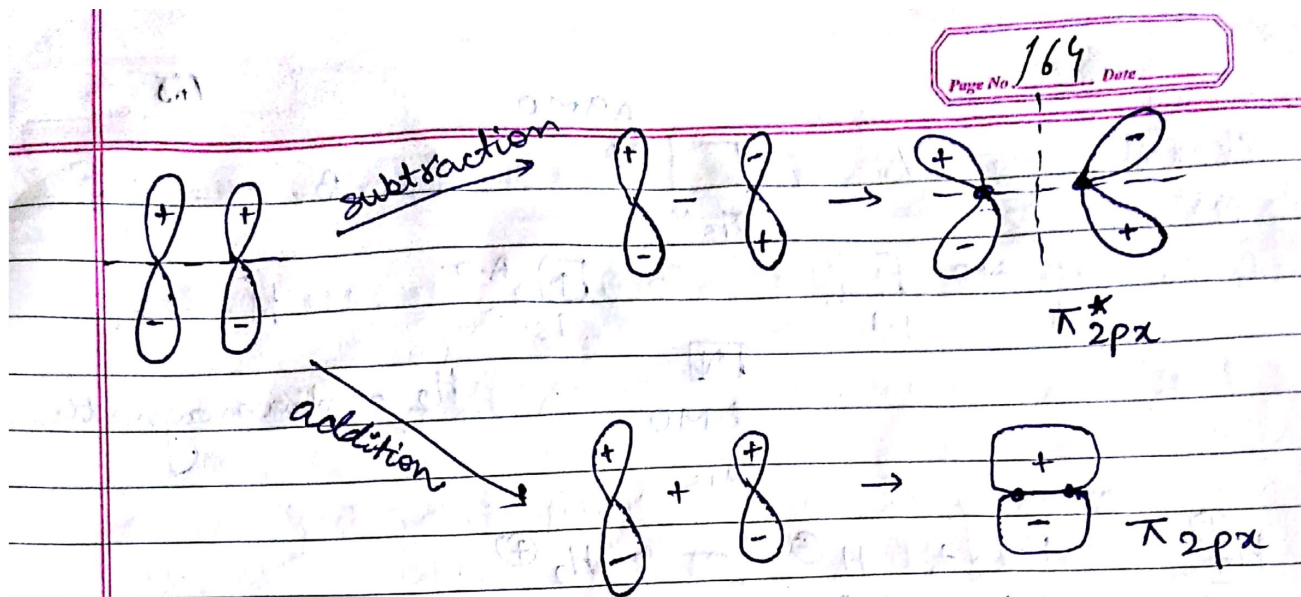


2. P-P overlapping



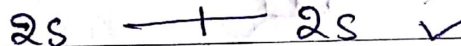
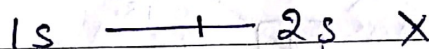
π MO:-



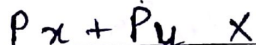
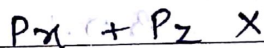
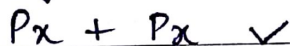


* Condition :-

1. A.O. orbitals of same energy overlap.



2. A.O. having same symmetry about axis will overlap.



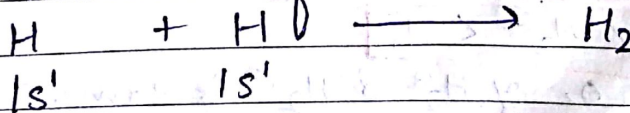
3. A.O. must overlap to larger extent so that e^- density b/w nuclei is max^m.

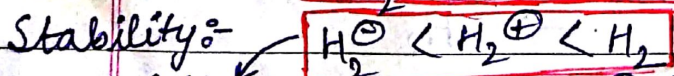
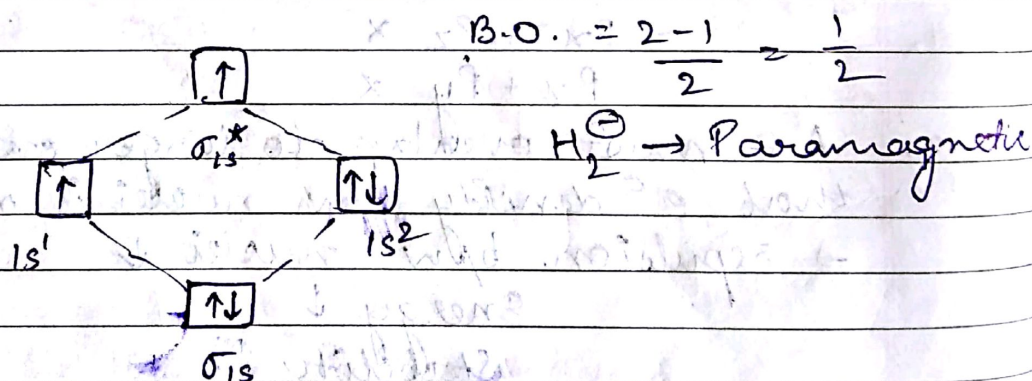
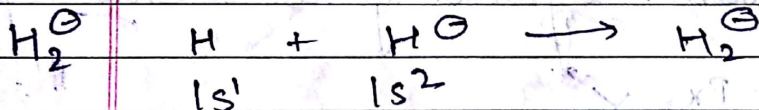
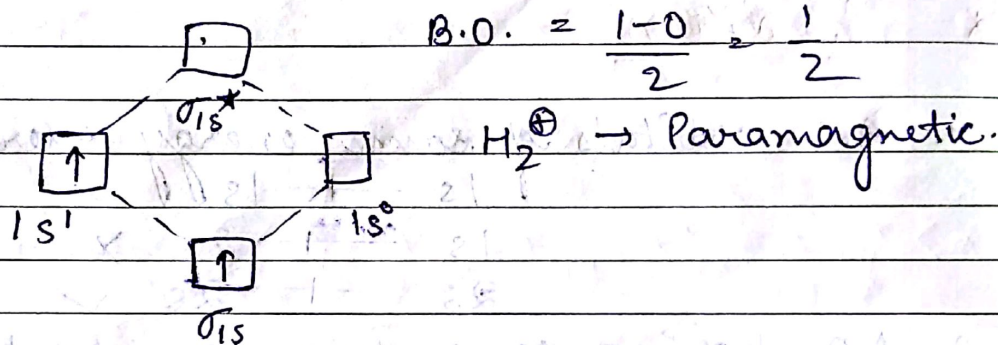
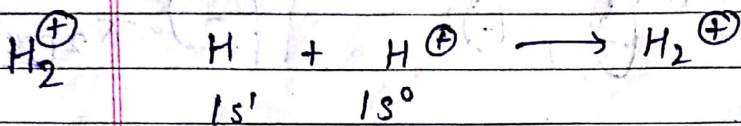
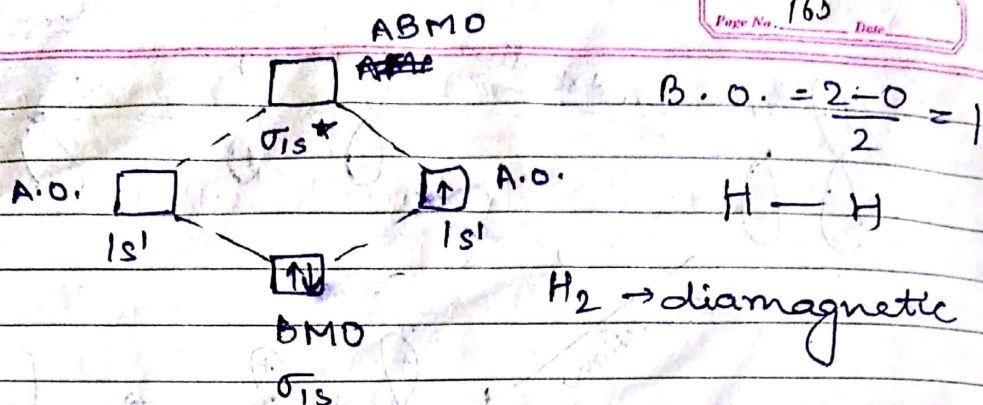
$\rightarrow$ repulsion b/w nuclei $\downarrow$

Energy $\downarrow$

Stability $\uparrow$

eg:- Formation of H_2 molecule :-

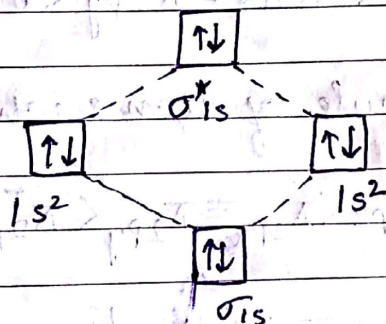




* Although B.O. of H_2^+ & H_2^- is same but H_2^+ is slightly more stable becoz there is no e^- in ABMO while H_2^- is less stable becoz there

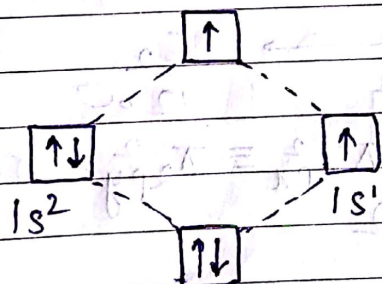
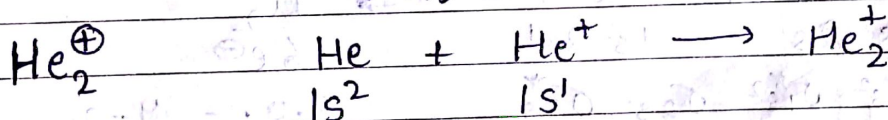
is one e^- in ABMO which cause destabilising effect

- ① He_2
- ② He_2^+
- ③ He_2^-



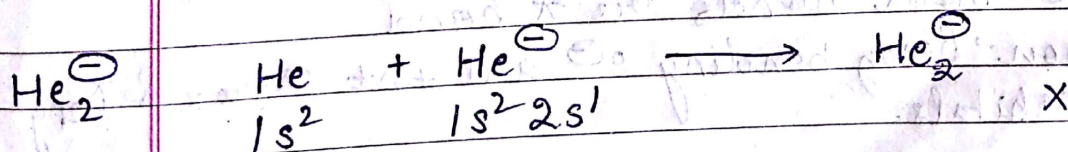
$$B.O. = \frac{2-2}{2} = 0$$

He_2 does not exist
(Reason $B.O. = 0$)



$$B.O. = \frac{2-1}{2} = \frac{1}{2}$$

$He_2^+ \rightarrow$ Paramagnetic



not exist $\text{He}_2, \text{Be}_2, \text{Ne}_2, \text{Ar}_2, \text{Kr}_2, \text{Xe}_2, \text{Rn}_2$

AIPMT

Ques Which of the following molecule does not exist?

(i) He_2^+

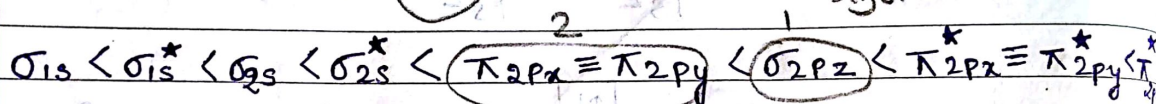
(iii) Li_2

(ii) B_2

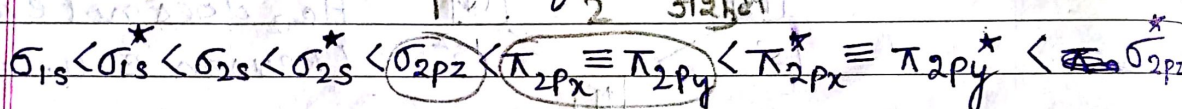
(iv) Be_2

Energy & e^- configuration of M.O. :-

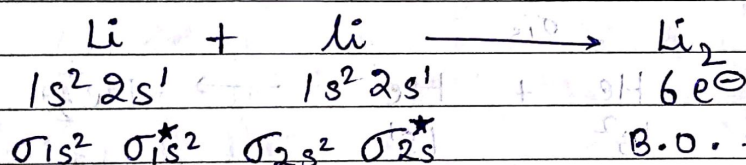
* For $\text{Li}_2, \text{B}_2, \text{C}_2, \text{N}_2$



* For O_2, F_2 & molecule of atoms which have $Z \geq 10$

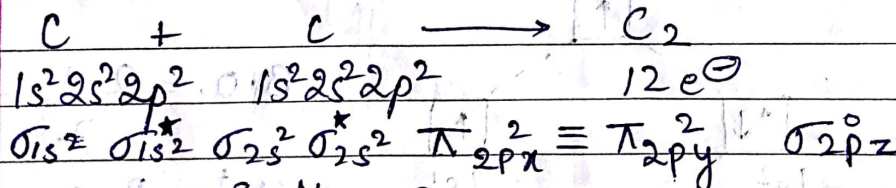


Li_2



$$\text{B.O.} = \frac{4-2}{2} = 1 \text{ diamagnetic}$$

C_2



$$\text{B.O.} = \frac{8-4}{2} = 2$$

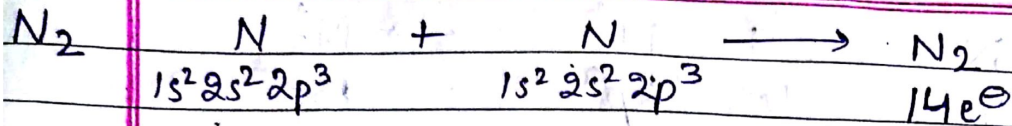
diamagnetic

$\text{C}=\text{C}$ both bonds are π bond

Reason - Because bonding e^- are in π_{2px} & π_{2py} orbitals.

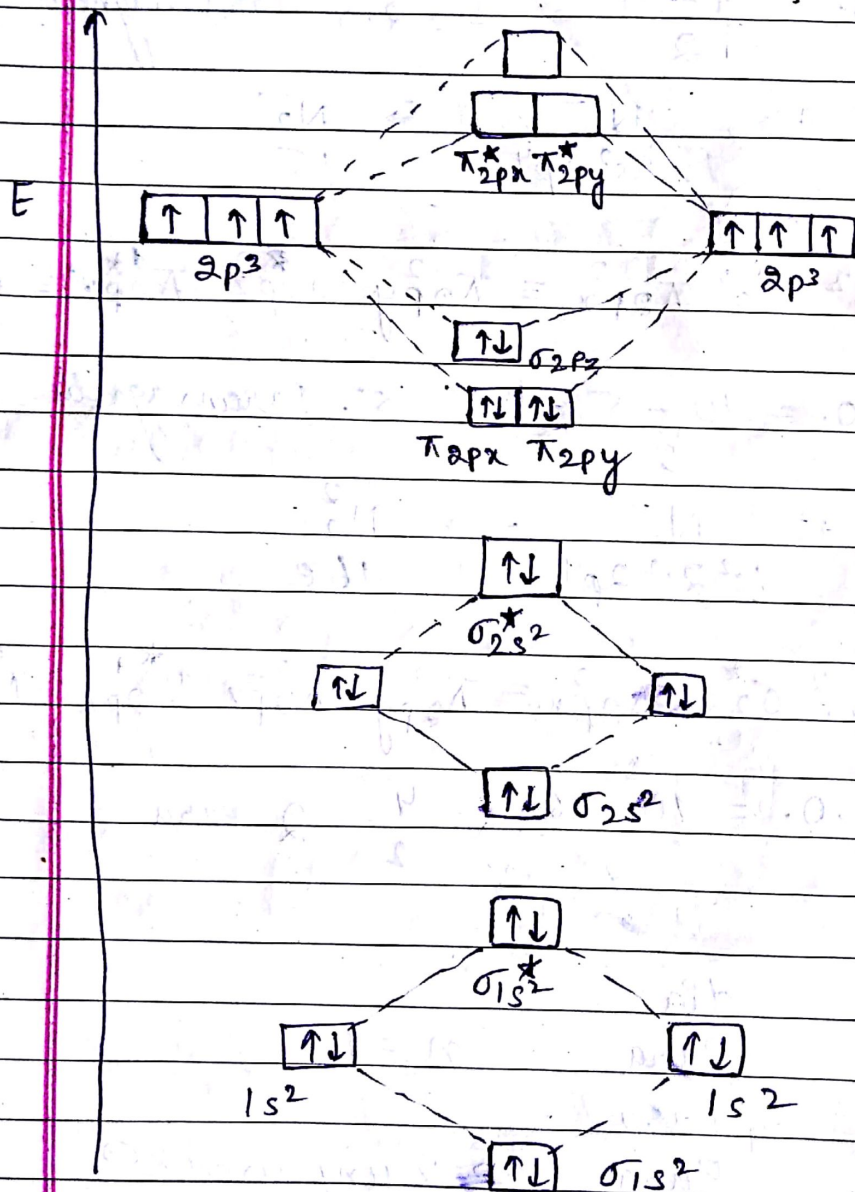
PAGE NO.:
DATE: / /

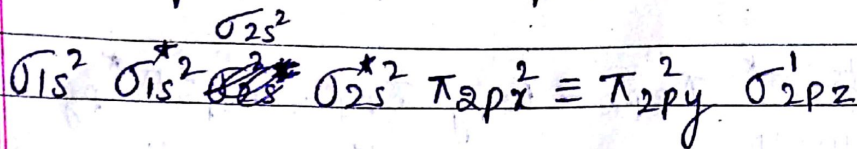
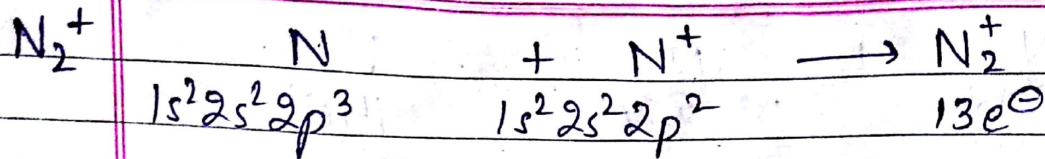
PAGE NO.: 168
DATE: / /



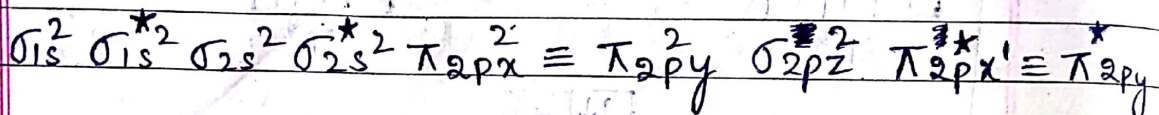
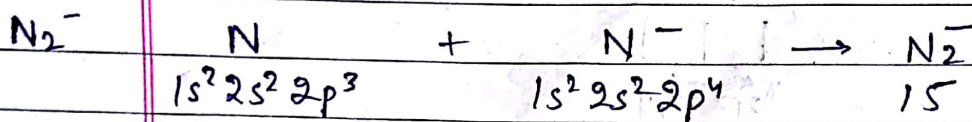
$$\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2px}^2 \equiv \pi_{2py}^2 \pi_{2pz}^2 \pi_{2px}^{*2} \equiv \pi_{2py}^{*2} \sigma_{2pz}^{*2}$$

$$\text{B.O.} = \frac{10 - 4}{2} = 3 \quad \text{N} \equiv \text{N} \text{ diamagnetic}$$

