Review 7

Chapter 7

Steps for determination of molecular geometry and type of hybridization

- **The steps are as follows:**

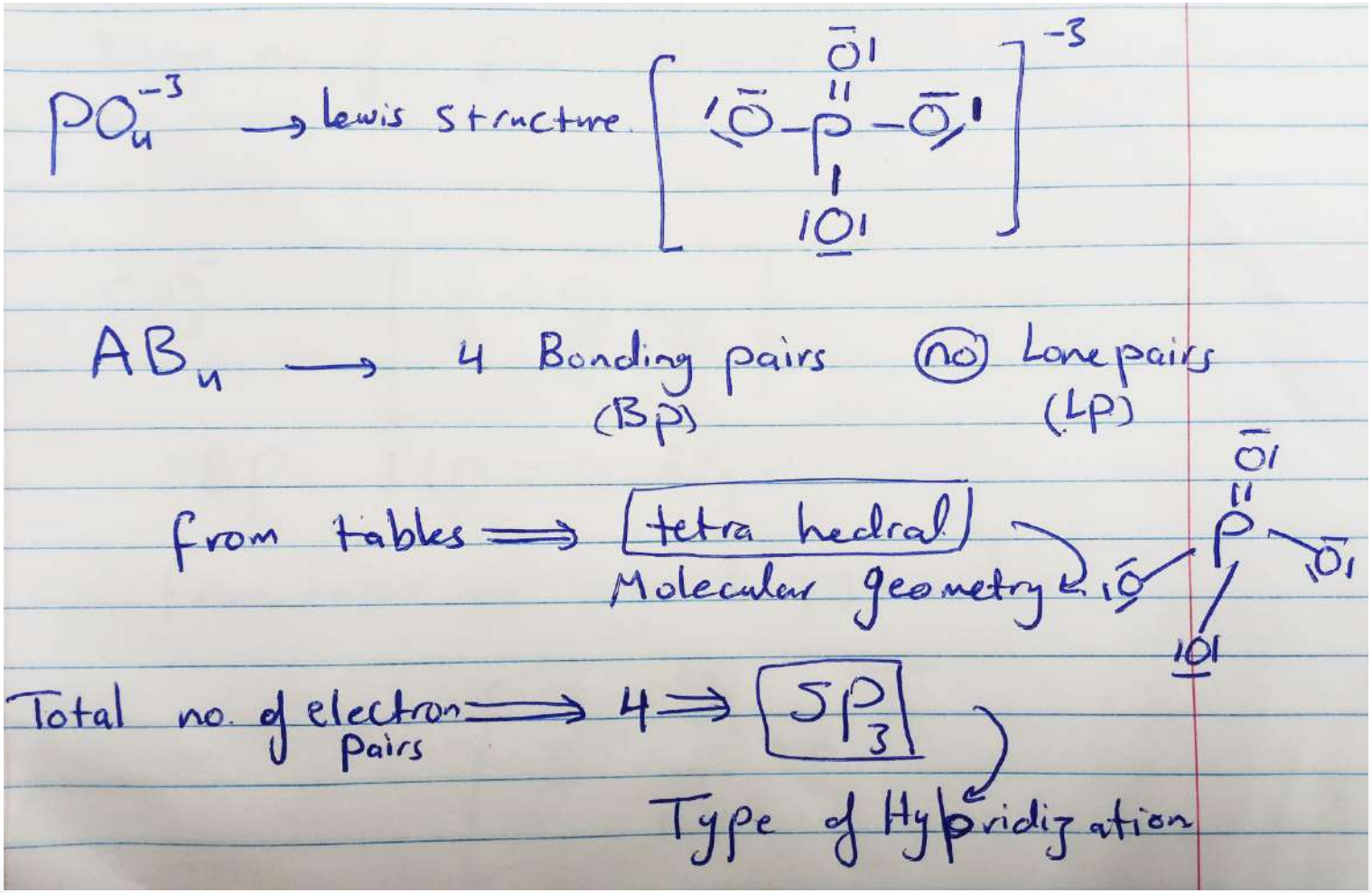
1. Draw the Lewis structure of the molecule.

