

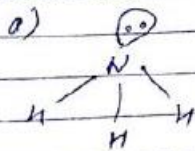
Valence Shell Electron Pair Repulsion Theory [VSEPR]

According to valence shell electron pair repulsion theory, every molecule acquires those shape in space in which lone pair - lone pair repulsion, lone pair - bond pair repulsion and bond - pair - bond pair repulsion is minimum.

1) If central atom has no lone pair, it has only bond pair electrons, geometry of molecule will be regular.

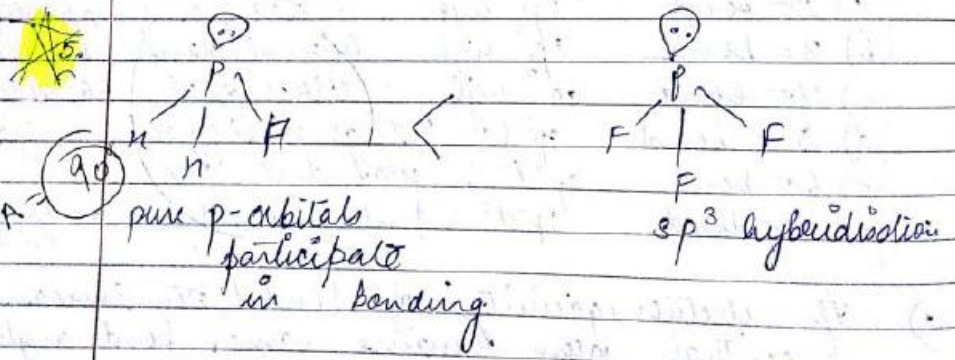
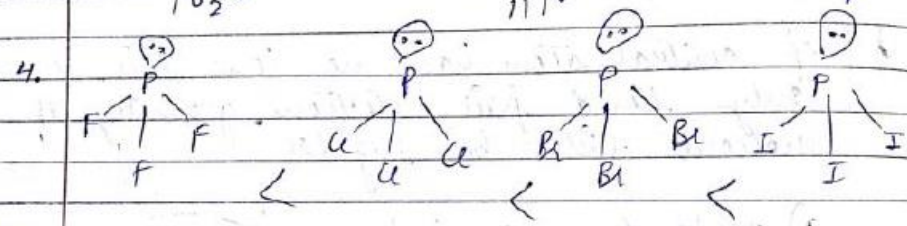
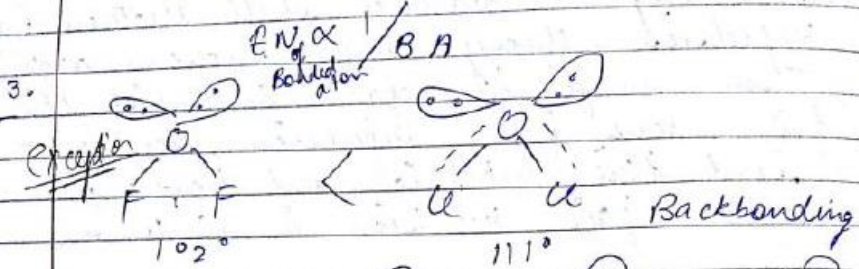
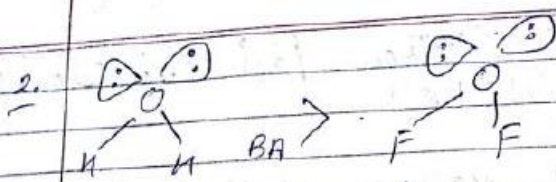
- a) 2-bond sp hyb. ; linear geo. ; $BA = 180^\circ$
- b) 3-bond sp^2 hyb. ; trigonal planar ; $BA = 120^\circ$
- c) 4-bond sp^3 hyb. ; tetrahedral ; $BA = 109.28^\circ$
- d) 5-bond sp^3d ; trigonal bipyramidal $BA = 120^\circ, 90^\circ$
- e) 6-bond sp^3d^2 ; octahedral ; $BA = 90^\circ$
- f) 7-bond sp^3d^2 ; pentagonal bipyramidal $BA = 72^\circ, 90^\circ$

2) If electronegativity of bonded atom increases central atom remains same, bond angle decreases.