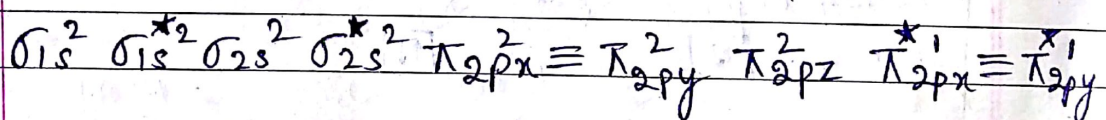
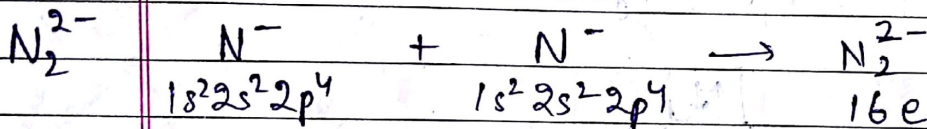




$$B.O. = \frac{9 - 4}{2} = \frac{5}{2} = 2.5 \text{ Paramagnetic}$$

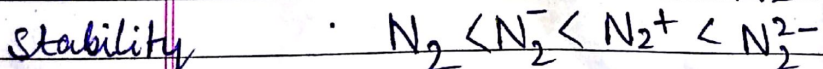
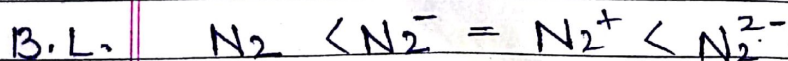


$$B.O. = \frac{10 - 5}{2} = 2.5 \text{ Paramagnetic}$$

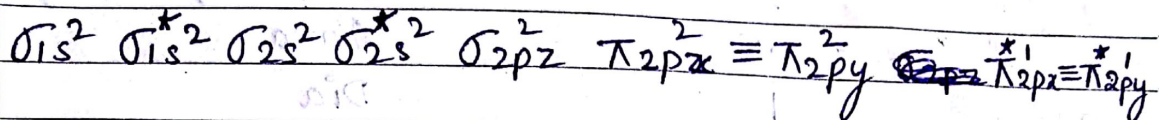
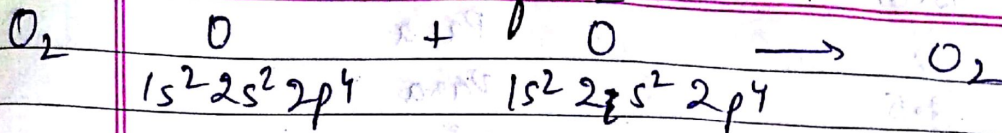


$$B.O. = \frac{10 - 6}{2} = \frac{4}{2} = 2 \text{ Para}$$

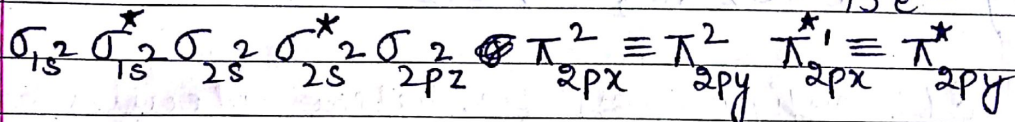
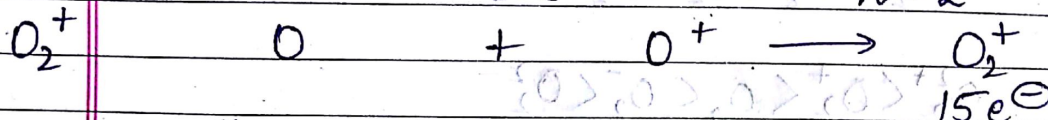
N_2	3	dia	
N_2^+	2.5	Para	$n = 1$
N_2^-	2.5	Para	
N_2^{2-}	2	Para	$\rightarrow 2 \text{ unpaired } e^-$



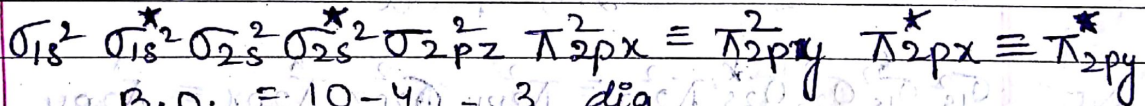
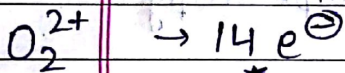
Formation of O_2



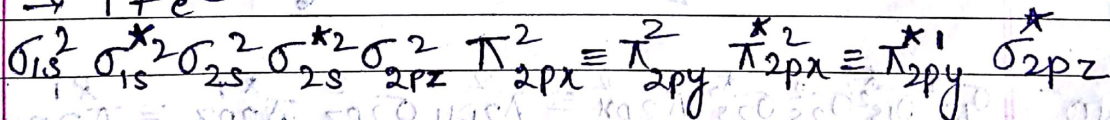
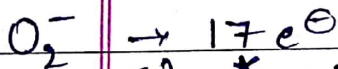
$$B.O. = \frac{10 - 6}{2} = 2 \quad \text{Para} \quad n=2$$



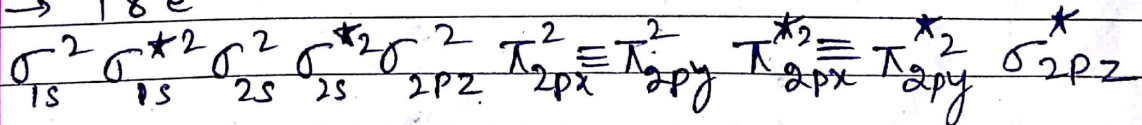
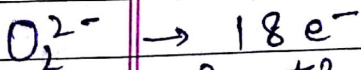
$$B.O. = \frac{10 - 5}{2} = 2.5 \quad \text{Para}$$



$$B.O. = \frac{10 - 4}{2} = 3 \quad \text{dia}$$



$$B.O. = \frac{10 - 7}{2} = 1.5 \quad \text{Para}$$



$$B.O. = \frac{10 - 8}{2} = 1 \quad \text{Dia.}$$

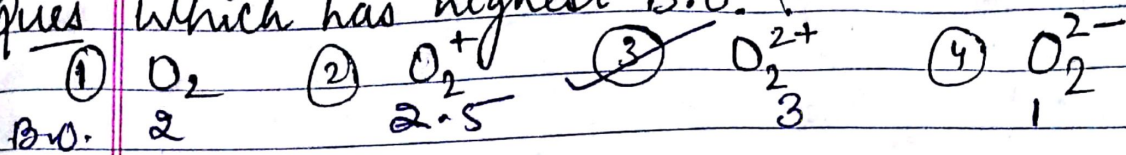
	B.O.	
O_2	2	Para
O_2^+	2.5	Para
O_2^{2+}	3	Dia
O_2^-	1.5	Para
O_2^{2-}	1	Dia
B.L.	$O_2^{2+} < O_2^+ < O_2 < O_2^- < O_2^{2-}$	
Stability	$O_2^{2+} < O_2^+ < O_2 < O_2^- < O_2^{2-}$	
E1- configuration for heteromolecules :-		
NO, CO		
NO → 15	$\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2px}^2 \equiv \pi_{2py}^2 \sigma_{2pz}^2 \pi_{2px}^{*1} \equiv \pi_{2py}^{*1}$	
	B.O. = $\frac{10-5}{2} = 2.5$	Para
NO ⁺ 14	$\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2px}^2 \equiv \pi_{2py}^2 \sigma_{2pz}^2 \pi_{2px}^{*1} \equiv \pi_{2py}^{*1}$	
	B.O. = $\frac{10-4}{2} = 3$	Dia
NO ⁻ 16	$\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2px}^2 \equiv \pi_{2py}^2 \sigma_{2pz}^2 \pi_{2px}^{*1} \equiv \pi_{2py}^{*1}$	
	B.O. = $\frac{10-6}{2} = 2$	Para
Short Trick no. of e⁻ B.O.		
2	1	
4	0	
6	1	
8	0	
10	1	
12	2	
14	3	
16	2	
18	1	
20	0	

172

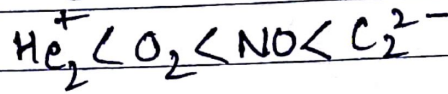
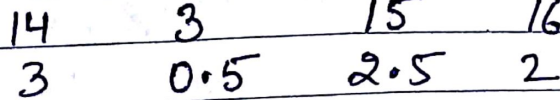
Page No.

Date

Ques Which has highest B.O. ?



Ques Write B.O. C_2^{2-} , He_2^+ , NO, O_2



Chemical Bonding

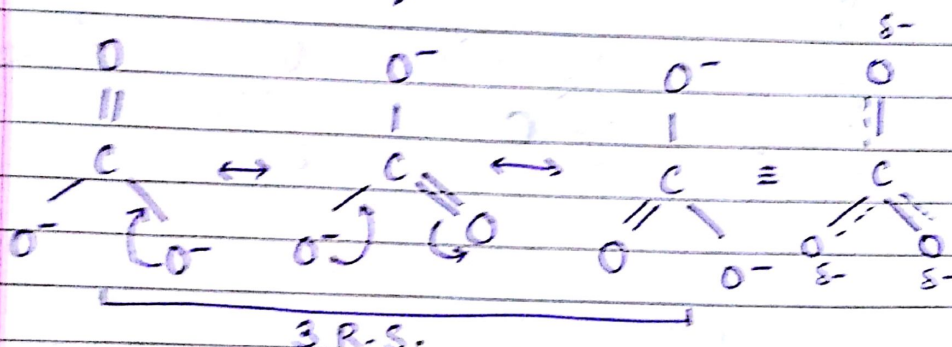
PAGE NO.:

DATE: / /

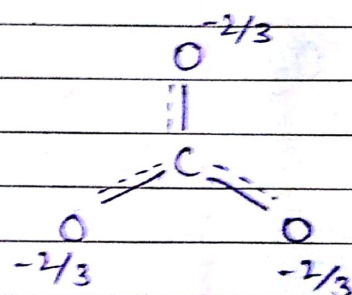
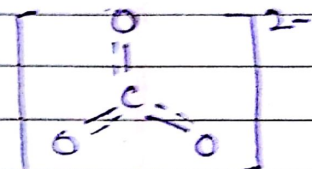
RESONANCE AND BOND ORDER

$$\text{B.O.} = \frac{\text{no. of bond}}{\text{no. of R.O.}}$$

CO_3^{2-}

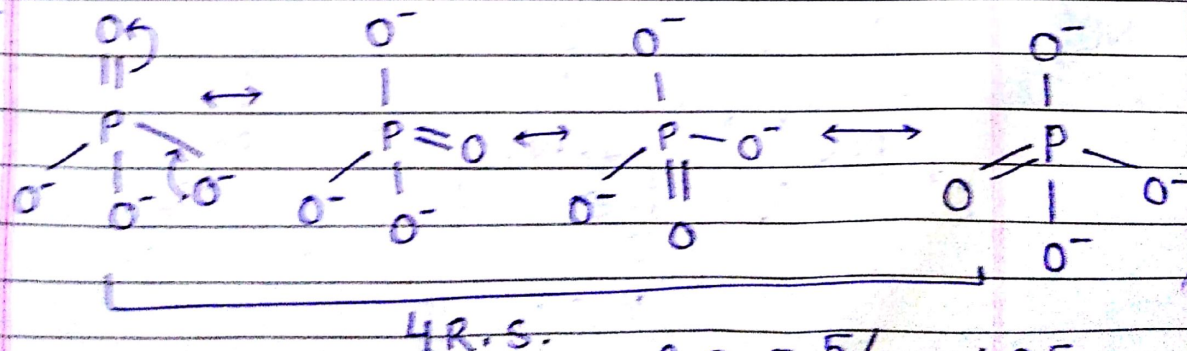


$$\text{B.O.} = \frac{4}{3} = 1.33$$



R.H.

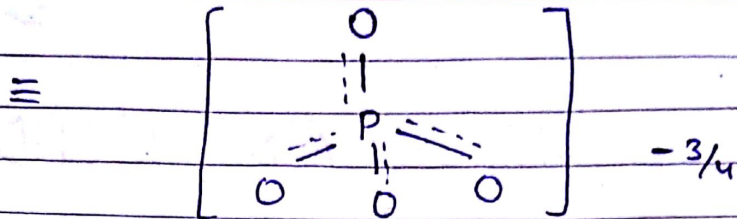
PO_4^{3-}



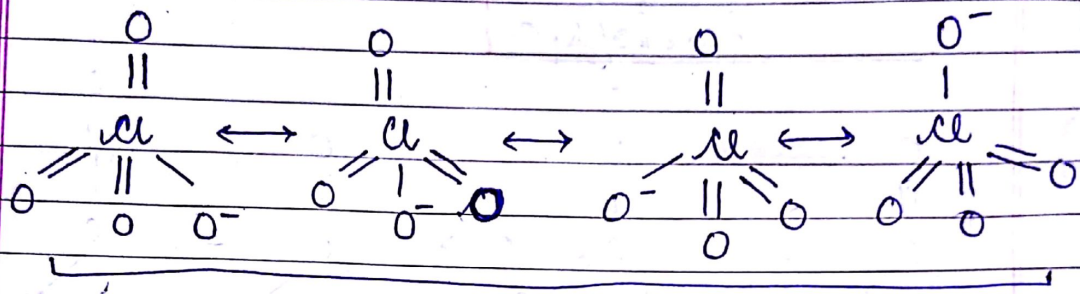
$$\text{B.O.} = \frac{5}{4} = 1.25$$

PAGE NO.:

DATE: / /

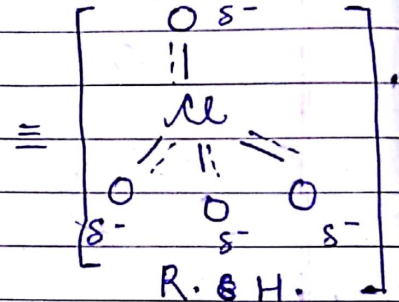


ClO_4^-

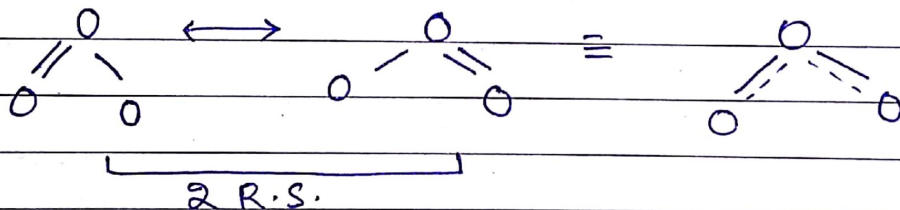


4 R.S.

$$\text{B.O.} = \frac{7}{4}$$

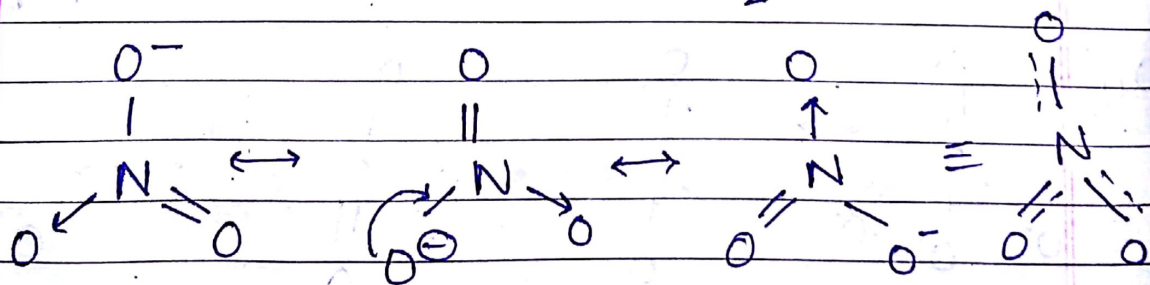


O_3



$$\text{B.O.} = \frac{3}{2}$$

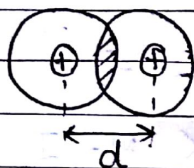
NO_3^-



$$\text{B.O.} = \frac{4}{3}$$

Bond Parameters :-

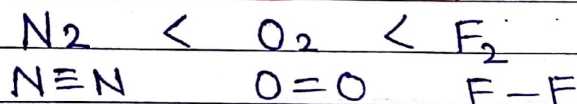
1. **Bond Length** : (B.L.) It is internuclear distance b/w 2 atoms.



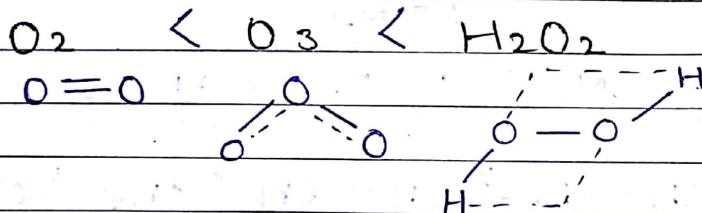
Factors affecting B.L. :-

(i) **B.O.**

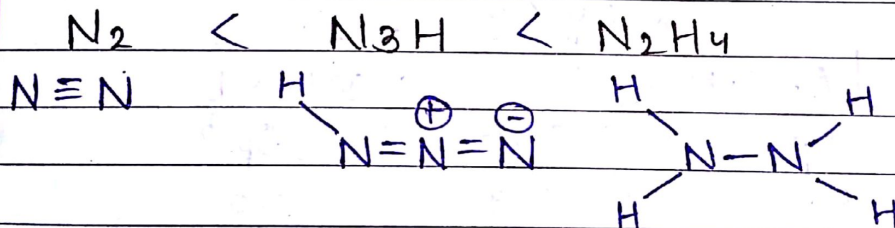
$$\text{B.L.} \propto \frac{1}{\text{B.O.}}$$



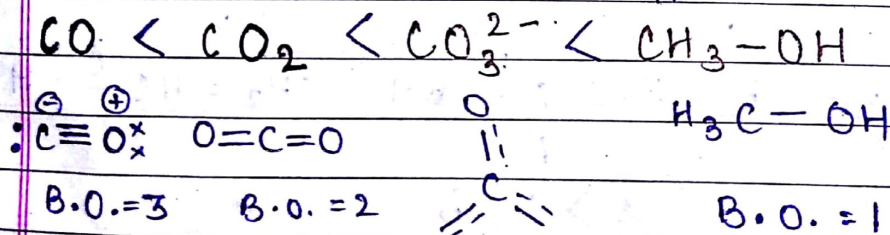
AIMS



eg



eg



C-O
B.L.

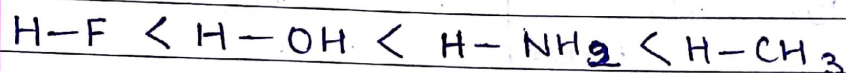
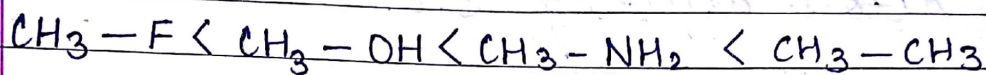
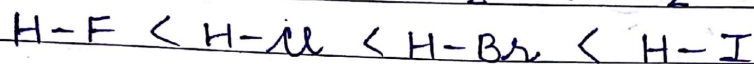
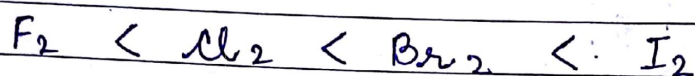
PAGE NO.:
DATE: / /

PAGE NO.:
DATE: / /

(ii) Size :-

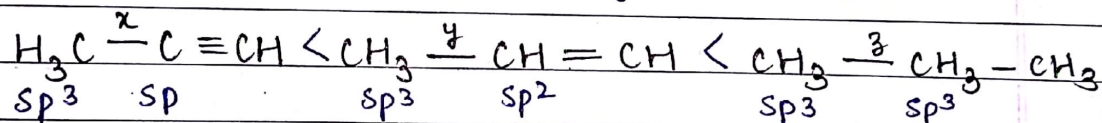
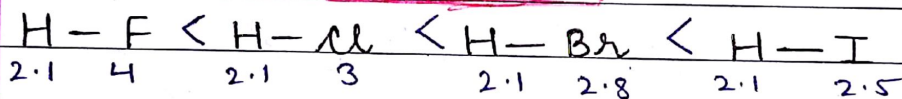
B.L. $\propto$ Size

Note: First check B.O., if B.O. is same then check size.