2. Predict the overall arrangement of the electron pairs (both bonding pairs and lone pairs) using the VSEPR model.

3. Write the symbol of the molecule as ABxEy, then from the tables, determine the molecular geometry .

4. Deduce the hybridization of the central atom taken into account that the total number of electron pairs equals pure atomic orbitals that participate in the hybridization process. Then, you can choose the type of hybridization from the table related to this subject.

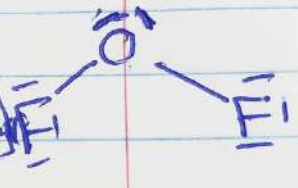
Q1)Show molecular geometry and hybridization in the following molecules



OF_2 ⟶ lewis structure

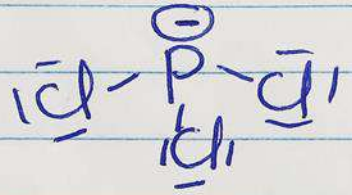
2 BP 2 LP ⟹ AB_2E_2

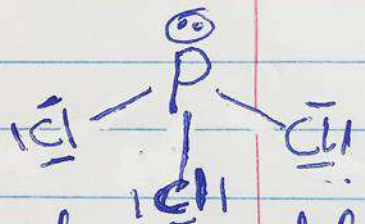
from tables ⟹ Bent or angular



Total no. of electron pairs ⟹ 4 ⟹ sp_3 hybridization

PCl_3





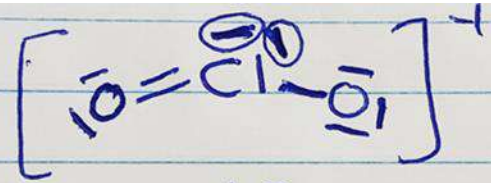
3BP 1 LP ⟹ AB_3E ⟹ Trigonal pyramidal

Total no of e⁻ pairs ⟹ 4 ⟹ sp_3 hybridization

HCN $H-C\equiv\bar{N}$

2 BP 0 LP ⟹ AB_2 ⟹ linear

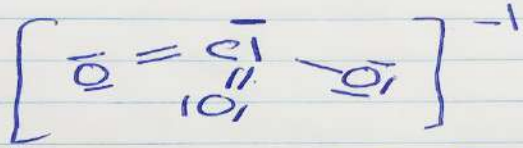
Total no. of electrons = 2 ⟶ sp hybridization

ClO_2^- 

2 BP 2 LP $\Longrightarrow$ AB_2E_2

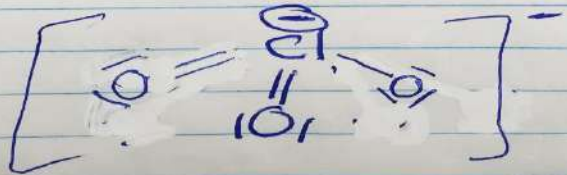
from tables $\Longrightarrow$ **bent or angular**