$bp - bp$ rep \uparrow B.A.
 $lp - bp$ rep. \downarrow B.A.
 $BA = 107.5^\circ$

$bp - bp \gg lp - bp$
 $BA \approx 102^\circ$

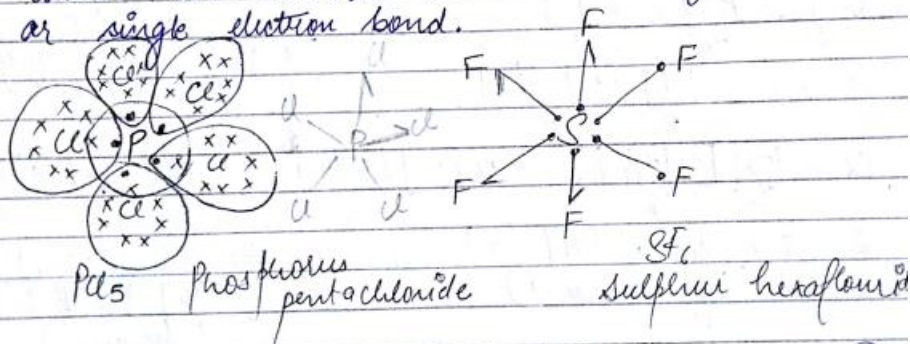


Limitations of Octet law can be explained by:-

1. Sidgen's Single Electron Concept
2. Sidgwick's Maximum Covalency Concept
3. Overlapping of Vacant Orbitals

1. Sidgen's Single Electron Concept

According to Sidgen, maximum 8 electrons are present in valence shell of central atom after bonding. If central atom forms more no. of bonds, bond formed between central atom and bonded atoms is through one e^- or single electron bond.



$$\text{no. of single } e^- \text{ bond} = \text{no. of Valence shell } e^- - \text{no. of } e^- \text{ required to complete octet}$$

$$S = N - A$$

$$\text{single bond} = e^- \text{ present in valence shell} - e^- \text{ req. to comp. octet}$$

① $\text{PCl}_5 \Rightarrow \text{no. of single } e^- \text{ bond} = 5 - 3 = 2$

② $\text{SF}_6 \quad S = 6 - 2 = 4$

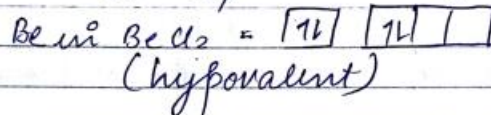
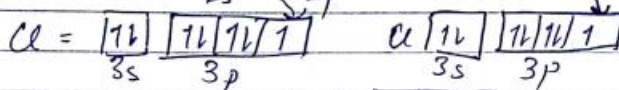
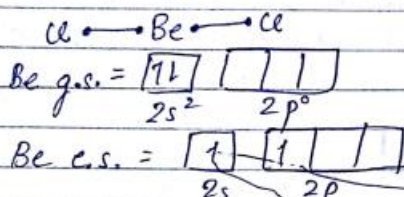
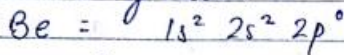
③ $\text{IF}_7 \quad S = 7 - 1 = 6$

④ $\text{XeO}_4 \quad S = 8 - 0 = 8$

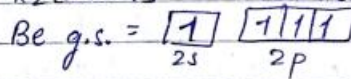
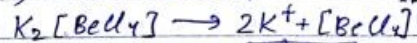
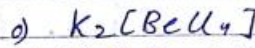
2] Sidgwick's Maximum Covalency Concept

According to Sidgwick maximum covalency of each period (no. of bond) is:-
 1st period = 1 2nd period = 4
 3rd period = 6 4th period = 6
 5th, 6th, 7th period = 8

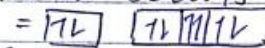
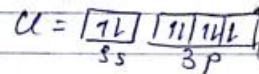
> Beryllium



maximum covalency of Be = 4.

