

(ii)

Mention 4 Points Similarity b/w VBT & MOT.

- ① Both involve distribution of e^- s. Thus whether it is atomic or molecular cannot have more than two e^- s.
- ② Both the theories include the sharing of e^- s by the nuclei.
- ③ According to both the theories the energy of overlapping orbitals must be comparable and there must be similarity in their symmetry.
- ④ They account for the directional nature of the bond.
- ⑤ Bond results by overlapping of two orbitals of mini energy.

(iii)

What is s-inert pair effect.

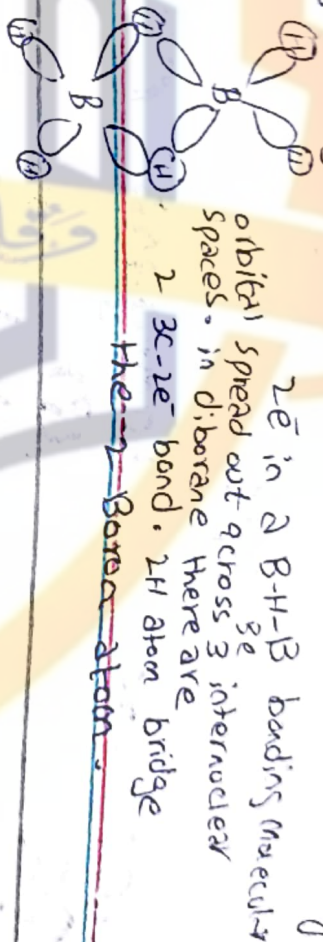
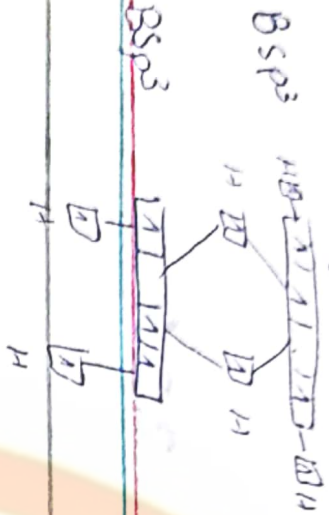
Shows the reluctance of valence e^- s in the s-orbital to be available for bonding. The $5s^2$ of In (Sn) & $6s^2$ of lead (Pb) can be examples of inert pair effect that don't participate in bonding.

→ the ns^2 valence e^- of metallic elements, especially the $5s^2$ & $6s^2$ pairs that follow the second & 3rd row of transition metals, are less reactive than would be expected based on periodic trends such as effective nuclear charge, atomic sizes & ionization energies.

(iv)

$3C-2e^-$ This is an e^- deficient chemical bond where 3 atoms share $2e^-$.

→ combination of 3 atomic orbitals form 3 molecular orbitals: one bonding, one non-bonding, & one antibonding. e.g. B₂H₆



→ Bond length is higher than normal linear 2c-2e⁻ bond. Because nuclei is more and e⁻ is low so bond length increases.

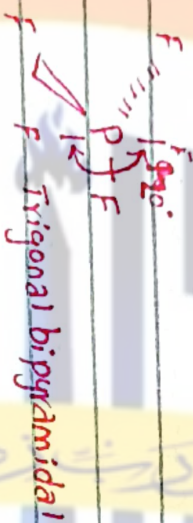
(iv) 2 uses of 8-hydroxy quinoline in organic analysis

(viii) PFS exist but NFS Not why.

→ Because N has no vacant d-orbital & cannot extend its valency beyond 3, have small size so NFS is unstable

→ 3rd period element PFS, the central Phosphorous atom can increase its valence shell to accommodate five fluorine atoms.

N → have no 2d orbitals in its valence shell P → have 3d vacant orbital



(ix) 2 advantages and drawback VSEPR

Limitations ① VSEPR Theory is applicable to covalent comp. only and

cannot be applied to ionic comp.

② Does not make any distinction b/w s, p, d & f orbitals.

③ Does not help in the prediction of shapes of coordination comp.

④ VSEPR predict that molecules such as NH_3 , H_2O , CHCl_3 are distorted from the regular geometrical shapes but does not quantify the extent of distortion.

⑤ This theory gives the shapes of molecules not their tendency to have such structures.

2019

i Give 2 Failure of VBT

- It does not explain the colour of complexes
- It does not explain the electronic spectra of complexes.
- VBT does not tell us why water & halide ion form commonly from spin complexes while cyanide ion form low spin complexes.
- This theory not explain as to why in some cases inner orbitals and in other cases outer orbitals are used in hybridization.
- Doesn't explain or unable to predict relative stabilities of diff ligand.

ii Why state of Diff halogens at room

temp & why they are diff.

2 diff b/w hybrid & Molecular orbital

^{M.O}
→ Orbitals formed after combination of atomic orbital of 2 diff atoms.

→ Proposed in a theory named molecular orbital theory proposed by Hund-Mulliken.

^{H.O}
→ Only orbital formed combination of orbitals of same atoms.

→ Proposed in the theory of hybridization proposed by Linus Pauling.