Total no. of e⁻ pairs = 4 $\Longrightarrow$ sp^3 hybridization

ClO_3^- 

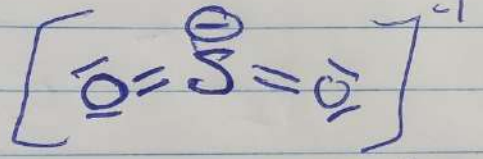
3 BP 1 LP $\Longrightarrow$ AB_3E

from tables $\Longrightarrow$ Trigonal pyramidal

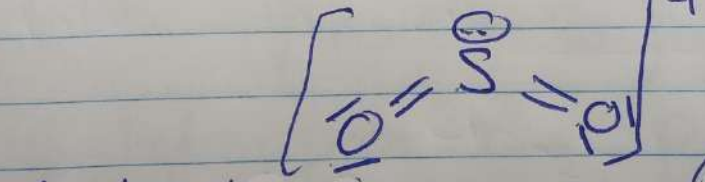


Total no. of e⁻ pairs = 4 $\Longrightarrow$ sp^3 hybridization

SO_2

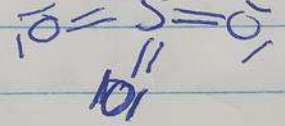


2 BP + 1 LP $\Rightarrow$ AB_2E $\Rightarrow$ bent or angular.

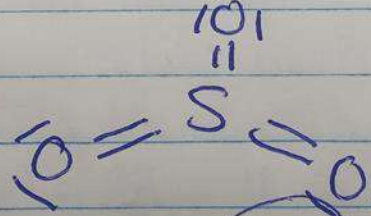


Total no. of electron pairs = 3 $\rightarrow$ sp_2 hybridization

SO_3

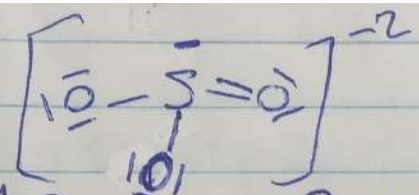


3 BP No lone pairs $\Rightarrow$ AB_3 $\rightarrow$ Trigonal planar