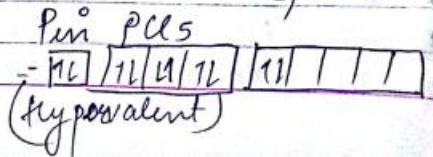
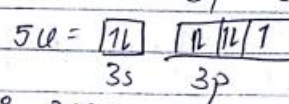
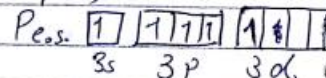
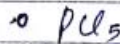
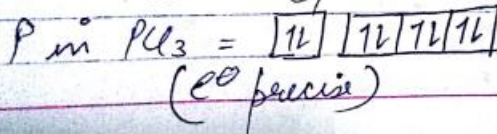
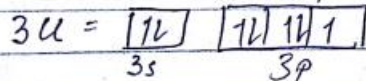
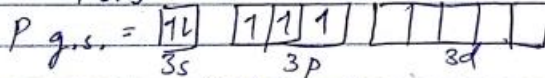
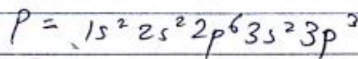


4 e^- in valence shell as it gained $2e^-$ from $2K^+$.

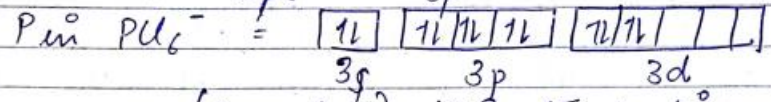
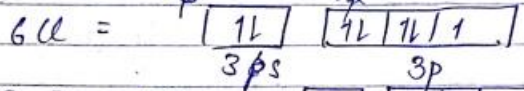
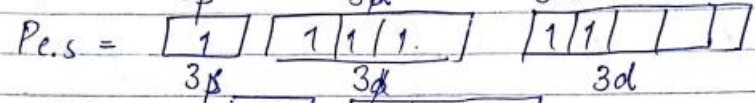
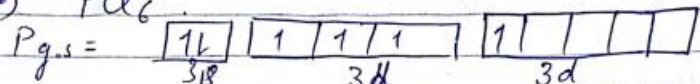


(e^- precise)

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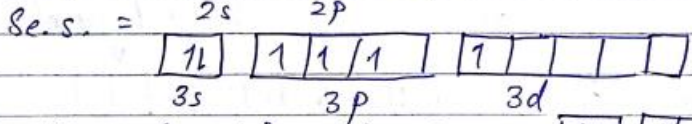
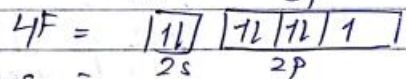
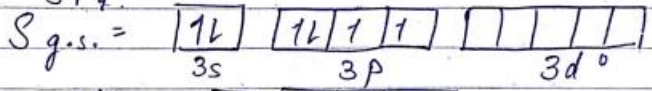
• PO_4^{3-}



(Hypervalent) $12e^-$ after bonding

maximum covalency of $P = 6$.

• SF_4



S after bonding in $SF_4 = \begin{array}{|c|c|c|c|} \hline 1 & 1 & 1 & 1 \\ \hline \end{array} \quad \begin{array}{|c|c|c|c|} \hline 1 & 1 & 1 & 1 \\ \hline \end{array} \quad \begin{array}{|c|c|c|c|} \hline 1 & & & \\ \hline \end{array}$

$10e^-$
[Hypervalent]

Applications of Maximum Covalency Concept

1. Existence of Molecule

\rightarrow NCl_5 does not exist but PCl_5 does exist
(Nitrogen Pentachloride) (Phosphorus Pentachloride)

Reason:- Maximum covalency of N is 4 but maximum covalency of P is 6.