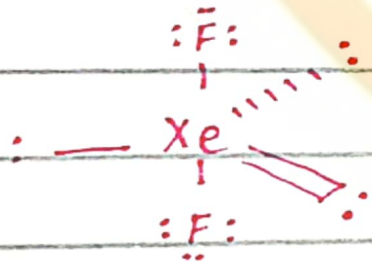
→ Bonding molecular orbital and Antibonding molecular orbital

→ sp, sp^2, sp^3, sp^3d & sp^3d^2

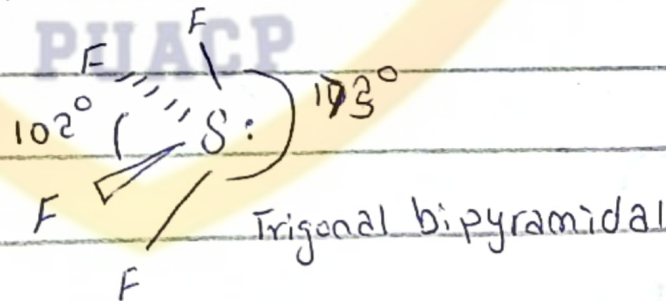
iv) $3C-4e$ bond. example.

→ $3C-4e$ is a model used to explain bonding in certain hypervalent molecules such as tetraatomic & hexatomic interhalogen Comp, Sulfur tetrafluoride, the xenon fluoride and bifluoride ion

→ Also known as Primentel-Rundle $3C$ model



xenon difluoride



Trigonal bipyramidal

v) 2 Similarities b/w Li & Mg

Repeat 2018 (Qiii) 2019 (Qvi)

Vi Inert pair effect.

Vii Why BH_3 is less stable than BF_3

Reason \rightarrow F is electro-negative atom as compared to H. It pulls the e^- away from the central B atom. As a result B atom of BF_3 is more e^- poor (low e^- density) than B atom of BH_3 . This makes BF_3 more capable to accept or receive the e^- pair from Lewis base.

\rightarrow Due to absence of lone pair of e^- on H and back bonding not occur in BH_3

Repeat 2018 (Q.iii) 2019 (Q.17) 2020 (Q.16)

☒ inert pair effect.

SiCl₄ react with H₂O while CCl₄ not ☒ justify.

Reason → The Carbon does not have d-orbitals to accept lone pair of e⁻ from water, while silicon has vacant 3d-orbitals to accept lone pair of e⁻ from H₂O.

→ CCl₄ is non-polar & dissolve in non-polar solvent. Water is polar solvent.

→ Silicon tetrachloride react with H₂O to give white solid silicon dioxide and

$$\text{SiCl}_4 + 2\text{H}_2\text{O} \longrightarrow \text{SiO}_2 + 4\text{HCl}$$

steamy fumes of HCl.

Q.1007 Repeat 2018 Q (VIII)

Points of Similarity between VBT and MOT:

- Both theories
- are approximations (مشابہت۔ قربت).
 - predict the concentration of electron density between the nuclei.
 - interpret (ترجمانی کرتا) covalent bonds as orbitals embracing (بغل گیر ہوتا) two atomic nuclei.
 - require that the combining atomic orbitals should be of nearly equal energy.
 - can account for (صحیح ثابت کرتا) directed valency.
 - predict the non-existence (وجود نہ ہونا) of helium molecule.

Dissimilarities:

S. No.	Valence Bond Theory (VBT)	S. No.	Molecular Orbital Theory (MOT)
(i)	An electron moves under the influence of only one nucleus (ایک نیوکلئیس کے اثر کے تحت) of an atom.	(i)	An electron moves under the influence of two or more nuclei of a molecule.
(ii)	VBT starts with individual atoms (انفرادی ایٹمز) and considers the interaction between them.	(ii)	MOT starts with nuclei of the constituent atoms.
(iii)	In VBT, only half-filled orbitals of the valence shell take part in bonding and completely filled orbitals remain non-bonding orbitals.	(iii)	In MOT, all the atomic orbitals, whether completely filled, partially-filled or vacant, overlap to form molecular orbitals, provided they have proper symmetry and comparable energy (انرجی جس کا موازنہ ممکن ہو).
(iv)	The atoms retain their individual identity.	(iv)	The atoms lose their identity.
(v)	VBT predicts the existence of anti-bonding orbitals in terms of repulsive forces.	(v)	MOT predicts the formation of bonding as well as anti-bonding molecular orbitals.

(vi)	VBT fails to explain the paramagnetic character of B_2 and O_2 molecules.	(vi)	MOT can well explain the paramagnetic character of B_2 and O_2 molecules.
(vii)	The concept of resonance plays an important role in VBT.	(vii)	The concept of resonance does not play any role in MOT.

2.6 General Properties of Metals

Metallic bond

We know that metals are good **conductors** of heat and electricity (حرارت اور بجلی کا موصل ہوتا). Metals have high **refracting power** (انعطاف کی طاقت) and have high **melting and boiling points**. They crystallise (تفہیمیں بناتے ہیں) with high co-ordination numbers of 8 or 12. Such properties of metals cannot be explained on the basis of normal ionic or covalent bonding.

2.6.1 Nature of Bonding in Metals:

The atoms of a metal crystal are identical. These cannot be bound together by ionic bonds. In ionic compounds cations and anions are bound together in an ionic crystal. Ionic bond is formed between atoms of **different electronegativity**. Van der Waals forces are too weak to account