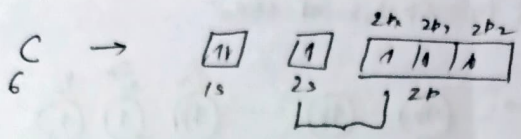
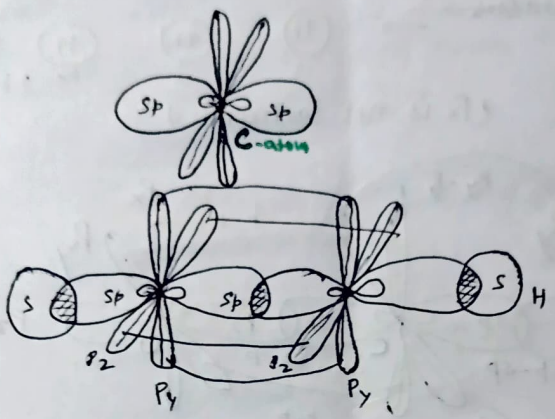
(i) C_2H_2 (H−C≡C−H). The Carbon is the central atom and it is in sp hybrid state



sp hybridised state

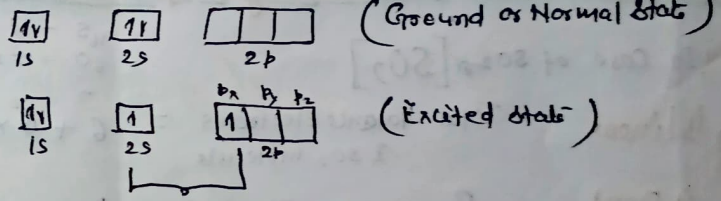
In One Carbon atom, there are two sp hybrid orbitals and two p_y & p_z Orbitals are perpendicular to hybridised Orbital.



$H_1 - 1s^1 \rightarrow$ (1s)$_H$

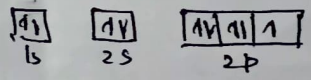
(ii) BeF_2 :- The central atom Be is in sp hybrid state in BeF_2

$_4Be \rightarrow 1s^2 2s^2$

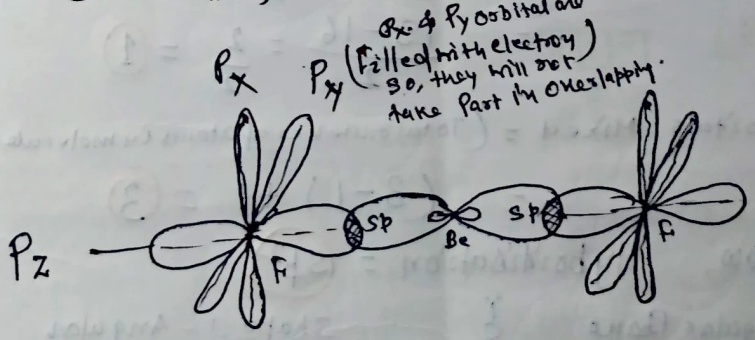


sp hybridization

$_9F \rightarrow 1s^2 2s^2 p^5 \longrightarrow$

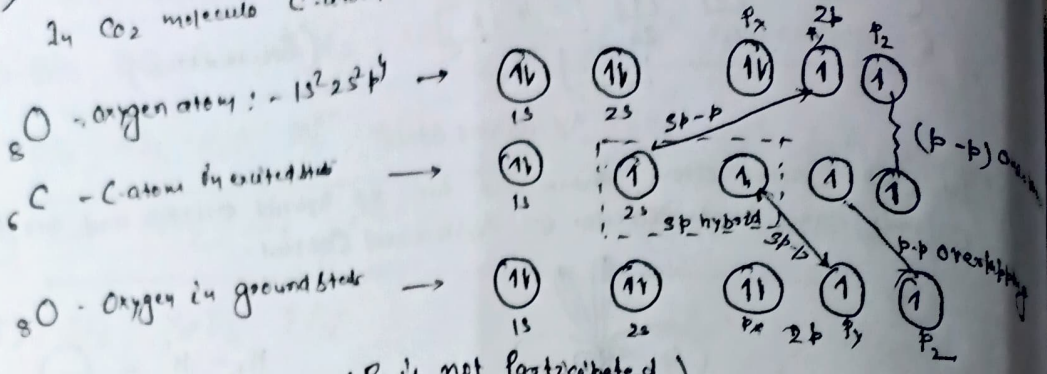


In BeF_2 molecule Two sp hybride orbitals of Be and One unpa Orbital p_z of Flourine takes part in Overlapping.

