

Hybridisation

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The process of formation of equal number of equivalent orbitals by intermingling of different orbitals of the same atom is known as hybridisation and equivalent orbitals are known as hybrid orbitals. e.g. -

Pure orbitals

$s + p$

$s + p + p$

$s + p + p + p$

$s + p + p + p + d$

$s + p + p + p + d + d$

$s + p + p + p + d + d + d$

hybrid orbitals

two sp hybrid orbitals

three sp^2 " "

four sp^3 " "

five sp^3d " "

six sp^3d^2 " "

seven sp^3d^3 " "

Predicting hybridisation formula -

$$\text{Hybridisation (H)} = \frac{1}{2} \left[\begin{array}{l} \text{no. of valence electrons} \\ \text{in valence shell of atom} \end{array} + \begin{array}{l} \text{no. of monovalent atoms} \\ \text{surrounding the atom} \end{array} - \begin{array}{l} \text{charge on cation} \\ + \text{charge on anion} \end{array} \right]$$

Q Predict ~~the~~ hybridisation of given molecules & ions -

CH_4 : $H = \frac{1}{2} [4 + 4 - 0 + 0] = \frac{8}{2} = 4$, sp^3 (Tetrahedral)

BF_3 : $H = \frac{1}{2} [3 + 3 - 0 + 0] = \frac{6}{2} = 3$, sp^2 (Planar)

NH_3 : $H = \frac{1}{2} [5 + 3 - 0 + 0] = \frac{8}{2} = 4$, sp^3 (Tetrahedral)

NH_4^+ : $H = \frac{1}{2} [5 + 4 - 1 + 0] = \frac{8}{2} = 4$, sp^3 (Tetrahedral)

NO_3^- : $H = \frac{1}{2} [5 + 0 - 0 + 1] = \frac{6}{2} = 3$, sp^2 (Planar)

(1) sp hybridisation - when one s and one p orbitals intermix together, two sp hybrid orbitals are formed and the process itself is known as sp hybridisation.

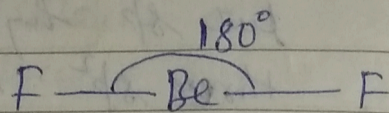
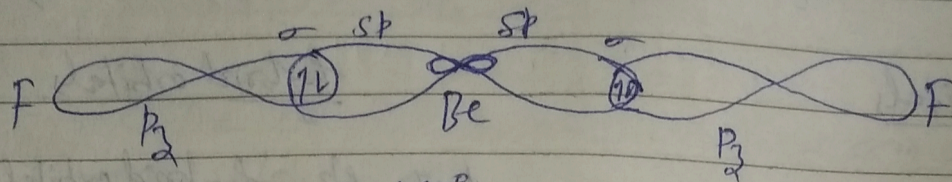
e.g. BeF_2

$\text{Be}(4) \quad 1s^2, 2s^2$

Ground state $\boxed{1\downarrow} \quad \boxed{2s} \quad \boxed{2p}$

Excited state $\boxed{1\uparrow} \quad \boxed{\uparrow} \quad \boxed{} \quad \boxed{}$

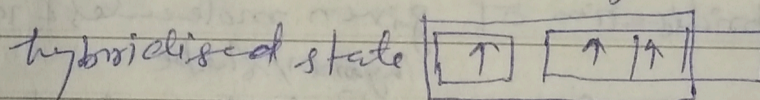
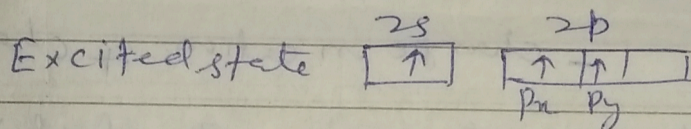
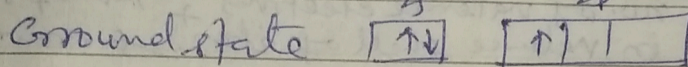
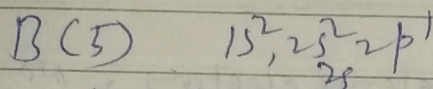
Hybridised state $\boxed{\uparrow} \boxed{\uparrow} \boxed{}$
 $2sp$ -hybrid orbitals



Bond angle $- 180^\circ$
 shape & structure - Linear
 hybridisation - sp

(ii) sp^2 hybridisation — when one s and two p orbitals intermix together, three sp^2 hybrid orbitals are formed and the process itself is known as sp^2 hybridisation.

e.g. -



$3sp^2$ -hybrid orbitals