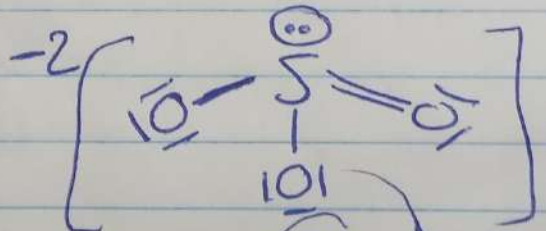


Total no. of e⁻ pairs = 3 $\Rightarrow$ sp_2 hybridization

SO_3^{-2}

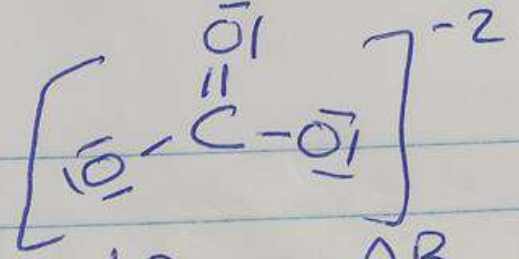


3 BP 1 LP $\Rightarrow$ AB_3E $\Rightarrow$ Trigonal pyramidal

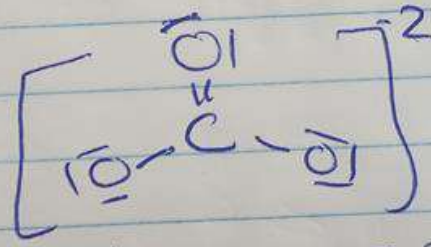


Total no of e^- pairs = 4 $\Rightarrow$ sp_3 hybridization

CO_3^{-2}

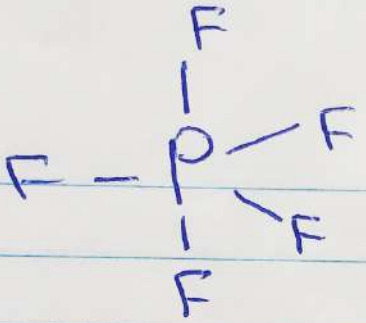


3 Bp 0 LP $\Rightarrow$ AB_3 $\Rightarrow$ Trigonal planar



Total no. of electron pairs = 3 $\Rightarrow$ sp_2 hybridization

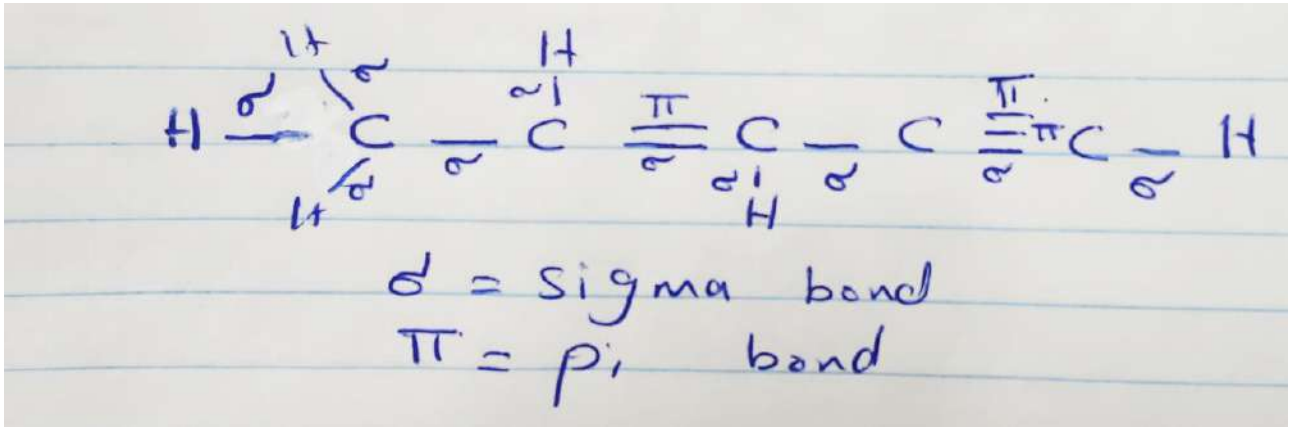
PF_5



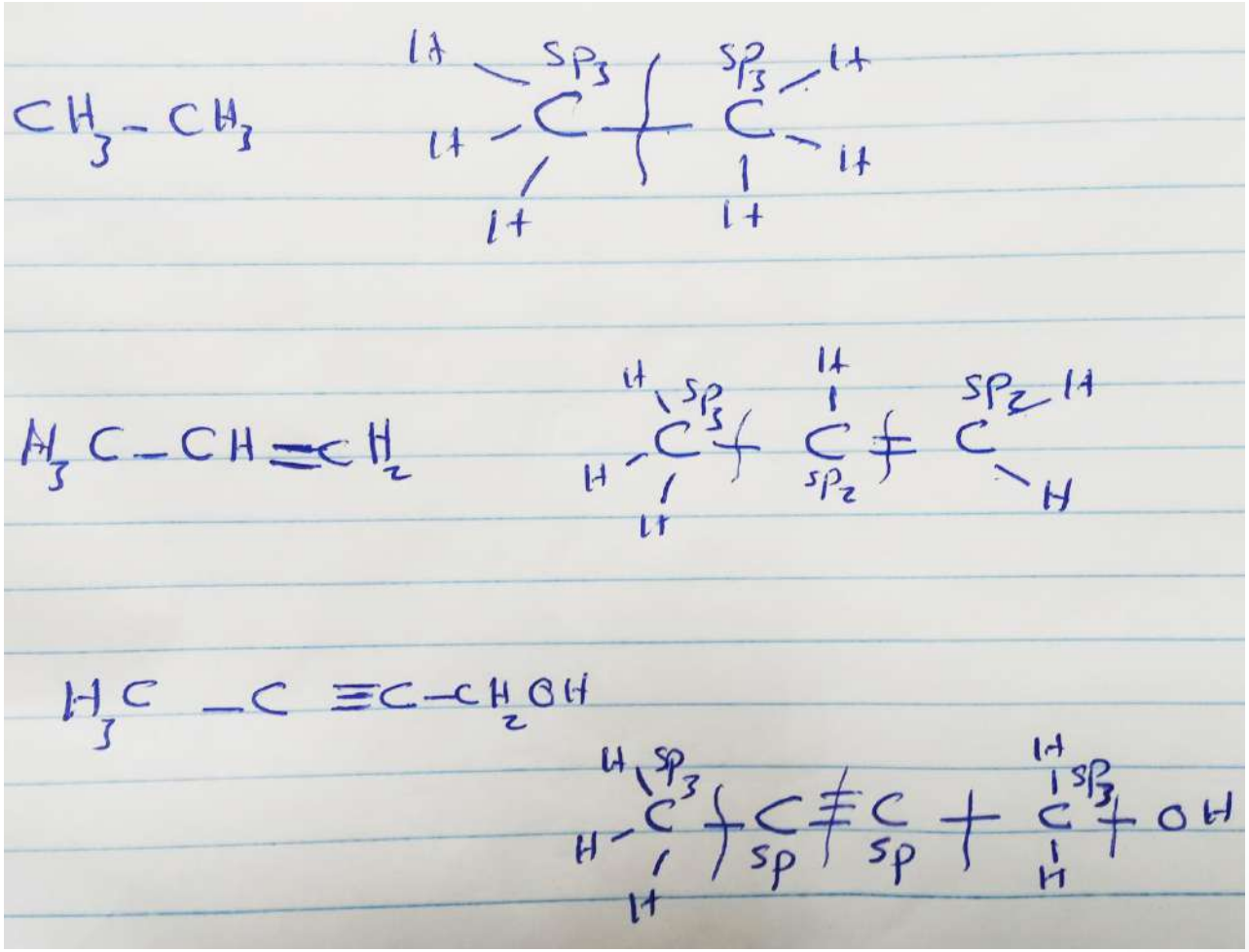
5 Bonding pairs → AB_5 → Trigonal Bipyramidal