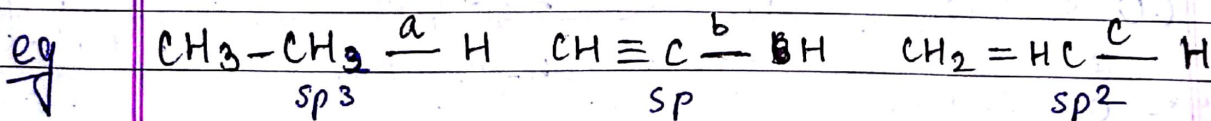
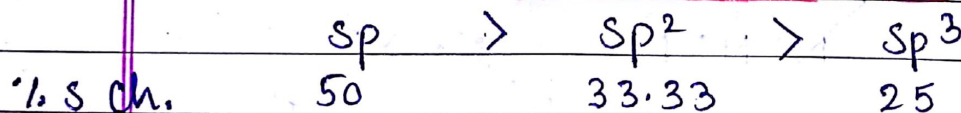
(iii) $\Delta E.N.$

B.L. $\propto$ $\Delta E.N.$



$x < y < z$

$\Delta E.N. \propto \% s \text{ character}$



$a > c > b$

$$\text{Si}-\text{Si} < \ddot{\text{P}}-\ddot{\text{P}} < \ddot{\text{S}}-\ddot{\text{S}} < \text{:}\ddot{\text{Cl}}-\ddot{\text{Cl}}\text{:}$$
$$\begin{array}{l} \ddot{N} - \ddot{N} < \ddot{P} - \ddot{P} \\ \ddot{O} - \ddot{O} < \ddot{S} - \ddot{S} \end{array}$$
$$:\ddot{\text{F}} - \ddot{\text{F}}: < :\ddot{\text{Cl}} - \ddot{\text{Cl}}:$$

* $C-C > Si-Si$
size $lp-\pi$ ही नहीं

Halogen B.E. $\text{Cl}_2 > \text{Br} > \text{F}_2 > \text{I}_2$
 शक्ति कम होती है

B.L. $\rightarrow F_2 < Cl_2 < Br_2 < I_2$

$$N_2 > O_2 > H_2 > F_2$$

$N \equiv N$	$O = O$	$H - H$	$F - F$
		1s 1s	2p 2p
		size छोटा	size बड़ा

(iv)	$\Delta E.N.$
------	---------------

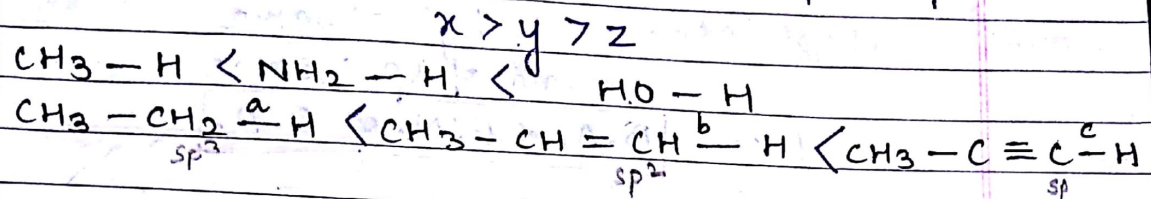
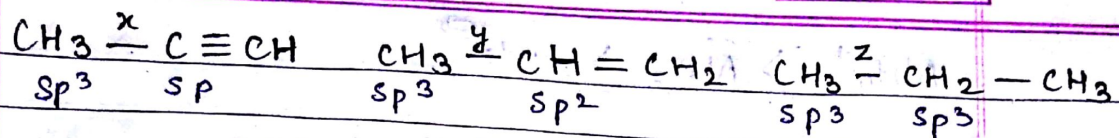
B.E. & ΔE.N. & Polarity

$$\begin{array}{cc} \text{H} - \text{F} & \text{H} - \text{I} \\ \hline 2.1 & 4 \end{array} \quad \begin{array}{cc} \text{H} - \text{I} & \\ \hline 2.1 & 2.5 \end{array}$$

DATE: / /

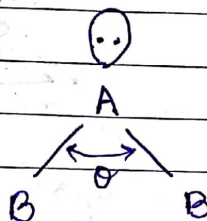
PAGE NO.:

DATE: / /



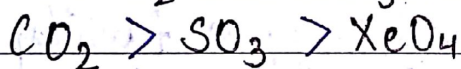
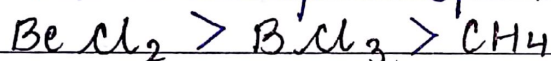
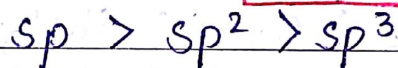
23/08/17

Bond Angle : B.A.



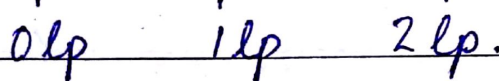
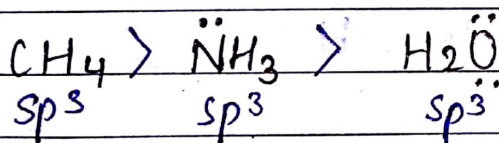
Factors affecting B.A. :-

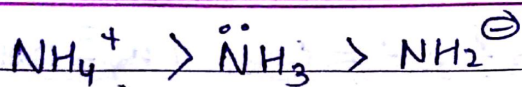
(i) Hybridisation : B.A. $\propto$ % s character



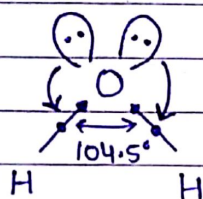
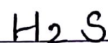
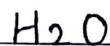
(ii) no. of lp : If hybridisation is same

$$\text{B.A.} \propto \frac{1}{\text{no. of lp.}}$$

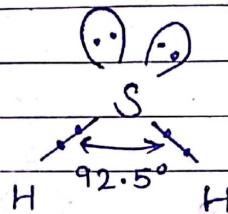




(iii) Central Atom :- If hyb. $\rightarrow$ same
no. of lp $\rightarrow$ same
then B.A. $\propto$ E.N. of C.A.

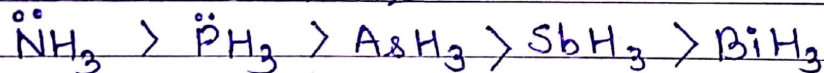


$>$



sp^3 bp-bp
2lp repulsion $\uparrow$

sp^3 bp-bp repulsion $\downarrow$
2lp



Drago's Rule : In Nitrogen & oxygen family down the group B.A. approaches 90° becoz pure p orbitals take part in hybridisation & involvement of s-orbital less

H

|

Bi — H

|

H

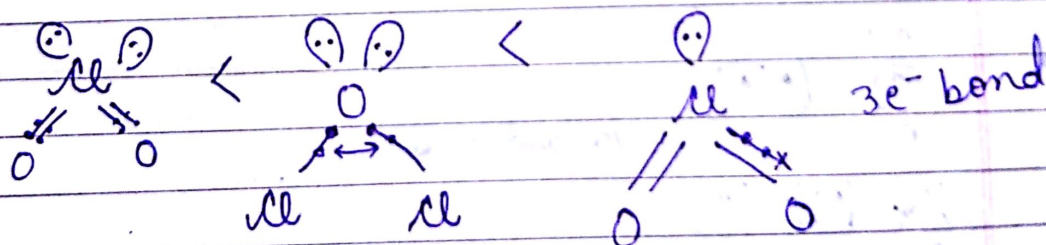
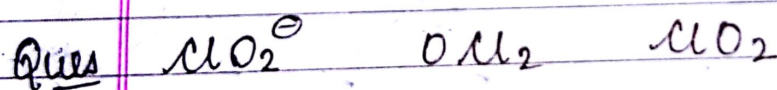
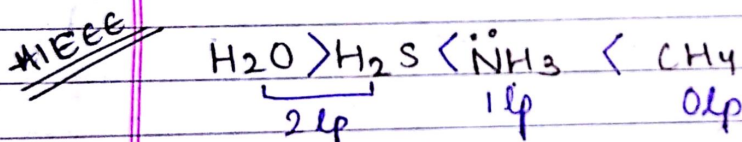
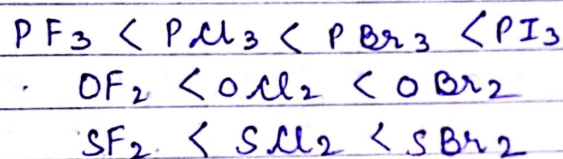
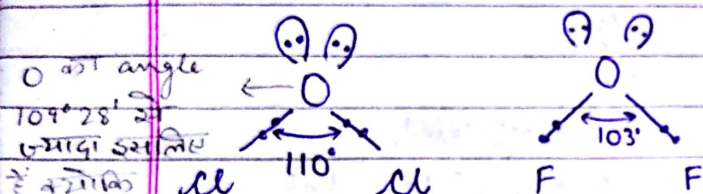
H

|

Te — H

(iv) S.A. $\rightarrow$ hyb. $\rightarrow$ same
no. of lp $\rightarrow$ same
C.A. $\rightarrow$ same

$$B.A. \propto \frac{1}{E.N. \text{ of S.A.}} \propto \text{Size of S.A.}$$



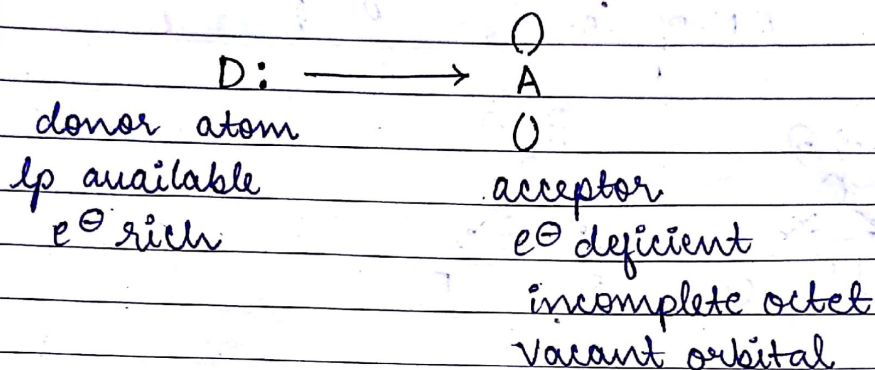
1 Ques A11M

PAGE NO.:
DATE: / /

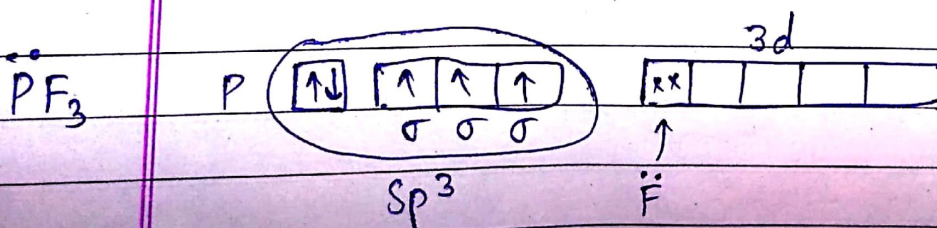
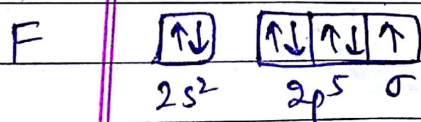
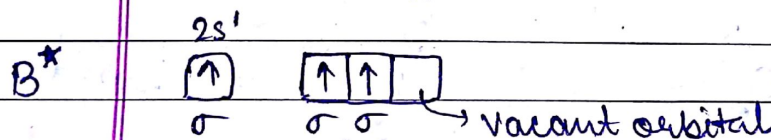
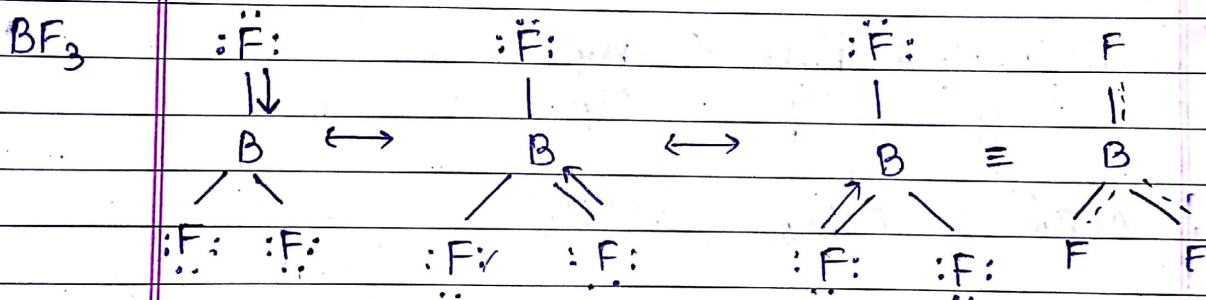
PAGE NO.:
DATE: / /

Back Bonding :

It involves transfer of lp from ^{filled} field shell of an atom to vacant orbital of another atom.

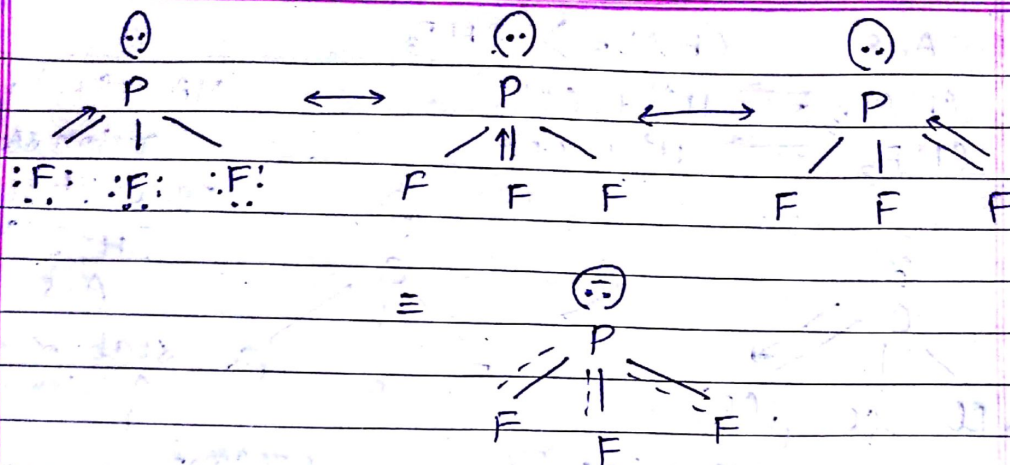


Donor atom generally : F, O, N, C $\checkmark$
 $\rightarrow$ Al, Br, I, P, S

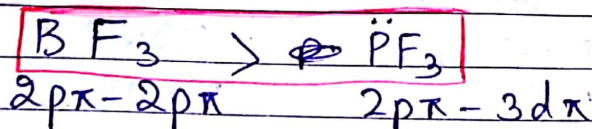


PAGE NO.:
DATE: / /

PAGE NO.:
DATE: / /

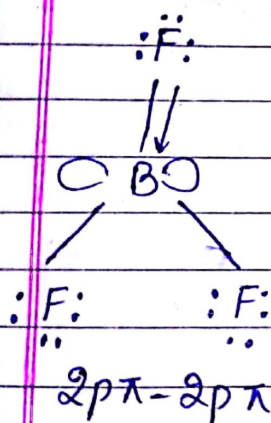
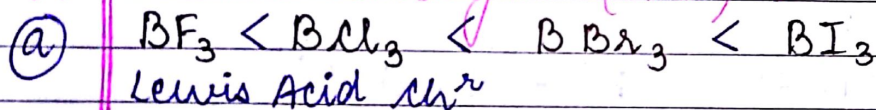


BB

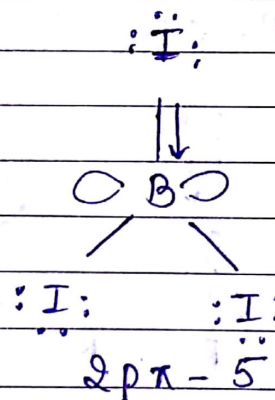


Application of B.B. :-

(i) Acidic strength (A.S.) :-



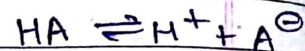
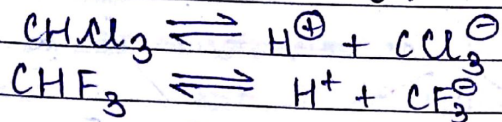
e- donation ↑
 e deficiency ↓
 A.S. ↓



lp donation ↓
 e deficiency ↑
 A.S. ↑

(b)

A.S. $\text{CHAl}_3 > \text{CHF}_3$



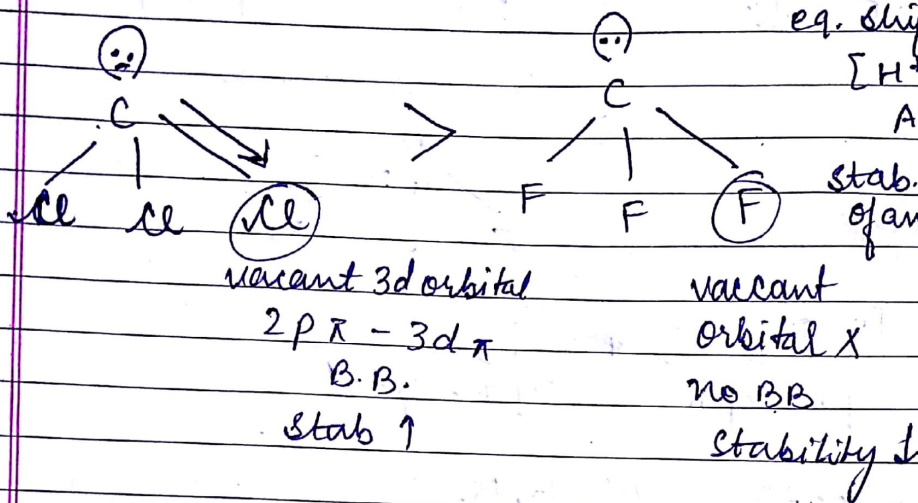
anion stab. ↑

eq. shift forward

$[\text{H}^+] \uparrow$

A.S. ↑

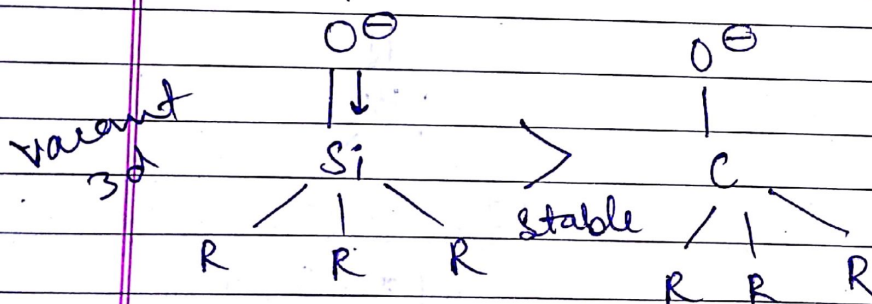
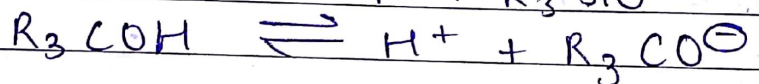
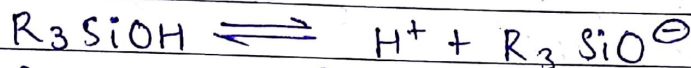
stab. ↓ of anion withdrawing gp.



(c)

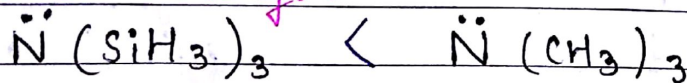
A.S. $\text{R}_3\text{SiOH} > \text{R}_3\text{COH}$

A.S.