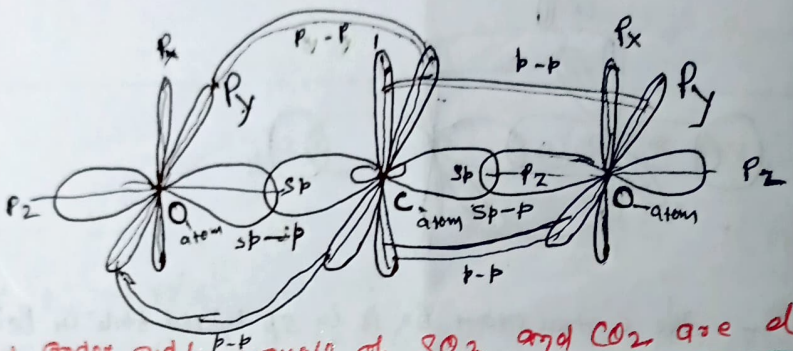


iii) CO_2 molecule :- O=C=O

In CO_2 molecule C-atoms is in sp hybrid state



(Px is not participated)



Why Bond Order and bond angle of SO_2 and CO_2 are different.

or

Explain in case of SO_2 or $[SO_2]$

$_{16}S \rightarrow 1s^2 2s^2 p^6 3s^2 p^4$ i.e 2,8,6

$_8O \rightarrow 1s^2 2s^2 p^4$ i.e, 2,6

CO_2 is Linear

$\Rightarrow$

SO_2 is Bent

Total Valence electrons in SO_2 molecule $= 6 + 6 \times 2 = 6 + 12 = 18$

Bonding Electrons $= (\text{Total Number of atom in molecule} - 1) \times 8$

$= (3-1) \times 8 = 16$

Multiplied by 8 because each atom has 8 electrons

$$\text{Lone Pair} = \frac{\text{Valence Electron} - \text{Bonding Electrons}}{2}$$

$$= \frac{18-16}{2} = \frac{2}{2} = 1$$

Total Orbitals Mixed = (Total number of atoms in molecule -1) + Lone pair

$= (3-1) + 1 = 3$

Now, Hybridisation = sp^2

Structure - Triangular Plane

Shape :- Angular

In Case of CO_2

Total Valence Electron $= 4 + 6 \times 2 = 16$

Bonding Electrons $= (3-1) \times 8 = 16$

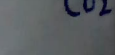
Lone Pair $= \frac{16-16}{2} = 0$

Total Orbital mixed $= (3-1) + 0 = 2$

Hybridisation = sp

Structure $\rightarrow$ Linear

Shape $\rightarrow$ Linear



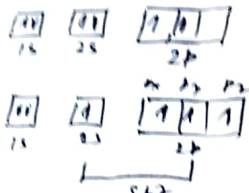
CO_2 has

Examples of sp^2 Hybridisation.

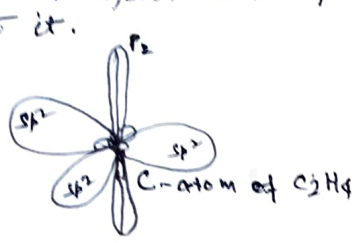
i) C_2H_4 Ethylene molecule :

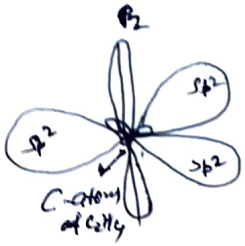
In Ethylene molecule the Central atom Carbon is in sp^2 hybrid state

$_6C \rightarrow 1s^2 2s^2 2p^2$



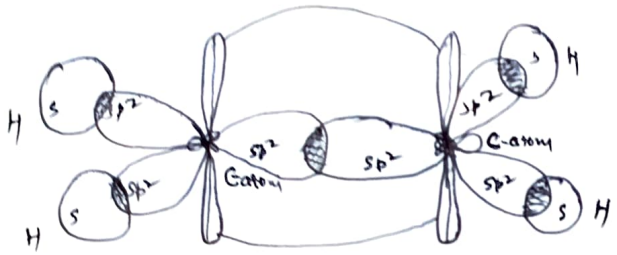
One 2s orbital and two 2p orbital takes part in hybridisation and forms three three sp^2 hybrid orbital of Carbon and p_z orbital is laying perpendicular to it.