Total no. of e^- pairs = 5 → sp^3d hybridization

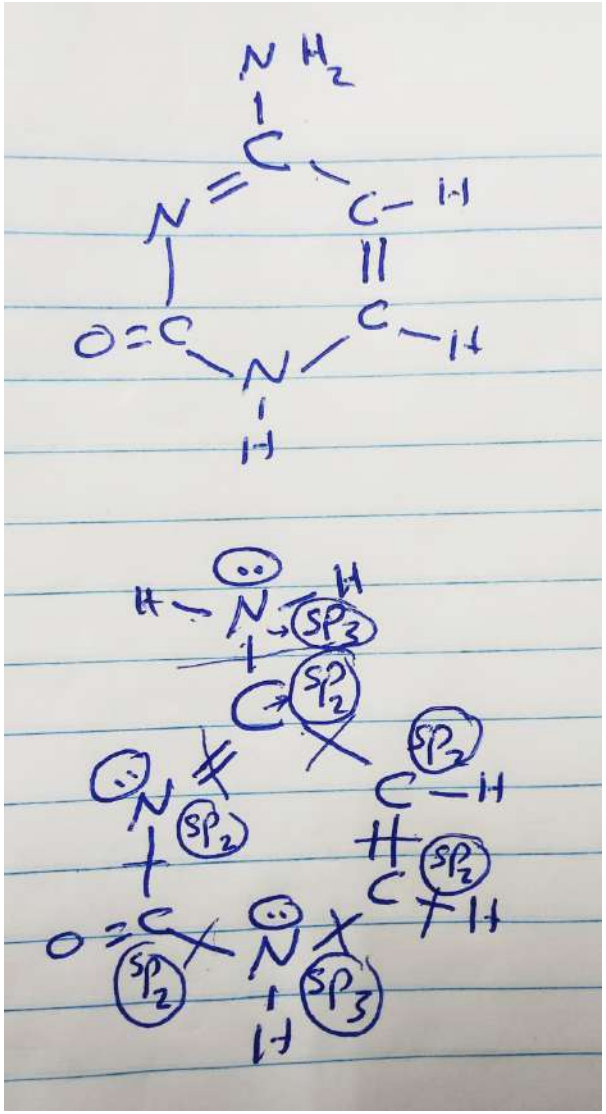
Q2) Show sigma bonds and pi bonds in the following