(ii)

Basic Strength :-



Acidic → H^+ donor

→ e^- deficient or e^- acceptor

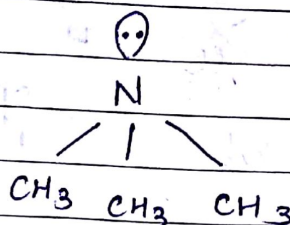
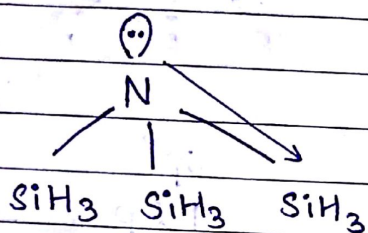
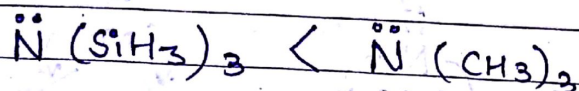
PAGE NO.:

DATE: / /

PAGE NO.:

DATE: / /

Basic $\rightarrow$ $\text{OH}^\ominus$ donor
 $\rightarrow$ $e^\ominus$ rich or $e^\ominus$ donor



Si $\rightarrow$ vacant orbital 3d

B.B. $\checkmark$

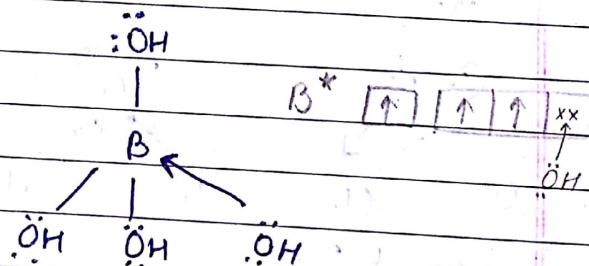
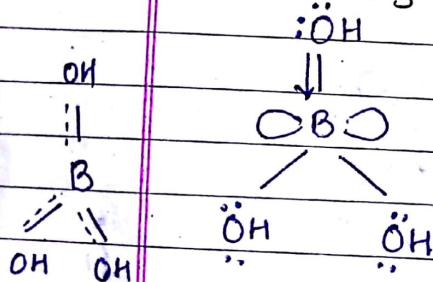
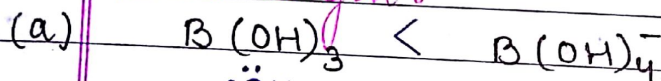
$e^\ominus$ density of N $\downarrow$
B.S. $\downarrow$

C $\rightarrow$ vacant orbital X

B.B. X

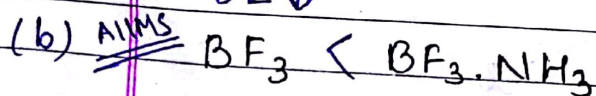
$e^\ominus$ density of N $\uparrow$
B.S. $\uparrow$

(iii) Bond length :-

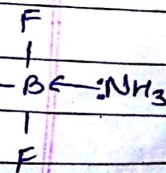
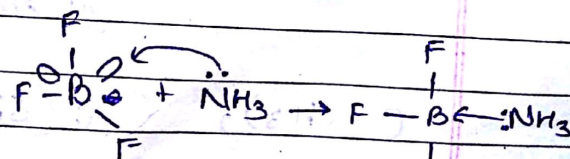
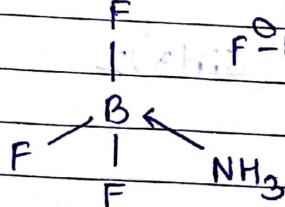
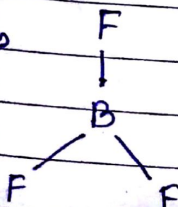


Partial db char $\uparrow$

B.L. $\downarrow$



Partial db
char $\uparrow$
B.L. $\downarrow$



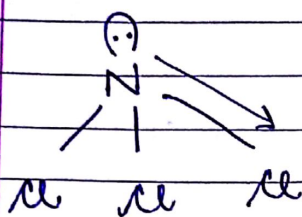
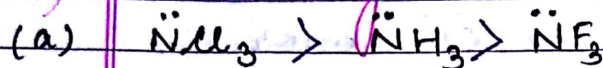
PAGE NO.:

DATE: / /

PAGE NO.:

DATE: / /

(iv) Bond Angle :-



vacant 3d

B.B.

$\rightarrow sp^2$

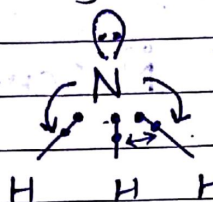
Cl

Cl

N

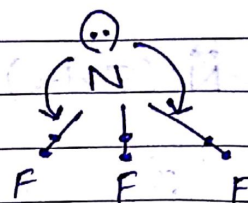
Cl

Cl



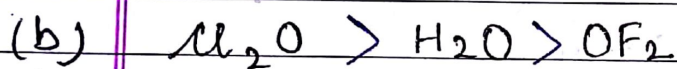
sp^3

1 lp



sp^3

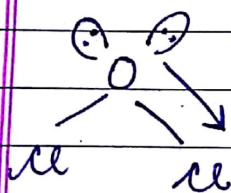
1 lp



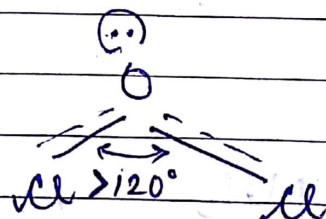
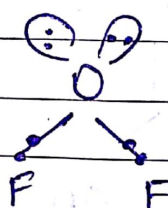
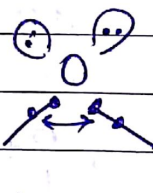
$> 120^\circ$

104.5°

103°



vacant 3d



PAGE NO.:

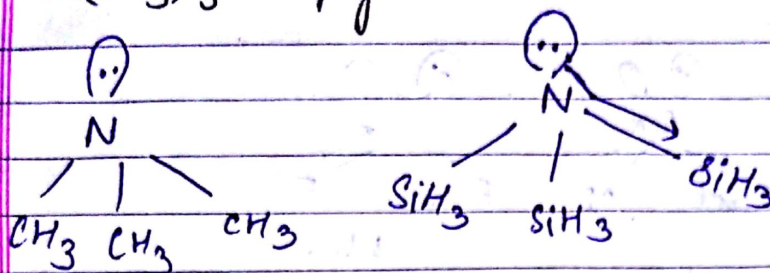
DATE: / /

PAGE NO.:

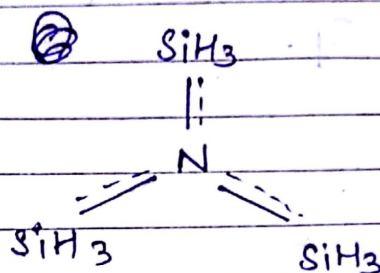
DATE: / /

(v) Structure :

(a) $\ddot{\text{N}}(\text{CH}_3)_3$ is pyramidal while $\ddot{\text{N}}(\text{SiH}_3)_3$ is planar

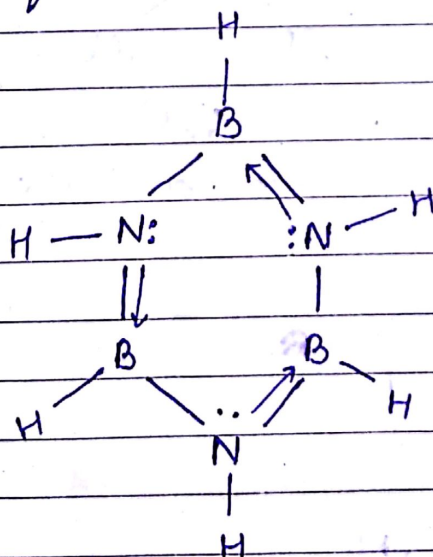


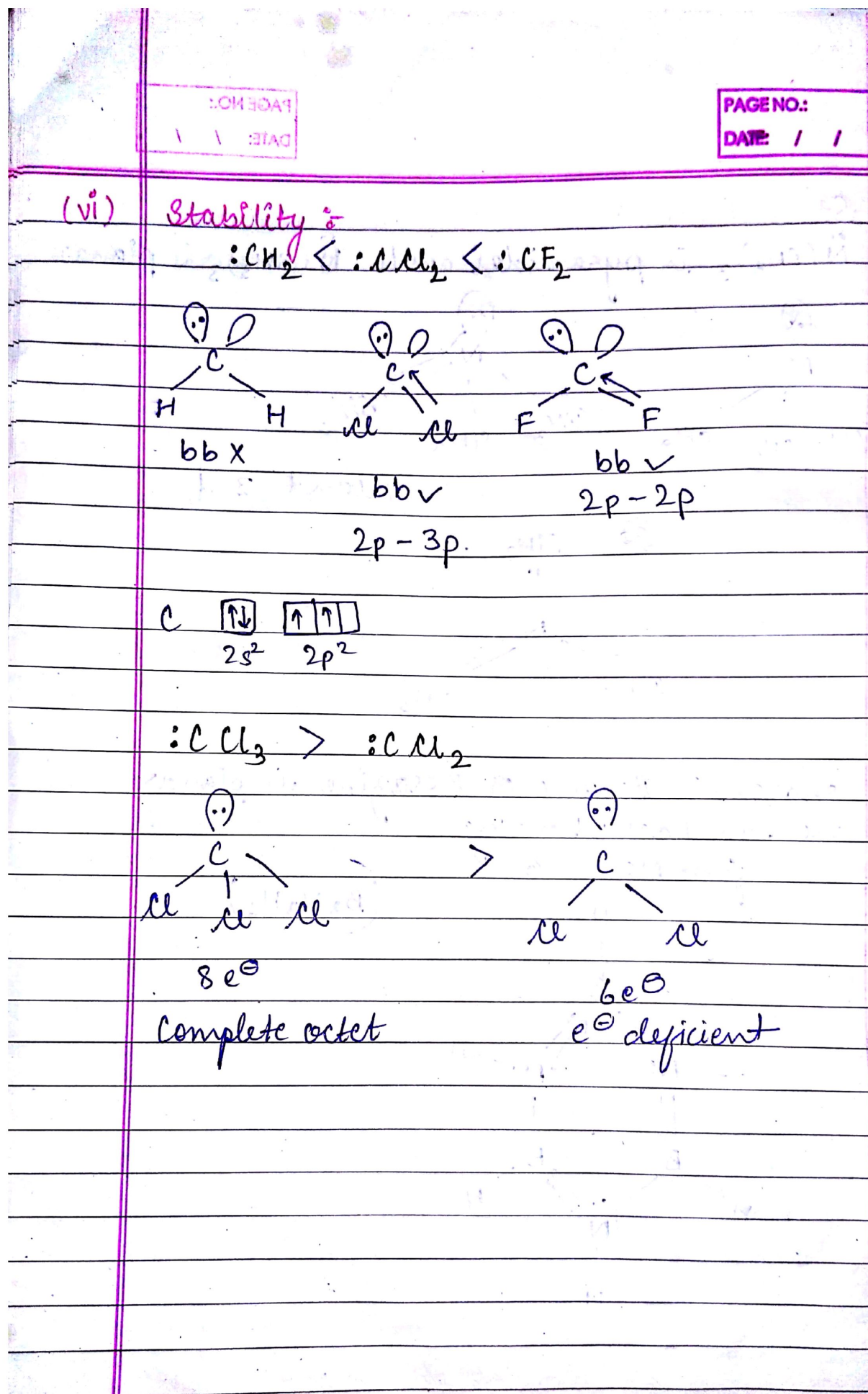
valant 3 d



(b) Inorganic Benzene or Borazine is planar
due to back bonding
from $\text{N}:$ $\rightarrow$ B

($\text{B}_3\text{N}_3\text{H}_6$)





PAGE NO.:

DATE: / /

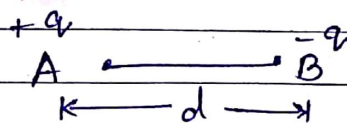
PAGE NO.:

DATE: / /

Dipole Moment : (μ) Pauling

It is defined as product of magnitude of charge and distance of separating them.

$$\mu = q \times d$$

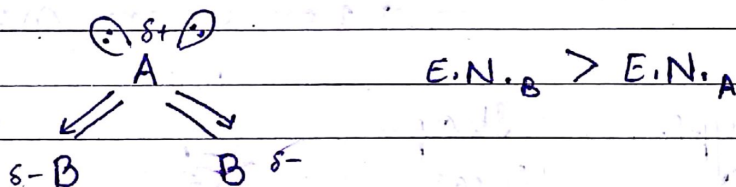


dirⁿ $\oplus \longrightarrow \ominus$

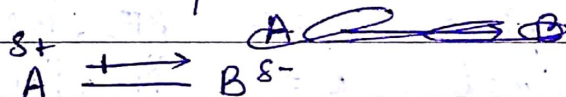
Unit: It is a vector quantity
Debye (D)

$$1D = 10^{-18} \text{ esu} \cdot \text{cm}$$

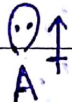
$$1D = 3.34 \times 10^{-30} \text{ C} \cdot \text{m}$$



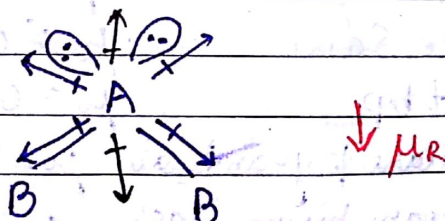
Bond Moment :- It is a moment of Particular bond



lp Moment :- It is a moment of lp

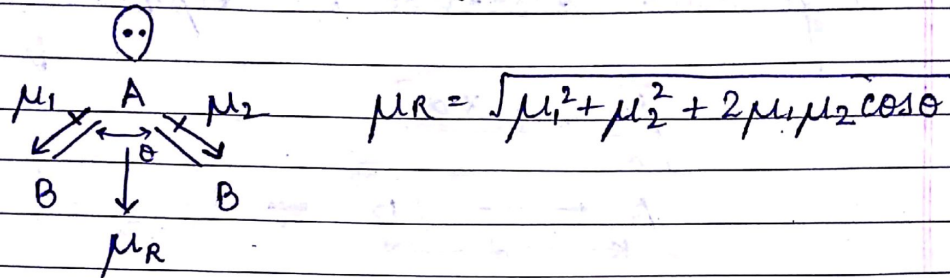


μ for AB_2



bond Moment $\neq$ lp Moment

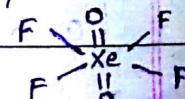
(i) Application of Dipole Moment :-
To decide Polarity of molecule :-



$\mu = 0 \rightarrow$ non polar $H_2, Cl_2, O_2, BCl_3, CCl_4, CO_2$
 $\rightarrow$ Symm. molecule

$\mu \neq 0 \rightarrow$ polar $HF, HCl, HBr, HI, \ddot{N}H_3, \ddot{N}F_3$
 $\rightarrow$ non symm. molecule

	Type	Shape	μ	Example
1.	AX	Linear	$\mu \neq 0$	
2.	AX_2	Linear	$\mu = 0$	$BeCl_2, CO_2, CS_2$
		Vshape / Bent	$\mu \neq 0$	$H_2\ddot{O}, H_2S, SO_2, NO_2, Cl_2O$
3.	AX_3	trigonal planar	$\mu = 0$	$BF_3, BAl_3, AlCl_3, SO_3$
		Pyramidal	$\mu \neq 0$	$\ddot{P}H_3, \ddot{N}H_3, H_3O^+, \ddot{N}Cl_3, XeO_3$
		T-shaped	$\mu \neq 0$	ClF_3, BrF_3
4.	AX_4	tetrahedral	$\mu = 0$	CCl_4, CH_4, XeO_4
		Square planar	$\mu = 0$	XeF_4
		See Saw	$\mu \neq 0$	SF_4, XeO_2F_2
5.	AX_5	tpb	$\mu = 0$	PF_5, SbF_5
		Square pyramidal	$\mu \neq 0$	IF_5, BrF_5
6.	AX_6	Square bipyramidal or octahedral	$\mu = 0$	SF_6, XeO_2F_4

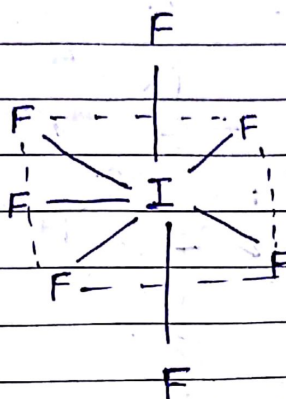


PAGE NO.:
DATE: / /

PAGE NO.:

DATE: / /

7. AX_7 distorted octahedral $\mu \neq 0$ XeF_6
Pentagonal bipyramidal $\mu \neq 0$ IF_7



HF	1.92 D
H ₂ O	1.85 D
SO ₂	1.60 D
NH ₃	1.47 D
HAl	1.07 D
CH ₃ Cl	1.04 D

HF > H₂O > SO₂ > NH₃

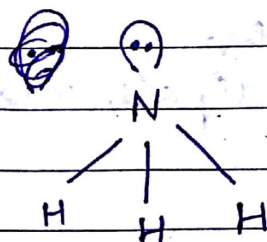
$\mu \propto \Delta E.N.$

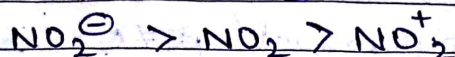
HF > HAl > HBr > HI

H₂O > H₂S > H₂Se > H₂Te ~~> NH₃~~

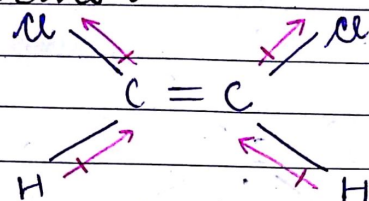
NH₃ > PH₃ > AsH₃ > SbH₃

$\ddot{N}H_3 > \ddot{N}F_3 > BF_3$
1.47 $\mu = 0$

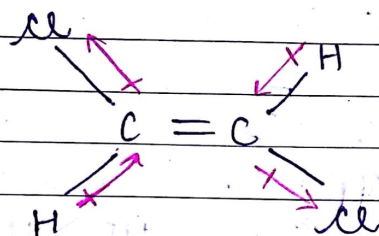




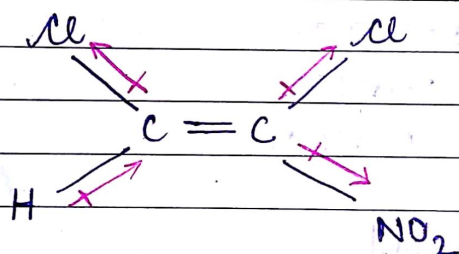
(ii) cis-trans :-



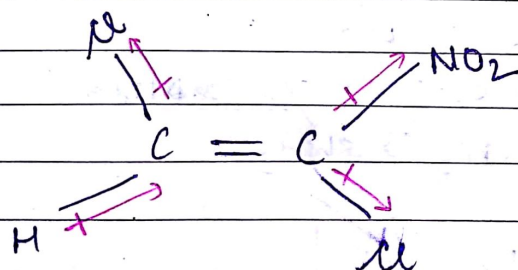
cis $\mu \neq 0$



$\mu = 0$ trans



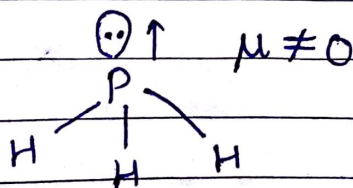
cis $\mu \neq 0$



$\mu \neq 0$
trans

A $\rightarrow$ $\ddot{P}H_3$ is a polar molecule.