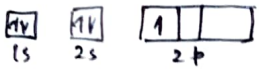
$_1H \rightarrow 1s^1 \rightarrow$  [Four H atom having S orbital takes part in overlapping

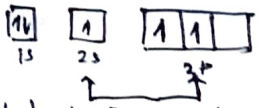
After overlapping



ii) BH_3 Molecule

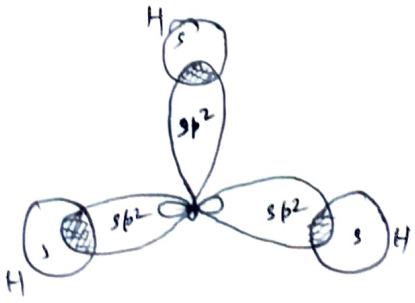
$_1H \rightarrow 1s^1 \rightarrow$

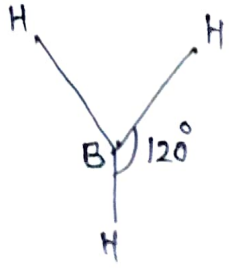
$_5B \rightarrow 1s^2 2s^2 2p^1 \rightarrow$  (Normal State)

 (Excited State)

One 2S and two 2p Orbital of Boron takes part in hybridisation and forms three sp^2 hybrid Orbital.

The three sp^2 hybrid orbitals Overlapp with S-orbital of H-





Shape. Triangular.

iii) BF_3 Molecule :-

$_9F \longrightarrow 1s^2 2s^2 2p^5$ → [↑↓] 1s [↑↓] 2s [↑↓ | ↑ | ↑] 2p

$_5B - 1s^2 2s^2 2p^1$ → [↑↓] 1s [↑↓] 2s [↑ | |] 2p

[↑↓] 1s [↑] 2s [↑ | ↑ |] 2p (Excited state)

sp^2

Boron atom is in sp^2 hybrid state one 2s and two 2p orbitals hybrid together and forms three sp^2 hybrid orbitals.

iv) $SnCl_2$ Molecule :—

$_{50}Sn$ — $4d^{10}\ 5s^2 5p^2$ or — $5s^2\ p_x^1\ p_y^1$

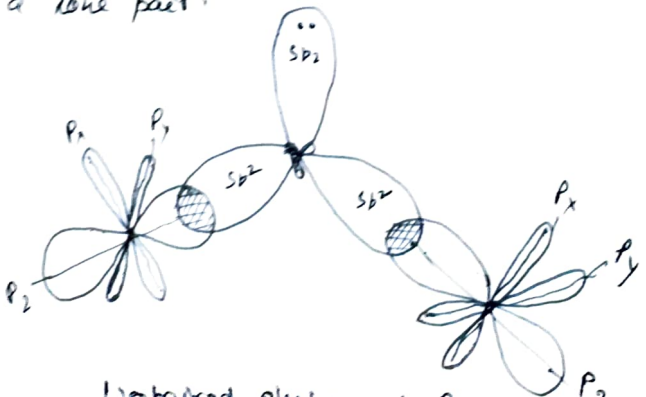
$_{17}Cl$ — $[Ne]3s^2 3p^5$ → $3s^2\ 3p_x^2\ 3p_y^2\ 3p_z^1$ [↑↓] 3s [↑↓ | ↑ | ↑] 3p

In $SnCl_2$ Sn exhibit sp^2 hybridization

Sn → [↑↓] 5s [↑ | ↑ |] $5p_x\ 5p_y\ 5p_z$

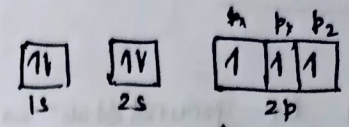
[↑↓] 5s [↑ | ↑ |] $5p_x\ 5p_y\ 5p_z$

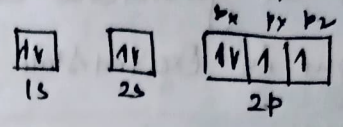
One 5S orbital and two 5p orbital hybrid together and gives three sp^2 hybrid orbitals in which two are unpaired and one has a lone pair.

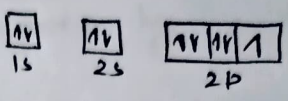


Unpaired electron of p_z orbital of Chlorine takes part

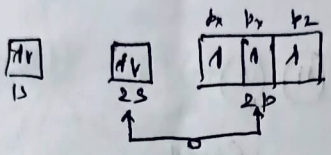
NO_3^- ion:- In NO_3^- ion Central atom N involves in sp^2 hybridisation

$_7N \rightarrow 1s^2\ 2s^2\ 2p^3 \rightarrow$ 

$_8O \rightarrow 1s^2\ 2s^2\ 2p^4 \rightarrow$ 

$_9O^- - 1s^2\ 2s^2\ 2p^5 \rightarrow$ 

$$NO_3^- \rightarrow NO_2 + O^-$$

$_7N \longrightarrow$ 

In N atom one 2s and two 2p orbital hybrid to form three orbital.