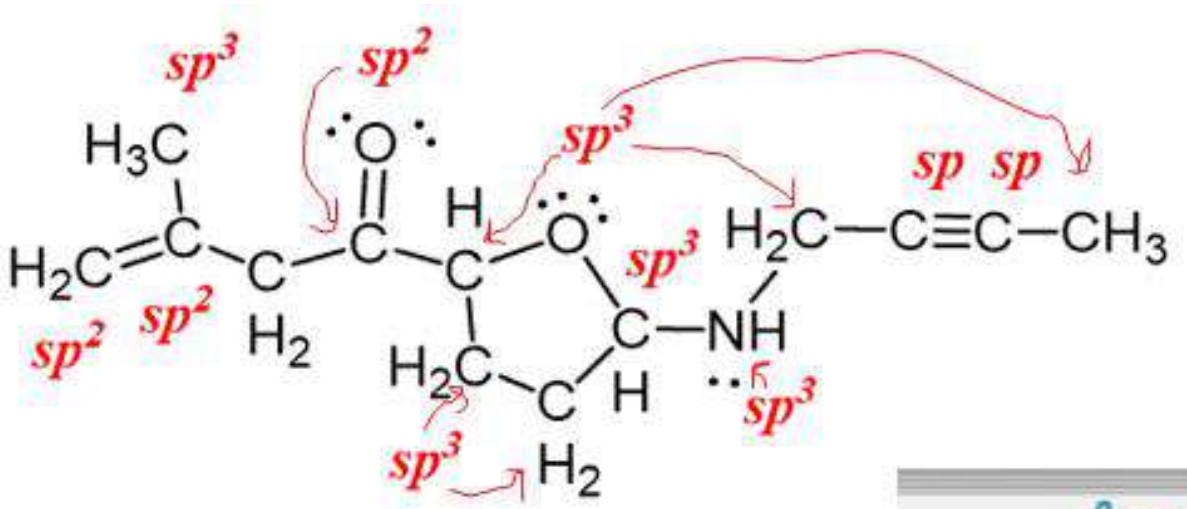


Q3) show the type of hybridization for each carbon atom



Q4) show the type of hybridization for each central atom

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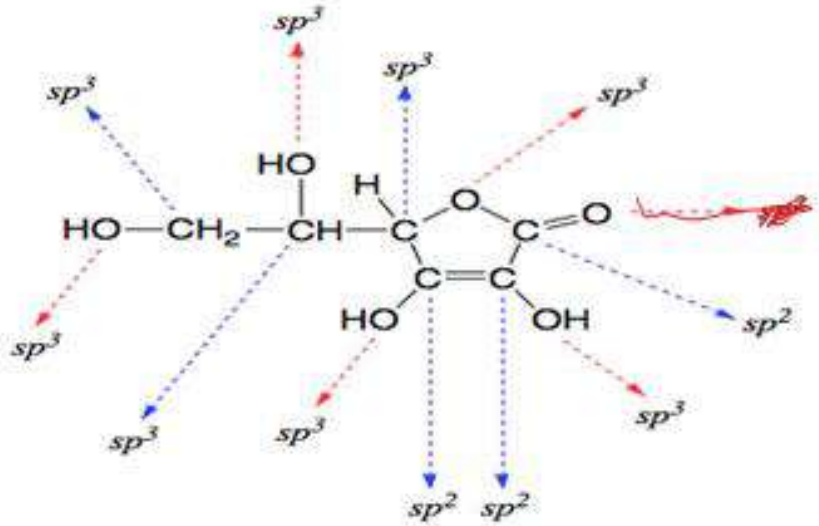
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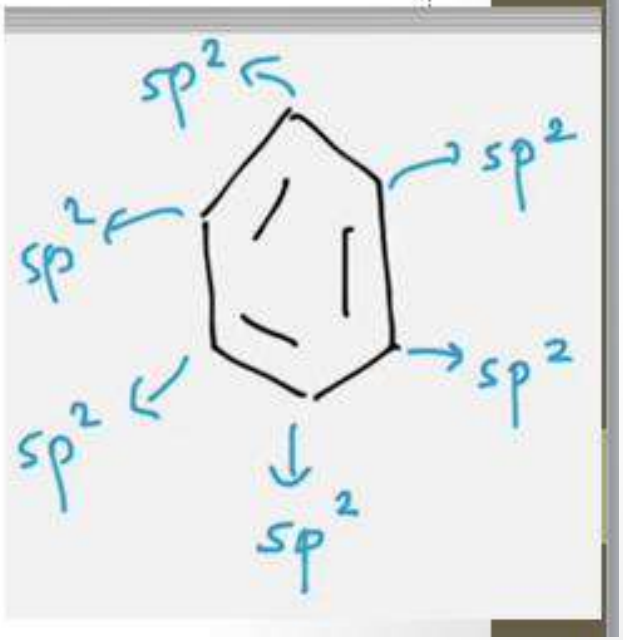
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TABLE 10.2 Geometry of Simple Molecules and Ions in Which the Central Atom Has One or More Lone Pairs

Class of molecule	Total number of electron pairs	Number of bonding pairs	Number of lone pairs	Arrangement of electron pairs*	Geometry	Examples
AB_2E	3	2	1	Trigonal planar	Bent	SO_2
AB_3E	4	3	1	Tetrahedral	Trigonal pyramidal	NH_3
AB_2E_2	4	2	2	Tetrahedral	Bent	H_2O
AB_4E	5	4	1	Trigonal bipyramidal	Distorted tetrahedron (or seesaw)	SF_4
AB_3E_2	5	3	2	Trigonal bipyramidal	T-shaped	ClF_3
AB_2E_3	5	2	3	Trigonal bipyramidal	Linear	I_3^-
AB_5E	6	5	1	Octahedral	Square pyramidal	BrF_5
AB_4E_2	6	4	2	Octahedral	Square planar	XeF_4

*The colored lines are used to show the overall shapes, not bonds.

مع خالص تمنياتي لكم بالتوفيق
و النجاح