R $\rightarrow$ P-H bond has non zero dipole moment. X



(iii) % ionic char:-

$$\% \text{ ionic char} = \frac{\mu_{\text{exp}}}{\mu_{\text{theo}}} \times 100 = \frac{q_{\text{exp. d.s.}}}{q_{\text{theo. d.s.}}} \times 100$$

$$= \frac{q_{\text{exp}}}{q_{\text{theo}}} \times 100$$

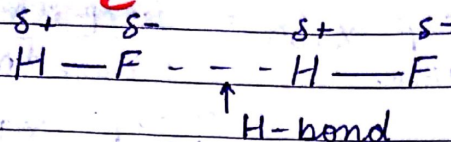
Ques Find % ionic char in H-F molecule if H-F
BL is $0.92 \text{ \AA}$ & charge is $4.8 \times 10^{-10} \text{ esu}$
given $\Rightarrow \mu = 1.92 \text{ D}$ $\rightarrow \text{exp.}$

$$\% \text{ ionic} = \frac{1.92 \times 10^{-18} \text{ esu.cm} \times 100}{0.92 \times 10^{-8} \text{ cm} \times 4.8 \times 10^{-10} \text{ esu}}$$

$$= \frac{192}{0.92 \times 4.8} = \frac{192 \times 10^3}{441.6} = 43.$$

$\text{CH}_3\text{Cl} > \text{CH}_3\text{F} > \text{CH}_3\text{Br} > \text{CH}_3\text{I} \rightarrow \text{dipole Moment}$

Hydrogen - Bonding

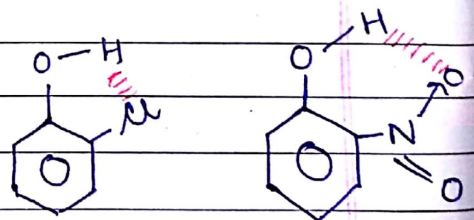
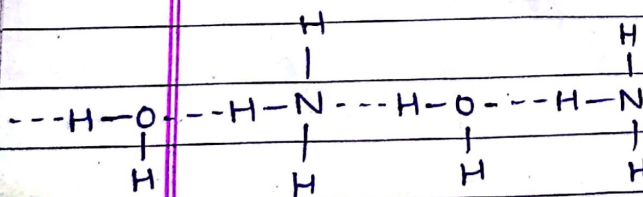
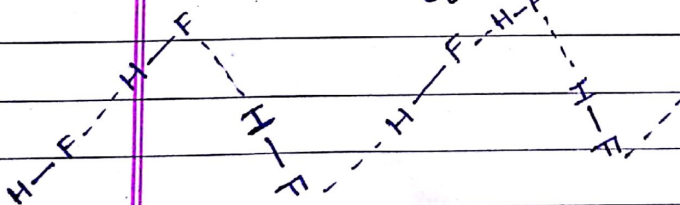


- When H attached to E.N. atoms, ^{like} F, O, N then a partial -ve charge is developed on E.N. atom & partial +ve charge is developed on H-atom, resulting in ^{form of} dipole.
- When ~~such~~ a no. of such dipole comes near to each other then a weak ~~is~~ electrostatic force of attraction is developed b/w them which is c/a hydrogen bonding.

H-bonding

Intermolecular H-bonding
It is +nt b/w 2 or more molecules which may be same or different

Intramolecular H-bonding
within same molecule



PAGE NO.:

DATE: / /

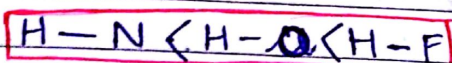
PAGE NO.:

DATE: / /

Intermolecular H-bonding

E.N. ≥ 3.0

- Conditions: ① H must be attached to highly E.N. F, O, N
② Size of E.N. must be small.



H-Cl

E.N. Cl = 3.0

Size $\uparrow$

H-bond x

Application of Intermolecular H-Bonding :-

①

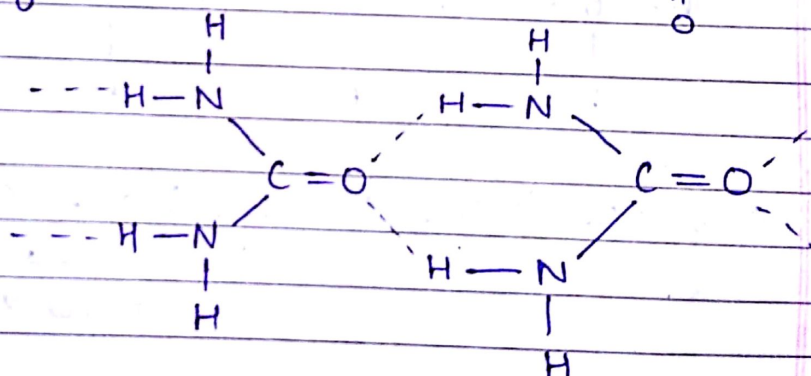
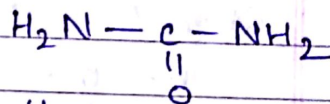
Physical state

(a)

$\text{H}_2\text{O}, \text{HF} \rightarrow$ liquid inter H-bond $\checkmark$
 $\text{H}_2\text{S}, \text{HCl} \rightarrow$ gas H-bond x

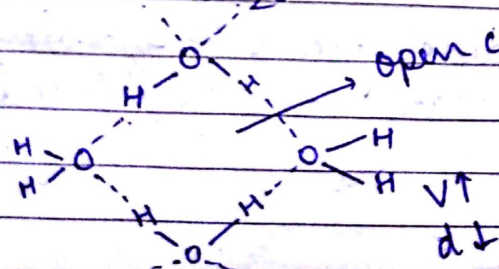
(b)

acetone is liquid while urea is solid
($\text{CH}_3-\text{C}(=\text{O})-\text{CH}_3$)



(c)

disc $<$ $d_{\text{H}_2\text{O}}$

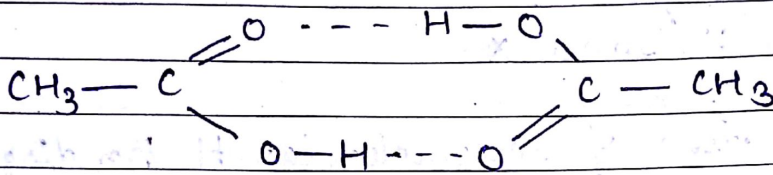


Note:- Density of ice is max. at 4°C

(2) Molecular wt.

Mol. wt. of acetic acid (CH_3COOH) is 120 instead of 60 due to dimer form.

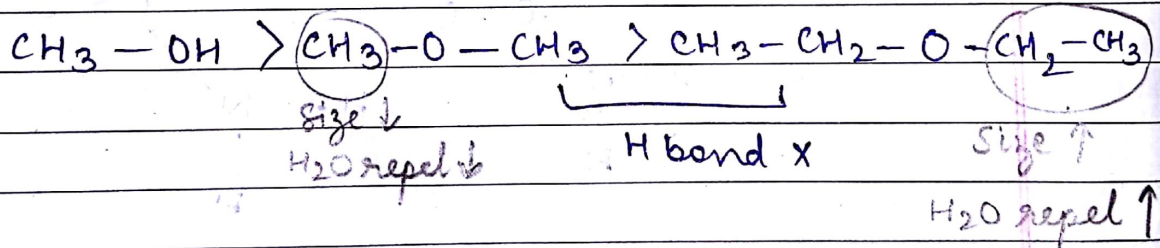
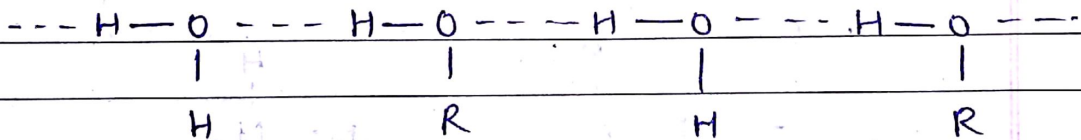
(intermolecular H-bonding)



③ Solubility :-

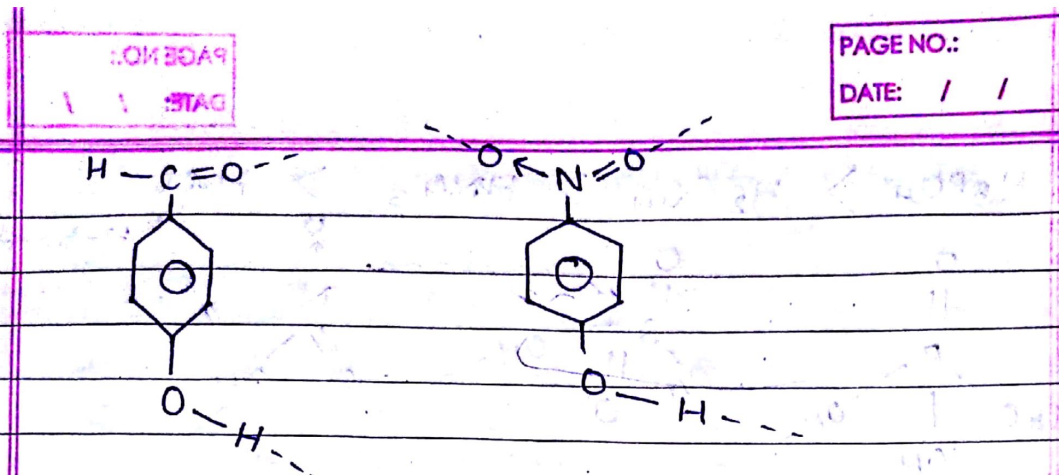
as H bond $\uparrow$ solubility $\uparrow$

- Alcohol are more soluble in water than ethers becoz alcohol form H-bond

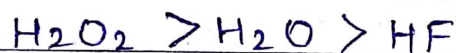
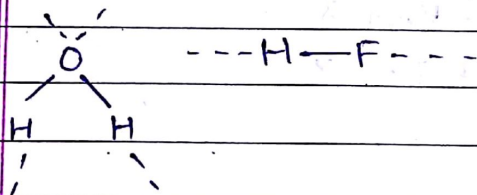
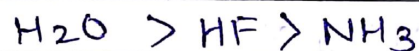
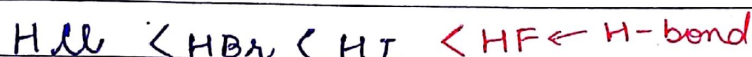
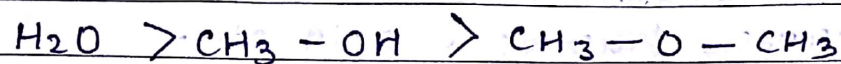


④ Melting Point & Boiling Point

P-hydroxy benzaldehyde & P-hydroxy nitrophenol are soluble in water due to inter H-bonding



(4) Melting Point and Boiling Point :
MP & B.P $\uparrow$ due to intermolecular H-bonding

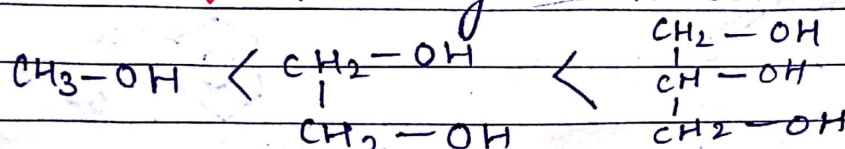


* Vapour Pressure $\propto \frac{1}{\text{B.P.}}$ (जितना जल्दी vapour बनेगा)

Volatility $\propto \frac{1}{\text{B.P.}}$

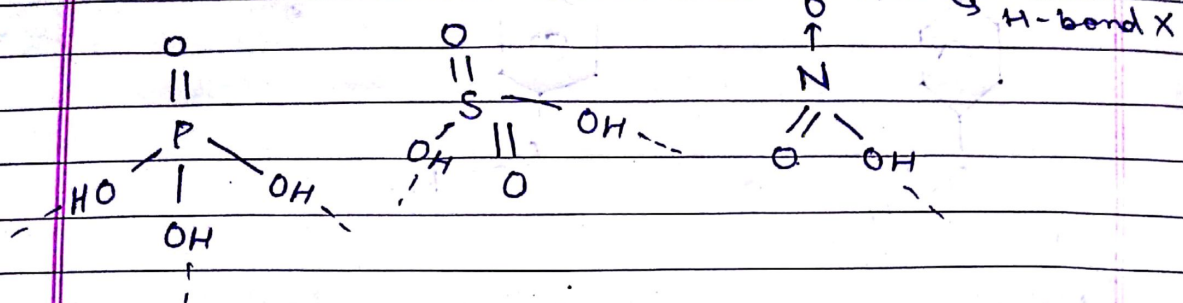
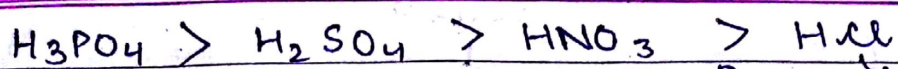
(5) Viscosity : गाढ़ापन

Viscosity $\propto$ H-bonding



PAGE NO.:
DATE: / /

PAGE NO.:
DATE: / /

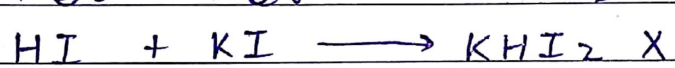
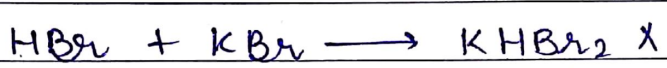
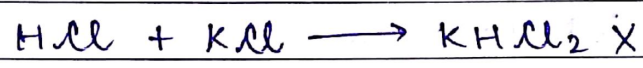
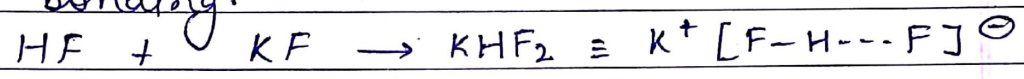


Surface Tension $\propto$ H-Bond

Intermolecular H-bond is also +nt in proteins, sucrose, fructose & DNA etc.

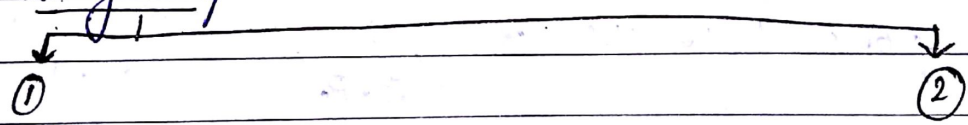
↓
Double helical str.

* HF combines with its salts KF due to intermolecular H-bonding.



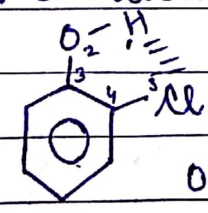
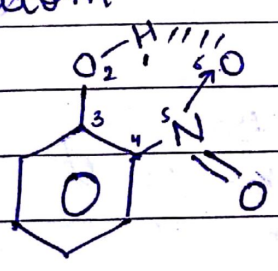
Intramolecular H-Bonding :-

It is present within same molecule which consist of 2-group.



H is attached to more EN atom

in other group more EN atom is attached to less EN atom



o-chloro phenol

PAGE NO.:

DATE: / /

PAGE NO.:

DATE: / /

Note ① 5-6 membered ring is more stable in intramolecular H-bonding

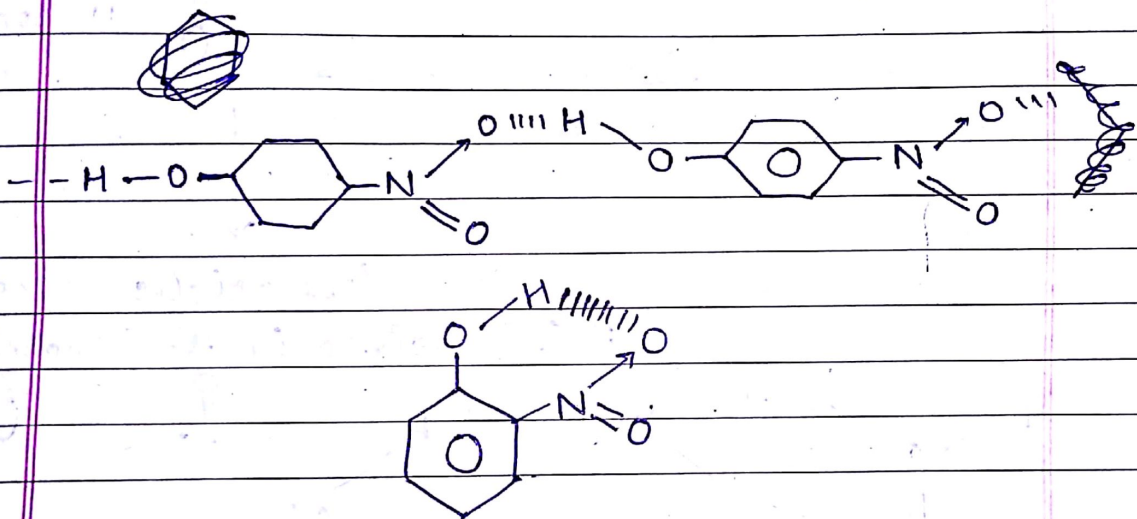
Note ② Intramolecular H-bond takes place only in ortho position not in ~~meta~~ meta & para.

becom more distance

Application of Intra molecular H-Bonding:-

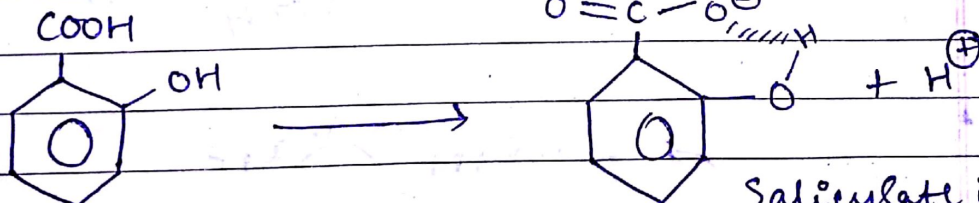
1. B.P.

B.P. of P-nitrophenol is more than O-nitrophenol



2. Acidic Strength:-

Salicylic acid ^{hydroxy} or ~~ortho~~ ortho benzoic acid is more acidic than its M & P isomers.

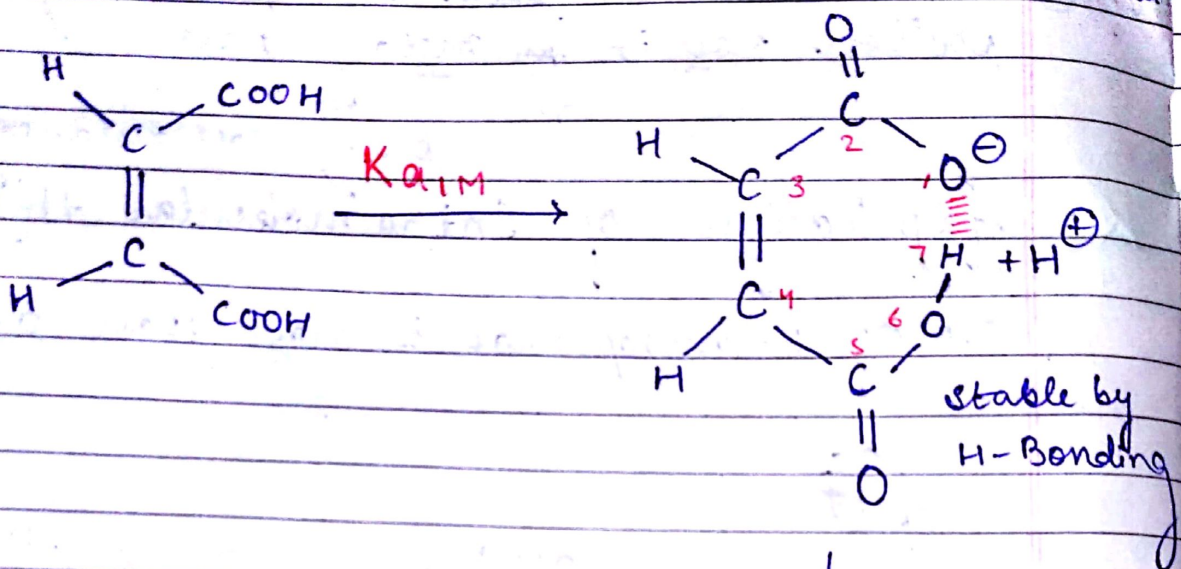


Salicylate ion
Stable by H-Bonding

Maleic acid is more acidic than fumaric acid.

