

Structure of carbenes

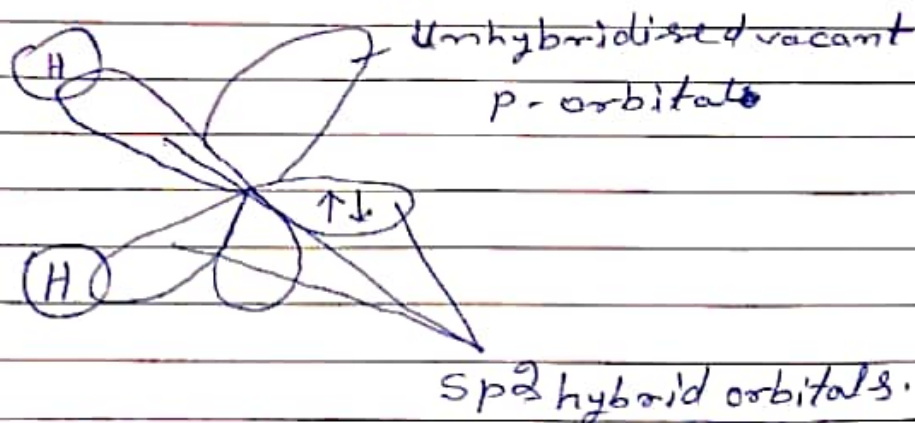
A carbene is similar to a carbocation, and it lacks electrons. It has only six electrons per carbon atom. It is a strong electrophile and exists as singlet and triplet.

1) Singlet carbene $\Rightarrow$ It has sp^2 -hybridised carbon atom. Among the three sp^2 hybrid orbitals, form two σ -bonds with two monovalent atoms or groups, while the remaining sp^2 hybrid orbital contains two non-bonding electrons with opposite spin. The unhybridised p -atomic orbital remains empty. Thus, singlet carbene has bent structure, for Example $\Rightarrow$ Methylene singlet carbene ($\uparrow\downarrow CH_2$) has a bent or V-shaped angular structure with 103° H-C-H bond angle and 1.12 Å C-H bond length. Stability of singlet carbene is lower due to greater lone pair and bond pair electron repulsion.

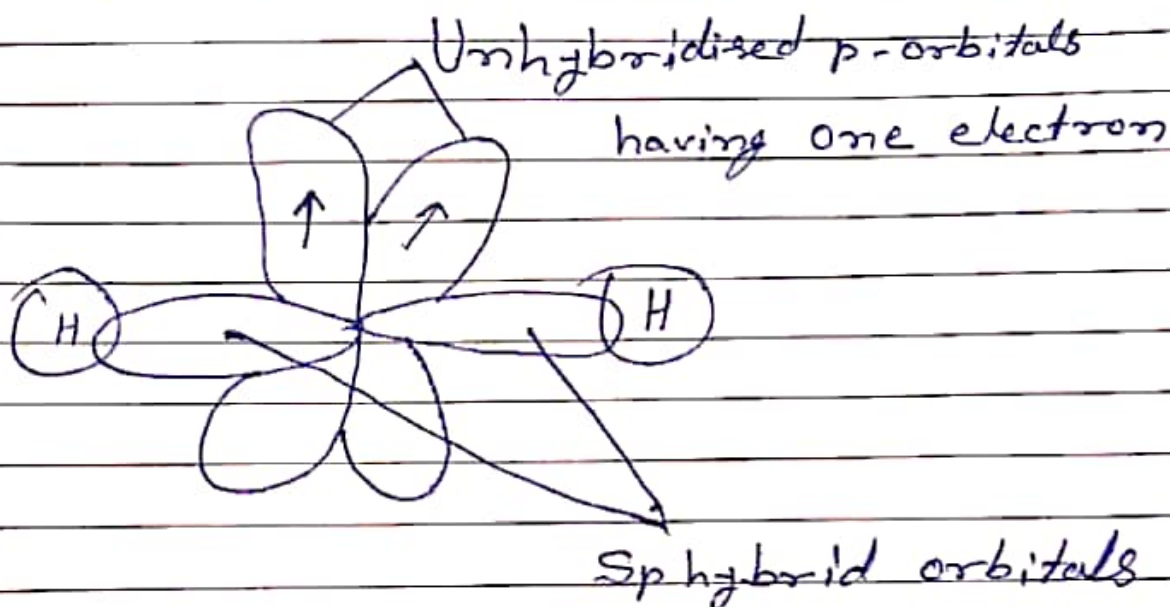
Triplet carbene $\Rightarrow$ This type of carbene has sp -hybridised carbon atom. The two sp -hybrid orbitals form two σ -bonds with two monovalent atoms or groups, while the two unhybridised p -atomic orbitals (perpendicular to each other) has one electron each.

Teacher's Signature _____

Thus, triplet carbene has a linear structure for example - Methylene triplet carbene has a linear structure with 180° H-C-H bond angle and $1.02 \text{ \AA}$ C-H bond length.



$\uparrow \downarrow \text{CH}_2$ Singlet carbene



$\uparrow \downarrow \text{CH}_2$ Triplet carbene

Teacher's Signature _____