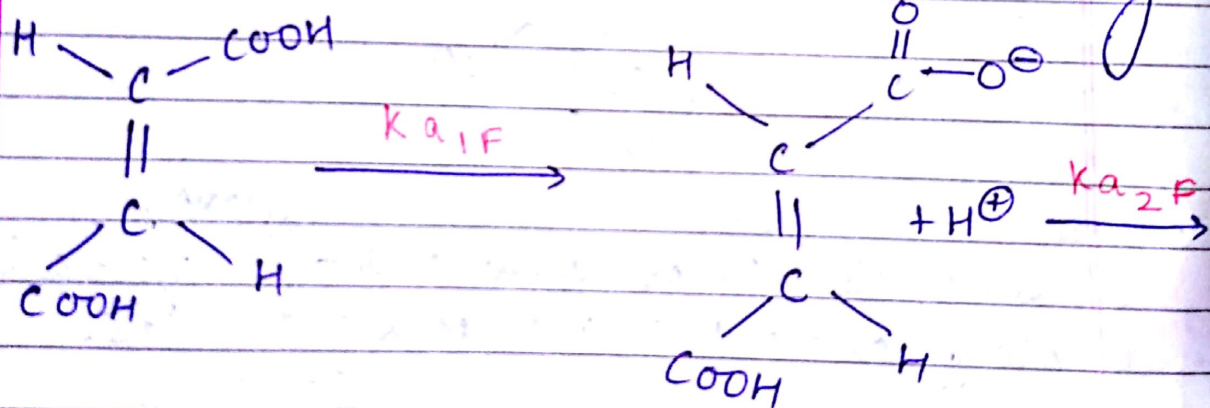
or
cis butenedioic acid

or
trans butenedioic acid



K_{a2M}

less acidic becoz
H is involved in H-bonding



$$K_{a1M} > K_{a1F}$$

$$K_{a2M} < K_{a2F}$$

PAGE NO.:

DATE: / /

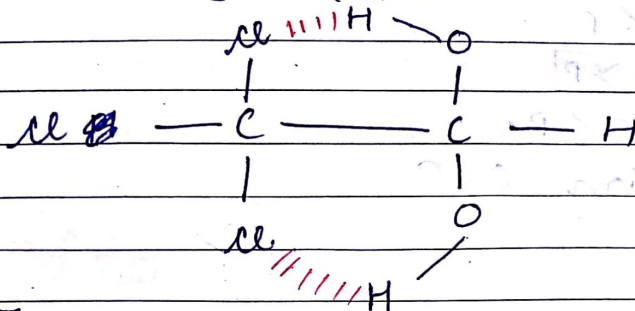
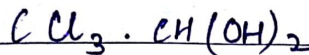
PAGE NO.:

DATE: / /

3.

Stability :

(a) chloral hydrate is more stable due to intramolecular H-bonding.



26/08/17

Note: Intermolecular H-bonding is more effective than Intramolecular H-bonding.

If 2 compounds in quesⁿ are compared for Solubility, viscosity, Surface Tension then M.P., B.P., V.P., (A.S), Volatility ^{check} H-bonding _{intra}

Solubility
Viscosity
Surface Tension
M.P.
B.P.

inter > intra

V.P.

Volatility

intra > inter

IIT-07	bp	$0 < P$
	V. P.	$0 > P$
	Viscosity	$0 < P$
	Surface Tension	$0 < P$

PAGE NO.:

DATE: / /

Intermolecular Forces

weak

attractive forces

↓

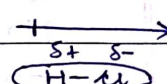
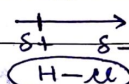
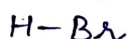
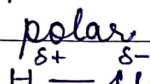
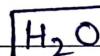
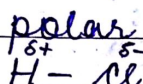
Vander Waal Forces

↓

3 types

1. Dipole-Dipole attractive forces (Keesom)

→ exist b/w 2 polar molecules.

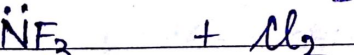
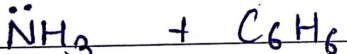
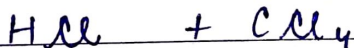
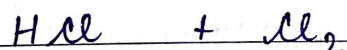


~~VWF~~ → H-bond

Note: VWF does not exist with H-bond

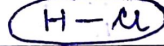
2. Dipole-induce dipole force (Debye)

exist b/w polar + non polar molecules

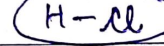


polar

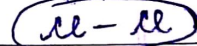
$\delta^+ \quad \delta^-$



$\delta^+ \quad \delta^-$



+ non polar



$\delta^+ \quad \delta^-$

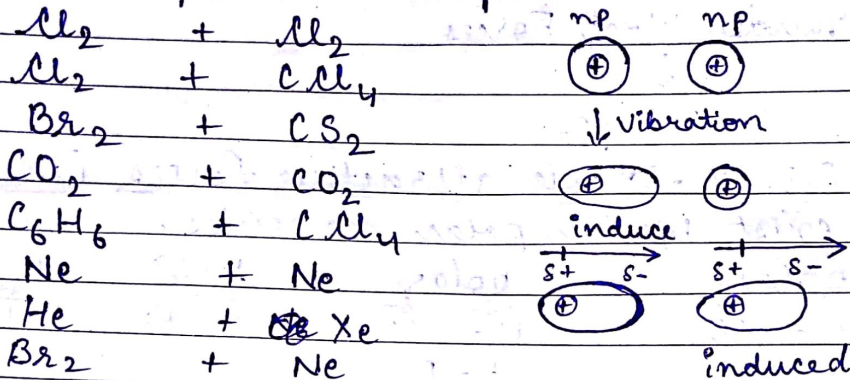


induce dipole

3. Dispersion Forces or London Forces:-

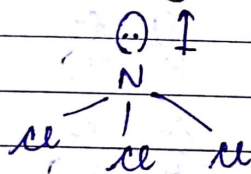
exist b/w 2 non-polar molecules

non-polar + non polar



Ques Find type of VWF in following

- ① HF^{P} + $\text{Cl}_2^{\text{N.P.}}$ Debye
- ② NH_3^{P} + $\text{CCl}_4^{\text{N.P.}}$ Debye
- ③ $\text{CH}_4^{\text{N.P.}}$ + $\text{C}_6\text{H}_6^{\text{N.P.}}$ L
- ④ Br_2 + H_2O D
- ⑤ H_2O + NH_3 → H-bond
- ⑥ H_2O + R-O-H → H-bond
- ⑦ HCl + NF_3 → Keesom
- ⑧ NF_3 + NCl_3 → Keesom



intermolecular forces weak forces

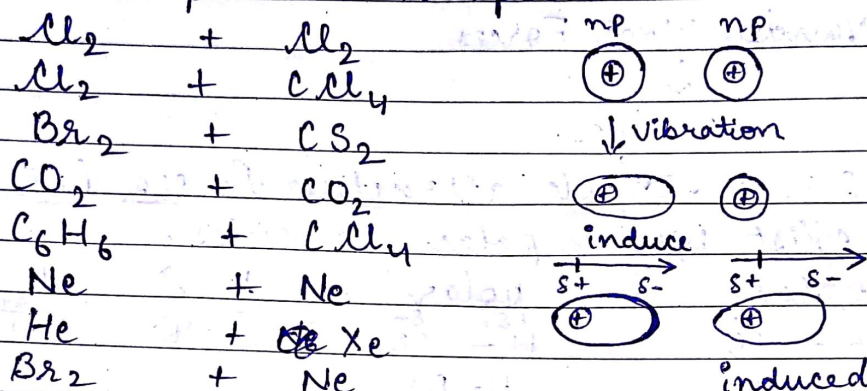
H-bond > Keesom > Debye > London

Interaction Energy $\propto \frac{1}{r^6}$

r → distance b/w particles

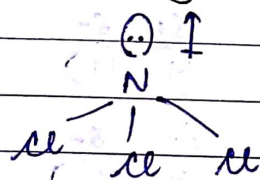
$r \sim 500\text{pm}$

3. Dispersion Forces or London Forces:- exist b/w 2 non-polar molecules non-polar + non polar



Ques Find type of VWF in following

- ① HF^{P} + $\text{Cl}_2^{\text{N.P.}}$ Debye
- ② NH_3^{P} + $\text{CCl}_4^{\text{N.P.}}$ Debye
- ③ $\text{CH}_4^{\text{N.P.}}$ + $\text{C}_6\text{H}_6^{\text{N.P.}}$ L
- ④ Br_2 + H_2O D
- ⑤ H_2O + NH_3 → H-bond
- ⑥ H_2O + R-O-H → H-bond
- ⑦ HCl + NF_3 → Keesom
- ⑧ NF_3 + NCl_3 → Keesom



intermolecular forces weak forces

H-bond > Keesom > Debye > London

Interaction Energy $\propto \frac{1}{r^6}$

r → distance b/w particles

$r \sim 500\text{pm}$

$VWF \propto \text{Mol. Mass}$

for Halogens & inert gas

as $\text{Mol. wt.} \uparrow \quad VWF \uparrow \quad bp \uparrow$

$F_2 < Cl_2 < Br_2 < I_2$

$He < Ne < Ar < Kr < Xe$

$H_2 < D_2 < T_2$

$H-Cl > Cl_2$
K L

$H-Br > Br_2$
K L

$CH_4 < SiH_4 < GeH_4 < SnH_4 < PbH_4$

$H_2S < H_2Se < H_2Te < H_2O \leftarrow \text{H-bond}$

$HAl < HBr < HI < HF$

$PH_3 < AsH_3 < NH_3 < SbH_3$

Metallic bond $\div$ (non directional)

→ A metal atom is surrounded by 8 or 12 atoms

→ Covalent and ionic electrostatic forces does not exist in metals so to explain

bonding in ~~the~~ metals Lorentz propose "e⁻ gas molecule Model" or "e⁻ sea Model".

→ Accⁿ to him a metal atom is consist of 2 part

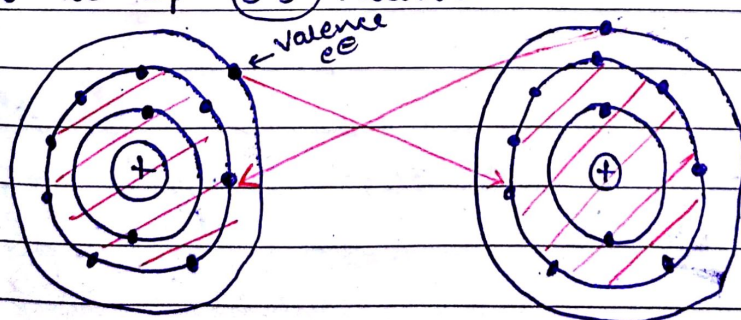
1. Valence e⁻

2. Kernel (nucleus + inner shell)
+vely charged

eg
↓

Na

$1s^2 2s^2 2p^6 (3s^1) \text{ valence}$



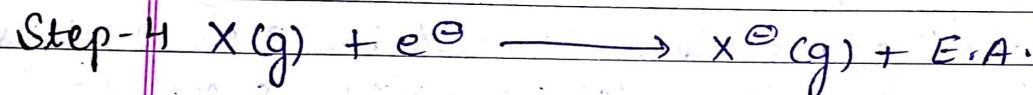
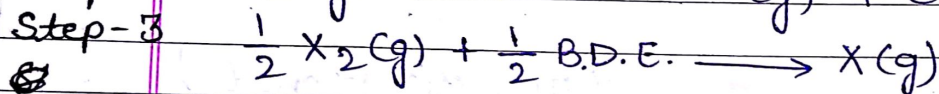
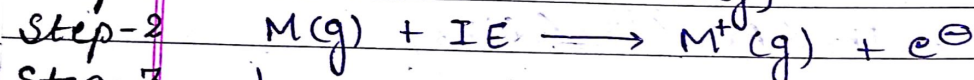
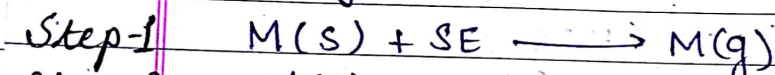
PAGE NO.:
DATE: / /

PAGE NO.:
DATE: / /

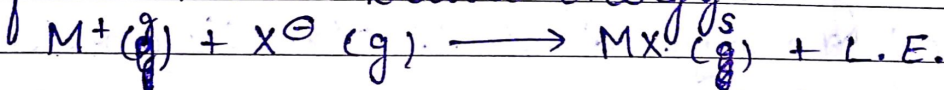
Ionic Bond or Electromerent Bond :-

- It is electrostatic force of attraction b/w cations & anions.
- Electropositive + Electronegative → ionic bond
 IA to IIIA VA, VIIA, VIIIA
 metal non metal
- It is non-directional.

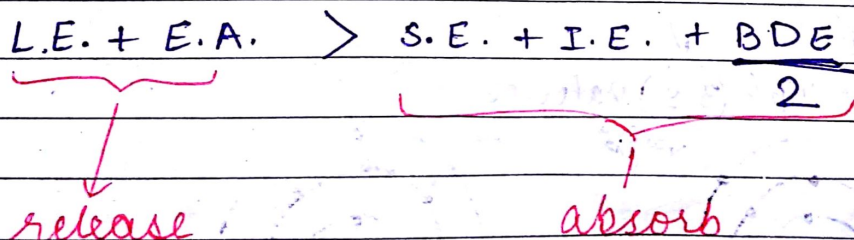
Steps involved in for^m of ionic bond :-
eg. M^+X^-



Step-5 When cation & anion comes closer to each other then energy is released due to attractive forces called Lattice energy.



for formation of ionic bond



PAGE NO.:

DATE: / /

PAGE NO.:

DATE: / /

Condition :-

S.E. ↓

I.E. ↓

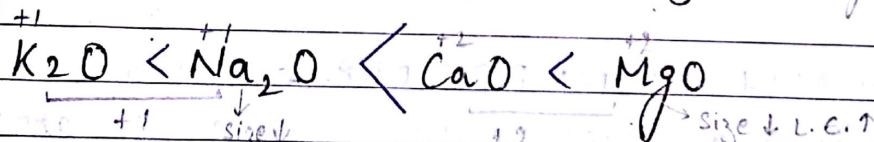
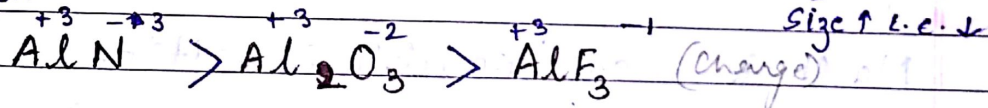
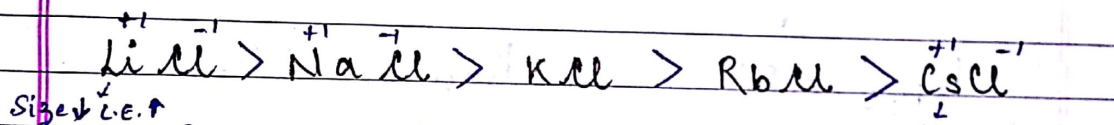
B.D.E. ↓

E.A. ↑

L.E. ↑

Lattice Energy :- It is the amt. of energy released when 1 mol of ionic crystal is formed from its gaseous constituent.

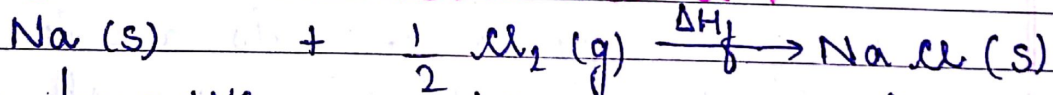
$$L.E. \propto \frac{q_1 q_2}{r^2}$$



28/08/17

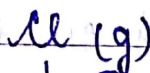
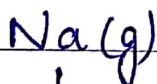
Born

Haber's Process :-



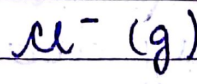
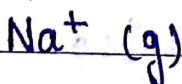
↓ $\Delta H_{sub} = +ve$

↓ $\frac{BDE}{2} = +ve$



↓ $IE = +ve$

↓ $EA = -ve$



L.E. = -ve

$$\Delta H_f = \Delta H_{sub} + I.E. + \frac{BDE}{2} - E.A. - L.E.$$

PAGE NO.:

DATE: / /

PAGE NO.:

DATE: / /

ionic bond > Covalent bond > Metallic > H-bond > VWF
 $K > D > 1$

~~Bo~~ Characteristic of Ionic bond:-

1. Physical State: hard, crystalline, solid

Hardness: diamond > Nitride (B_4C) > Carborandandum > Al_2O_3
(sic)

2. Solubility: "like dissolve like"
ionic compound are polar so they are more soluble in polar solvent.

Solubility $\propto$ Dielectric constant (K)

$$K_{H_2O} = 81$$

$$K_{CH_3OH} = 32$$

NaCl is more soluble in water.

3. B.P. and M.P.: ~~BP/M~~ BP & M.P. ~~bond~~ are higher due to high electrostatic force of attraction.

4. Electrical Conductivity Ionic compds are less conductive in solid state but highly conducting in ^{molten} solid state.

Solid NaCl $\rightarrow$ bad conductivity

Molten NaCl $\rightarrow$ good conductor

5. Isomerism: They do not show isomerism because they are non-directional.

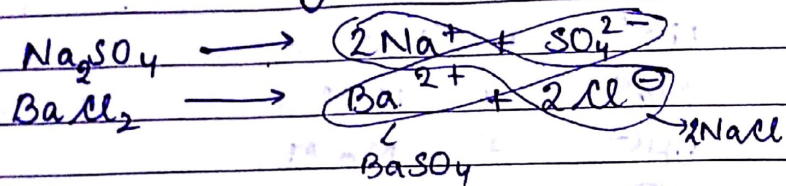
PAGE NO.:

DATE: / /

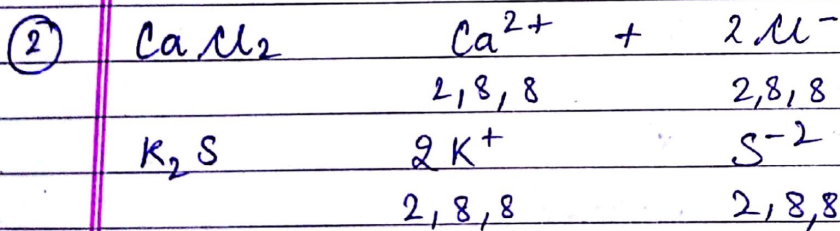
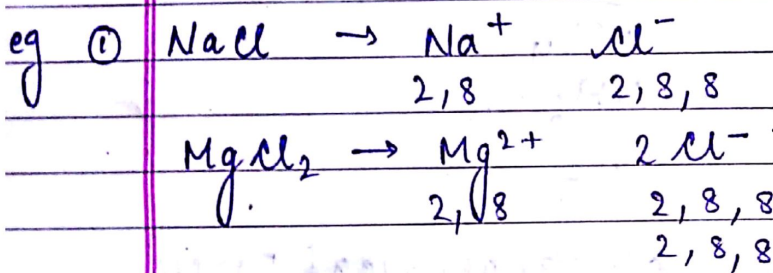
PAGE NO.:

DATE: / /

6. **Reactivity** : highly reactive becoz there is no bond breaking and ^{bond} making step.



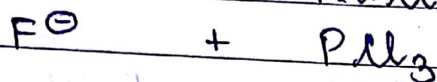
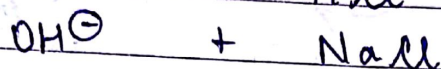
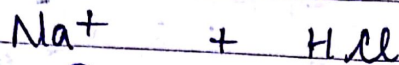
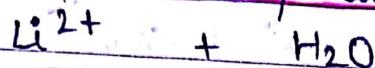
7. **Isomorphism** : ionic compd show isomorphism
isomorphism $\rightarrow$ 2 compd which have same configuration of their ions.



Other weak Forces :-

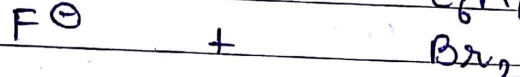
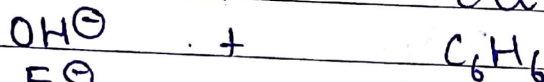
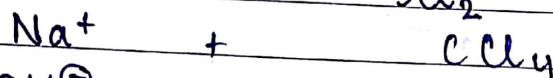
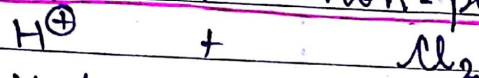
(a) Ion - Dipole Forces

ion + polar



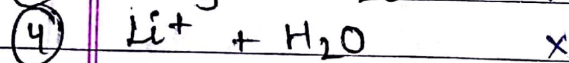
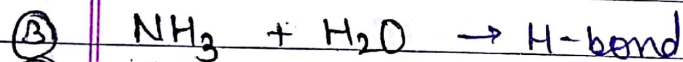
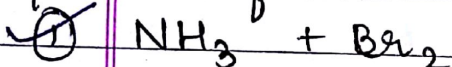
(b) Ion - Induced dipole Forces :-

ion + non-polar

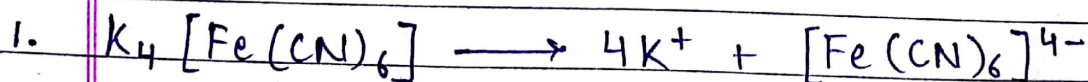


Note:- These forces are not vander waal Forces.

Ques Vw f are +nt in



* $\text{K}_4[\text{Fe}(\text{CN})_6]$, $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$, NH_4OH , NH_4Cl
have all 3 bonds i.e. ionic, covalent & coordinate.

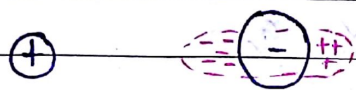


PAGE NO.:
DATE: / /

PAGE NO.:
DATE: / /

→ How this covalent character is developed in ionic bond is explained by Fajan Rule.

Polarisation Power : Ability of a cation to polarize an anion.

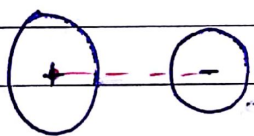
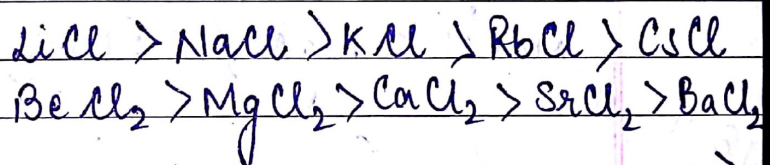
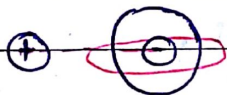


Polarizability : The ability of anion to get polarized.

Factors affecting Polarisation :-

1. **Size of cation :-**

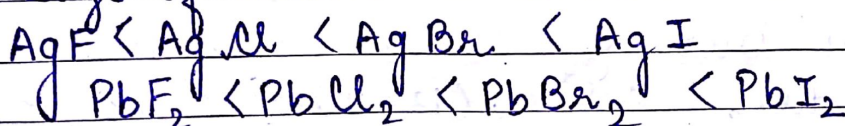
as size of cation $\downarrow$ Polarisation $\uparrow$ C.C. $\uparrow$



Polarisation $\downarrow$
C.C. $\downarrow$ I.C. $\uparrow$

2. **Size of Anion :-**

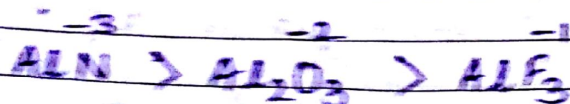
size of anion $\uparrow$ Polarisation $\uparrow$ C.C. $\uparrow$



C.C. $\uparrow$

3. **Charge on cation or anion**

C.C. $\propto$ Polarisation $\propto$ Charge on cation
C.C. $\propto$ Polarisation $\propto$ Charge on anion



4. ionic Potential (ϕ) = $\frac{\text{Charge}}{\text{radius}}$

$$\phi \propto \frac{q}{r}$$

ionic potential (ϕ) $\uparrow$ Polarisation $\uparrow$ c.c. $\uparrow$

$$\phi \propto \frac{c.c.}{I.E.}$$



Size $\uparrow$ but c.c. $\uparrow$ $\rightarrow$
due to Z_{eff}

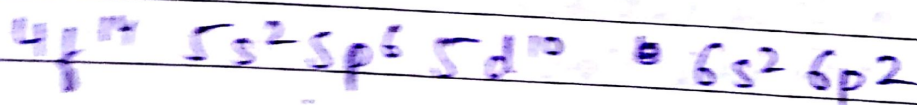
5. Pseudo inert gas configuration +
Polarisation



$\uparrow$
inert gas

$\uparrow$
Pseudo
inert gas

Pb $\rightarrow$



Colour :- Intensity of colour $\propto$ Polarisation

AgF	AgCl	AgBr	AgI
Colourless	White	Light Yellow	Dark Yellow

→ It does not mean that all iodide will be coloured
eg: NaI, KI, CuI $\rightarrow$ colourless

→ If iodide of any element is colourless then be sure other halide of that element will be colourless.

→ Bromide of an element $\rightarrow$ coloured
Fluoride & Chloride of that element may be coloured or colourless.
be sure Iodide of that element will be coloured.

ZnS	CdS	HgS
White	Yellow	Black

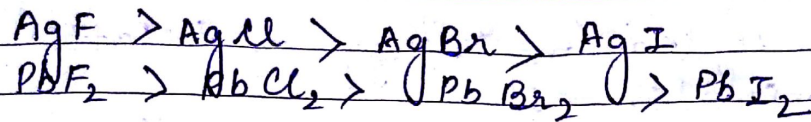
Solubility :- "like dissolve like".

Case-I When Polarisation is dominating factor.

- Solvent is of covalent nature

When common cation are from d-block like Hg^{2+} , Fe^{2+} , Cu^{+}
& P-block like Pb^{2+} , Sn^{2+}

(a) When Polar solvent is given :- then Polarisation $\uparrow$
 H_2O , HF, H_2SO_4 , D_2O c.c. $\uparrow$
 R-OH , R-COOH , DMF, DMSO I.e. $\downarrow$
Solubility $\downarrow$



(b) In non polar solvent : CCl_4 , Benzene, CS_2 , alkane, ether
non polar solvent Polarisation ↑
C.C. ↑

in np Solubility in np ↑
 $\text{NaCl} < \text{NaI}$
 $\text{KCl} < \text{KI}$

Ques which of the following is more soluble in ether? → np

① NaF ② NaCl ③ NaBr ④ NaI

Ques which is more soluble in alcohol

① AgF ② AgBr ③ AgCl ④ AgI

Ag → d block

Case-II when different solvents is given :-

Solubility $\propto$ dielectric constant (K)

$\text{HF} > \text{H}_2\text{SO}_4 > \text{H}_2\text{O}_2 > \text{H}_2\text{O} > \text{D}_2\text{O} > \text{CH}_3\text{OH}$

K → 120 102 98 81 79 32

Ques NaCl is less soluble in

(i) HF ② D_2O ③ H_2O_2 ④ H_2O

size of ion

PAGE NO.:

DATE: / /

Case-3 When Hydration Energy and Lattice Energy is dominating:-

(a) When size of common ion is small

small ion

$$\text{Solubility} \propto \frac{1}{\text{L.E.}}$$

$\text{O}^{2-}, \text{F}^{-}, \text{OH}^{-}, \text{Li}^{+}, \text{Na}^{+}$ & IIA cations
 $\text{Be}^{2+}, \text{Mg}^{2+}, \text{Ca}^{2+}, \text{Sr}^{2+}, \text{Ba}^{2+}$

CO_3^{2-} & HCO_3^{-} works as small ion in presence of IA cations

$$\text{Solubility} \propto \frac{\text{H.E.}}{\text{L.E.}}$$

H.E. $\rightarrow$ dissolve होने पर release energy

L.E. $\rightarrow$ crystal को बनाना

$$\text{Solubility} \propto \frac{\text{H.E.}}{\text{L.E.}}$$

(b) When common ion is large

$$\text{Solubility} \propto \text{H.E.}$$

$\text{K}^{+}, \text{Rb}^{+}, \text{Cs}^{+}, \text{Br}^{-}, \text{Cl}^{-}, \text{I}^{-}, \text{CO}_3^{2-}, \text{HCO}_3^{-},$
 $\text{SO}_4^{2-}, \text{PO}_4^{3-}, \text{S}^{2-}, \text{NO}_3^{-}$

30/8/18	PAGE NO.: DATE: / /	L.E. $\propto \frac{q_1 q_2}{r^2}$	PAGE NO.: DATE: / /
Oxide	$Li_2O < Na_2O < K_2O < Rb_2O < Cs_2O$	common ion $O^{2-} \rightarrow$ small $S \propto \frac{1}{L.E.}$	$BeO < MgO < CaO < SrO < BaO$
Hydroxide	$LiOH < NaOH < KOH < RbOH < CsOH$	common ion $OH^- \rightarrow$ small $S \propto \frac{1}{L.E.}$	$Be(OH)_2 < Mg(OH)_2 < \dots$
Carbonate	$Li_2CO_3 < Na_2CO_3 < K_2CO_3 < Rb_2CO_3 < Cs_2CO_3$	common ion CO_3^{2-} small (IIA) $S \propto \frac{1}{L.E.}$	$BeCO_3 > MgCO_3 > CaCO_3 > SrCO_3 > BaCO_3$
Bicarbonate	$LiHCO_3 < NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$	common ion HCO_3^- small (IIA) $S \propto \frac{1}{L.E.}$	$\times Be(HCO_3)_2$ bicarbonate IIA doesn't exist
	$\rightarrow$ does not exist in solid form $\rightarrow$ liquid		
Sulphate	$Li_2SO_4 > Na_2SO_4 > K_2SO_4 > Rb_2SO_4 > Cs_2SO_4$	common SO_4^{2-} large $S \propto H.E.$	$BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$
Nitrate	$LiNO_3 > NaNO_3 > KNO_3 > RbNO_3 > CsNO_3$	common NO_3^- large $S \propto H.E.$	$Be(NO_3)_2 > Mg(NO_3)_2 > Ca(NO_3)_2 > Sr(NO_3)_2 > Ba(NO_3)_2$
Fluoride	$LiF < NaF < KF < RbF < CsF$	common ion F^- small $S \propto \frac{1}{L.E.}$	$BeF_2 < MgF_2 < CaF_2 < SrF_2 < BaF_2$
Chloride	$LiCl > CsCl > RbCl > NaCl > KCl$	experimental data	$BeCl_2 > MgCl_2 > CaCl_2 > SrCl_2 > BaCl_2$
Bromide	$LiBr > NaBr > KBr > RbBr > CsBr$	common Br^- large $S \propto H.E.$	$BeBr_2 > MgBr_2 > CaBr_2 > SrBr_2 > BaBr_2$
Iodide	$NaI^* > LiI > KI > RbI > CsI$	exp. data	$BeI_2 > MgI_2 > CaI_2 > SrI_2 > BaI_2$

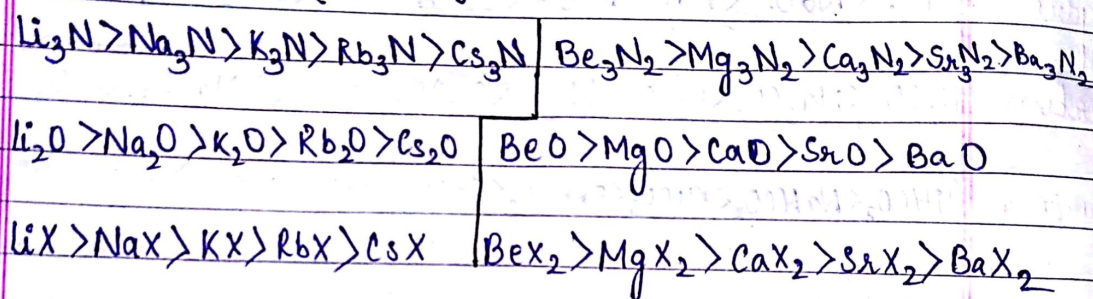
anion $\rightarrow$ small
Polarisation factor $\times$
check L.E. T.S. $<$ L.E.
down the gp size $\uparrow$ L.E. $\downarrow$ T.S.

PAGE NO.:

DATE: / /

Thermal Stability :

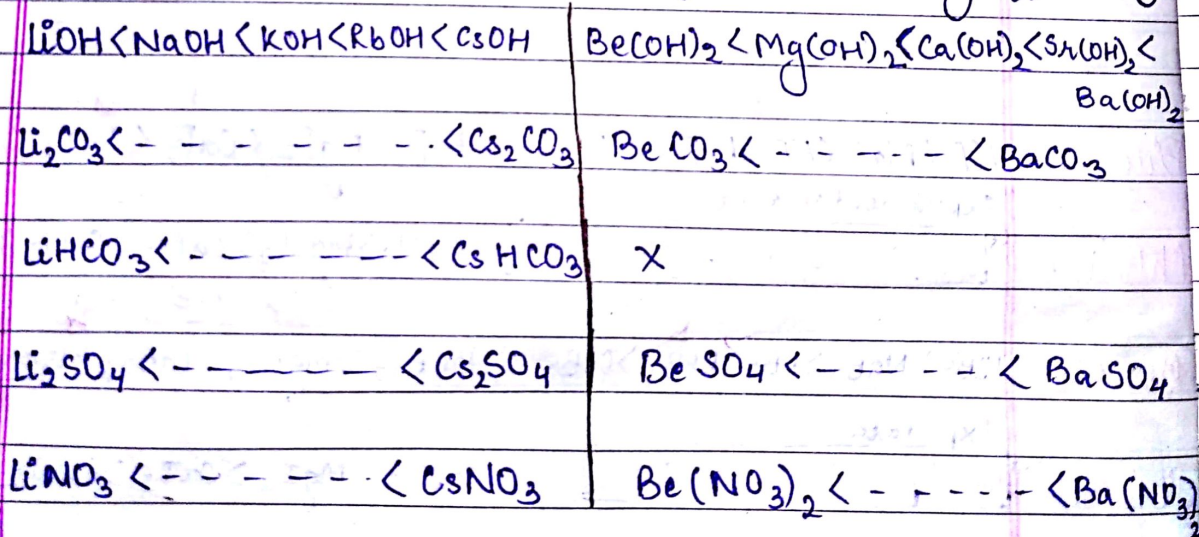
Case-I : When anion is monatomic like N^{3-} , O^{2-} , X^{-}
T.S. $\downarrow$ down the group $X = F, Cl, Br, I$



Case-II When anion is polyatomic like OH^{-} , CO_3^{2-} , HCO_3^{-} , SO_4^{2-} , NO_3^{-}

T.S. $\uparrow$ down the group

down the gp large cation & large anion $\rightarrow$ packing efficiently



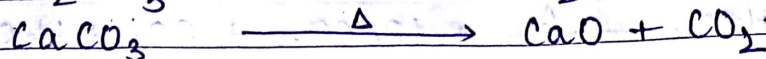
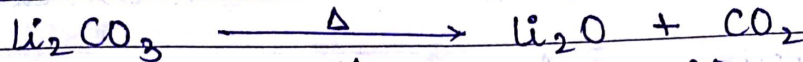
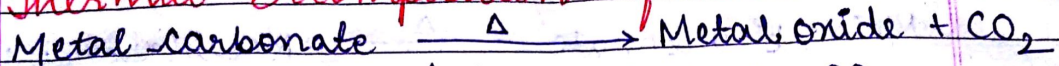
PAGE NO.:

DATE: / /

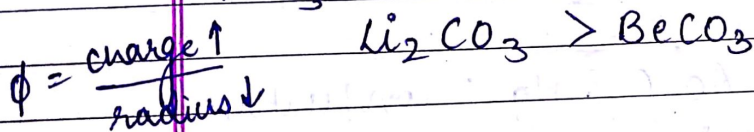
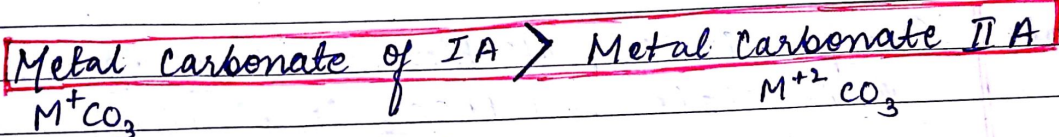
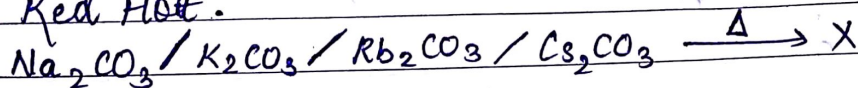
PAGE NO.:

DATE: / /

Thermal Decomposition of carbonates :



Note: Except Li_2CO_3 , all alkali metal carbonates are very stable & do not decompose even upto Red Hot.



Ques Which of the following metal carbonates give CO_2 gas on heating?

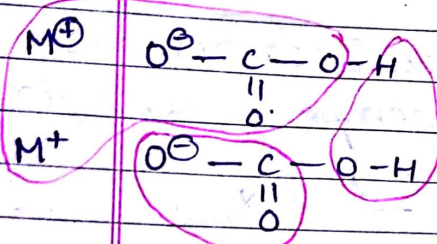
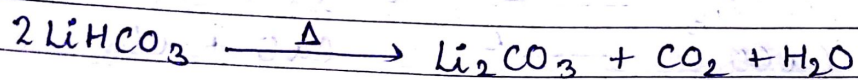
① Na_2CO_3 ② K_2CO_3 ③ Li_2CO_3 ④ Cs_2CO_3

Ques On slow heating Na_2CO_3 will give

① CO_2 ② CO ③ both ① & ② ④ none

Thermal Decomposition of bicarbonates:

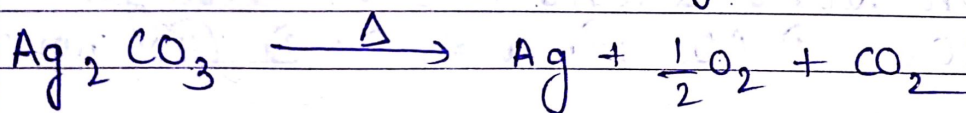
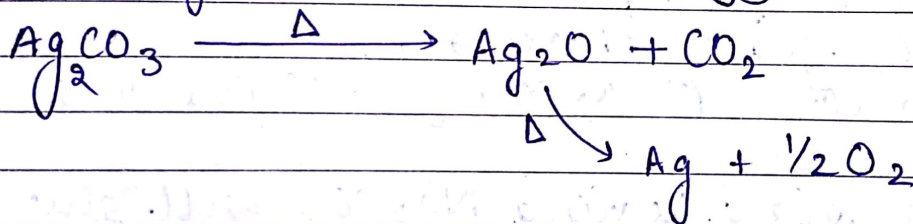
Metal bicarbonate $\xrightarrow{\Delta}$ Metal Carbonate + CO_2 + H_2O



IA bicarbonate > II A bicarbonate

Note : Except LiHCO_3 , all bicarbonate of IA exist in solid state, LiHCO_3 is liquid.

Note : Metal Oxides like Ag_2O & Hg_2O on further heating give metal & oxygen



31/8/17

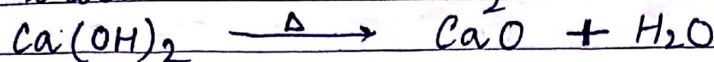
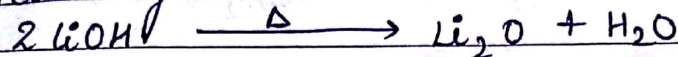
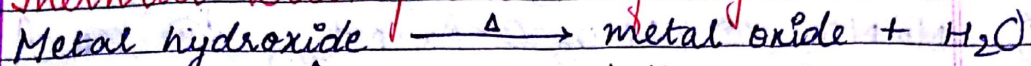
PAGE NO.:

DATE: / /

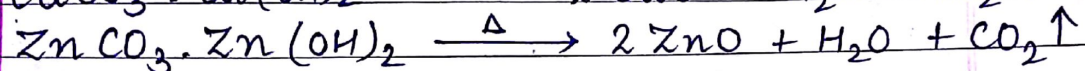
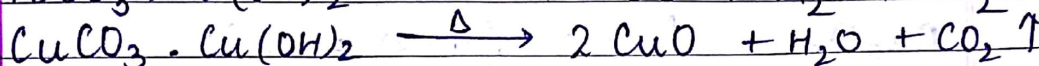
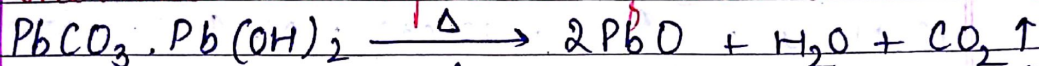
PAGE NO.:

DATE: / /

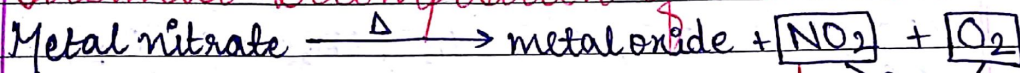
Thermal Decomposition of Hydroxide :-



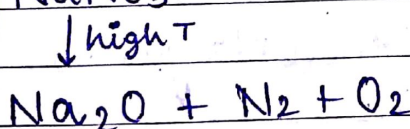
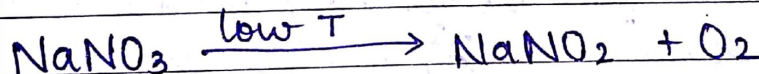
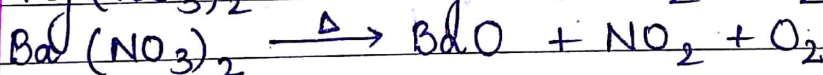
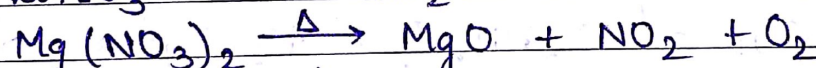
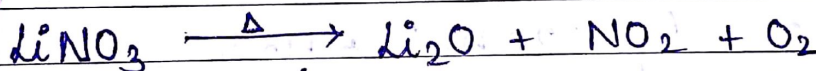
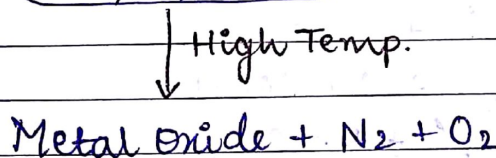
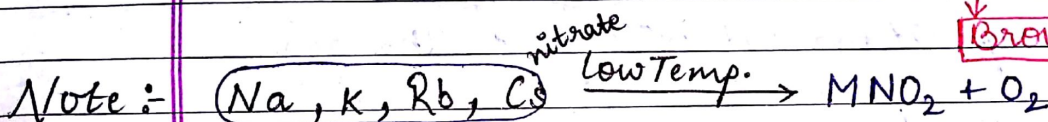
Thermal Decomposition of basic carbonates :-



Thermal Decomposition of Nitrate :-



Paramagnetic
Brown



Ques

Which of the following nitrate give brown coloured gas on heating?

①

NaNO_3 ② CsNO_3 ③ KNO_3 ④ LiNO_3

3/8/17

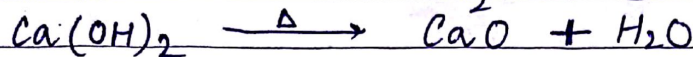
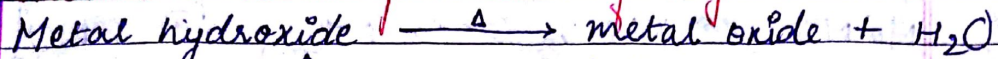
PAGE NO.:

DATE: / /

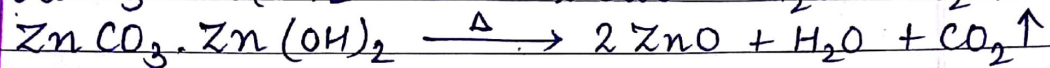
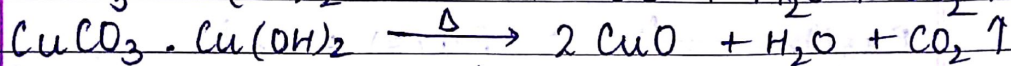
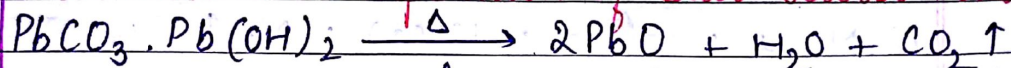
PAGE NO.:

DATE: / /

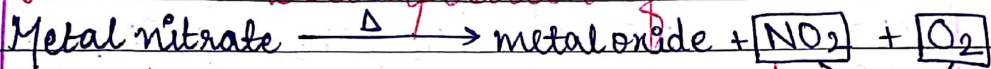
Thermal Decomposition of Hydroxide :-



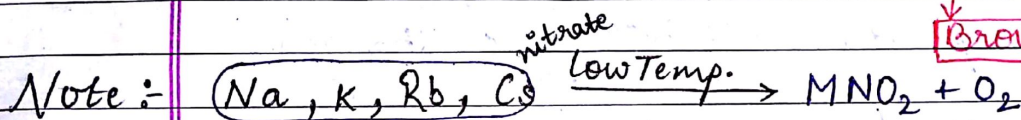
Thermal Decomposition of basic carbonates :-



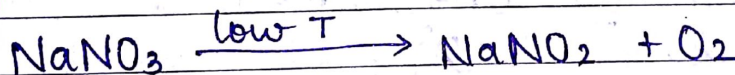
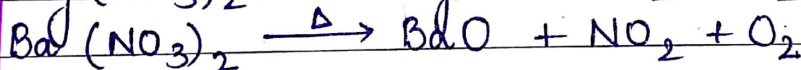
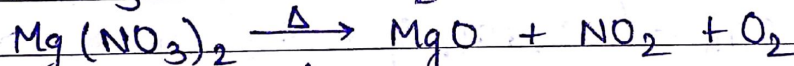
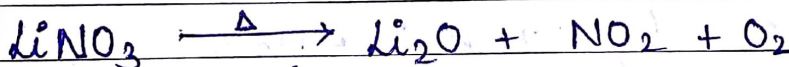
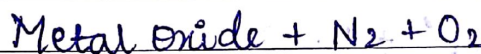
Thermal Decomposition of Nitrate :-



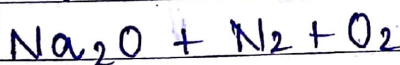
Paramagnetic
Brown



↓ High Temp.



↓ high T



Ques

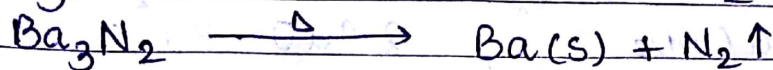
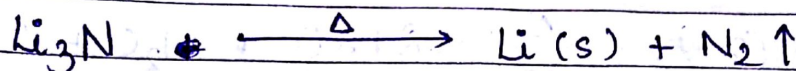
which of the following nitrate give brown coloured gas on heating?

①

NaNO_3 ② CsNO_3 ③ KNO_3 ④ LiNO_3

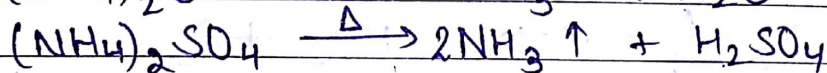
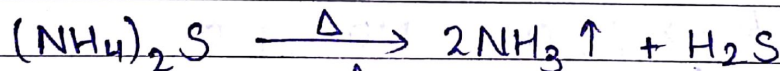
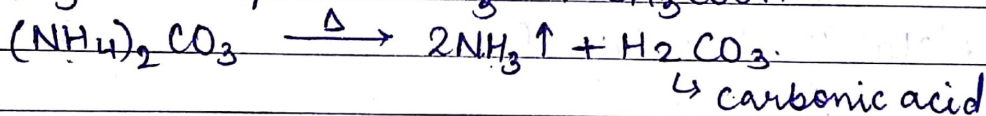
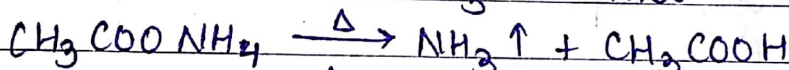
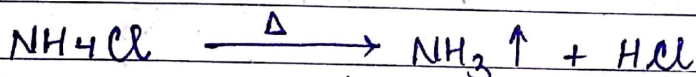
Ques ① which metal nitrate will give paramagnetic gas
① NaNO_3 ② RbNO_3 ③ $\text{Ca(NO}_3)_2$ ④ KNO_3

Thermal Decomposition of Nitrides :-
 $(\text{Li} + \text{IIA Metal}) + \text{Pure N}_2 \longrightarrow \text{Metal Nitride}$

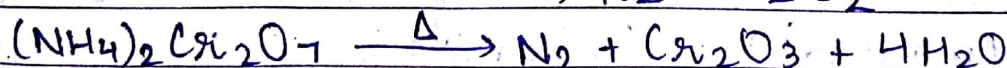
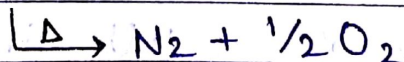
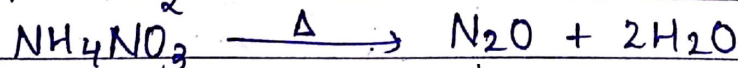
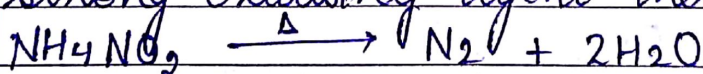


Thermal Decomposition of Ammonium Salts :-

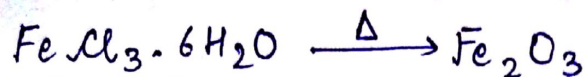
Case-I When ammonium salts have anion like Cl^- , Br^- , I^- , S^{2-} , CO_3^{2-} , CH_3COO^- , PO_4^{3-} , SO_4^{2-} which are weak oxidising agents then on decomposition, it will give NH_3 gas.



Case-II When ammonium salts have anion like NO_3^- , NO_2^- , ClO_4^- , $\text{Cr}_2\text{O}_7^{2-}$, IO_3^- which are strong oxidising agent then N_2 gas is released.



(green)

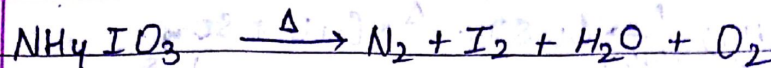


PAGE NO.:

DATE: / /

PAGE NO.:

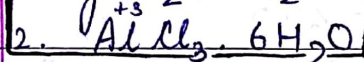
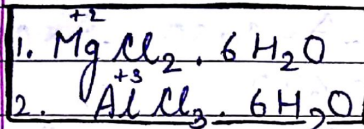
DATE: / /



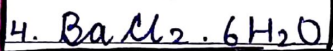
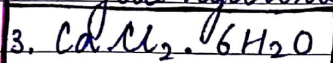
Chloride

Hydrated

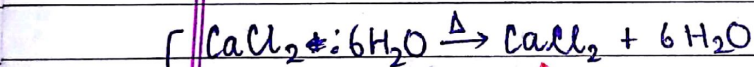
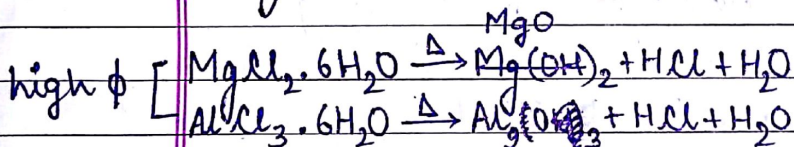
Anhydrous



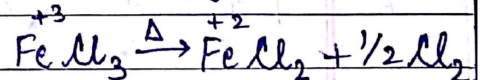
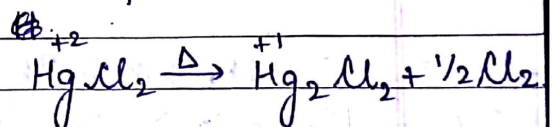
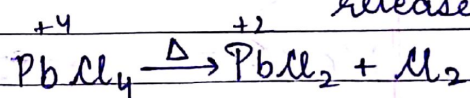
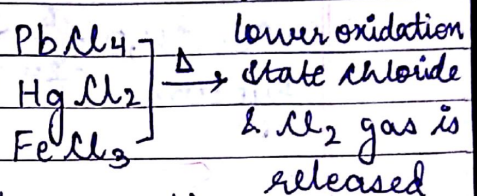
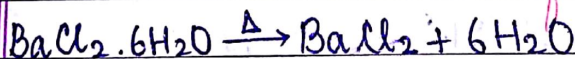
high ϕ $\rightarrow$ on decomposition give hydroxide oxide



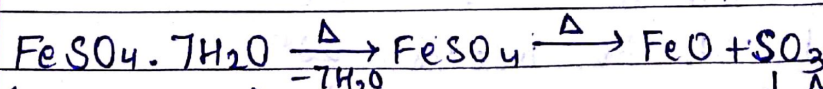
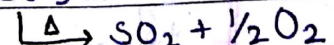
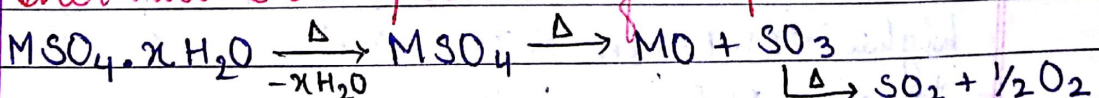
low ϕ $\rightarrow$ on decomposition dehydration takes place



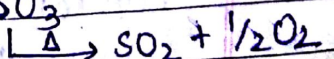
hygroscopic $\rightarrow$ absorb moisture from air

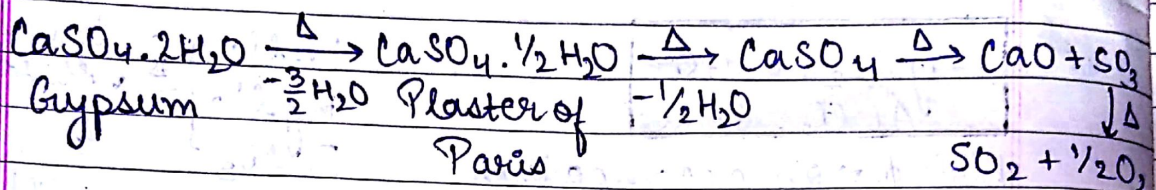
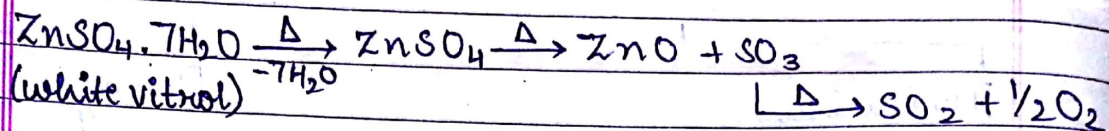
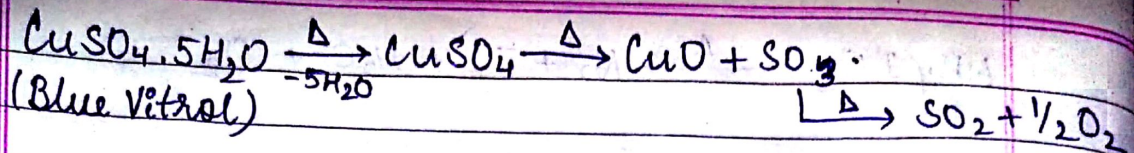


Thermal Decomposition of Sulphates :-



(green vitrol)





Melting Point:

IA: $\text{Li} > \text{Na} > \text{K} > \text{Rb} > \text{Cs}$

IIA: $\text{Be} > \text{Ca} > \text{Sr} > \text{Ba} > \text{Mg}$
बेकार सिर बाजयेगा मारियेगा.

d-Block: $3d < 4d < 5d$
 $\text{Zn} > \text{Cd} > \text{Hg}$

$\text{M.P.} \propto \text{no. of unpaired } e^-$

3d series $\rightarrow$ highest M.P. $\rightarrow \text{Cr}$

4d series $\rightarrow$ highest M.P. $\rightarrow \text{Mo}$

5d series $\rightarrow$ highest M.P. $\rightarrow \text{W}$

highest M.P. in P.T. $\rightarrow \text{C}$

lowest M.P. in P.T. $\rightarrow \text{He}$

highest M.P. in metals $\rightarrow \text{W}$

lowest M.P. in metals $\rightarrow \text{Hg}$

PAGE NO.:

DATE: / /

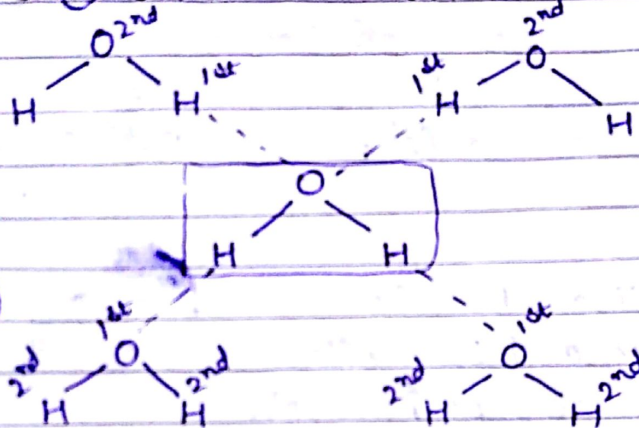
M.P. :- $\text{HCl} < \text{HBr} < \text{HF} < \text{HI}$

B.P. :- $\text{HCl} < \text{HBr} < \text{HI} < \text{HF}$

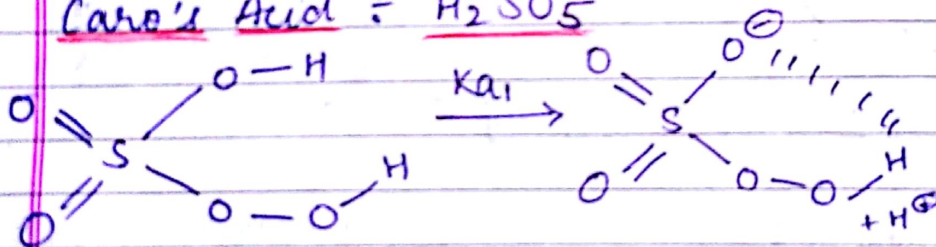
Ques no. of 1st nearest & 2nd nearest H & O atoms in ice?

6H & 2O (2) 6H & 4O 6H & 6O 4H & 4O

1st nearest 2H & 2O
2nd nearest 4H & 2O
6H & 4O



Caro's Acid $\div \text{H}_2\text{SO}_5$



$K_{a1} > K_{a2}$

