

**DPP-5****(Solution)**

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- Singlet carbene is more stable for  $\text{CCl}_2$ .

**Carbenes**

Any electron-deficient neutral molecules that are formed as an intermediate is known as carbenes.

This carbene ( $\text{CH}_2$ ) exists in two forms;

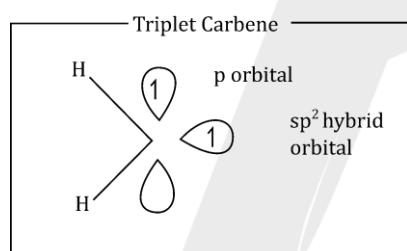
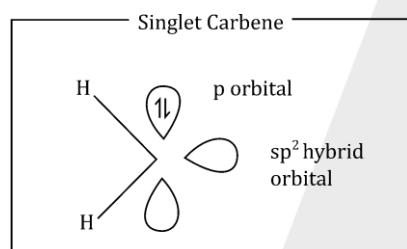
1. Triplet carbene

2. Singlet carbene

In triplet carbene, p orbitals are singlet occupied.

In the case of singlet carbene, p orbital is doubly occupied.

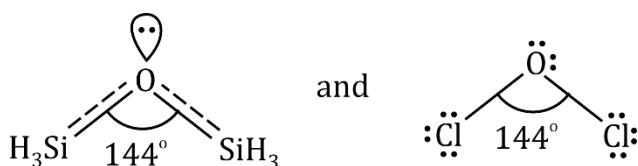
The structure of the triplet and singlet carbene are:



The bond angle in case of triplet carbene is 125-140 degree and the bond angle in case of singlet carbene is 102 degree.

2.  $\text{OCl}_2$  molecule has a trigonal planar geometry with a bond angle of  $120^\circ$ .

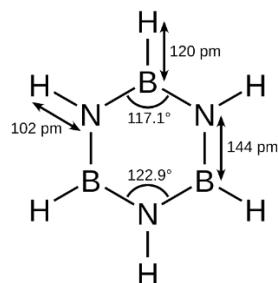
The bond angle in  $\text{SCl}_2$  is approximately 103 degrees.





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3.



4. Boraxine can show back bonding. Due to the significant difference in electronegativity between the boron and nitrogen atoms, borazine is a strongly polar compound.  
Borazine contains  $p\pi - d\pi$  back bond.

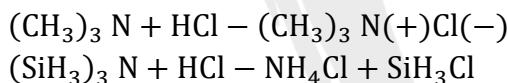
Due to its similarities to benzene, there have been a number of computational and experimental analyses of borazine's aromaticity. The number of pi electrons in borazine obeys the  $4n + 2$  rule, and the B-N bond lengths are equal

In  $B_3N_3H_6$  compound, the correct option is '3'  $p\pi - p\pi$  bond is present. It can show back bonding.

Due to the significant difference in electronegativity between the boron and nitrogen atoms, borazine is a strongly polar compound.  $B_3N_3H_6$  is non-polar with polar bonds. It has lumpy modes at nitrogen atom.

Here, first two statements are correct while other two are incorrect. Hence, option A is correct.

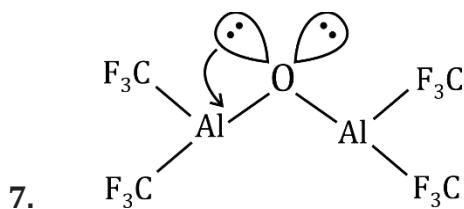
5. As the hybridisation of  $(CH_3)_3N$  is  $sp^3$ , the I.p of the N atom exist in  $sp^3$  hybrid orbital. So the I.p is more reactive... So in reaction with HCl it can form adduct, by donating its I.p. But for  $(SiH_3)_3N$  the hybridisation is  $sp^2$ . And the I.p situates in p orbital... And in reaction with HCl it produces  $NH_4Cl$  and  $SiH_3Cl$ .



6. Back bonding is a type of weaker  $\pi$  bond which is formed by sideways overlapping of filled orbital with empty orbital present on adjacent bonded atoms in a molecule. It is also considered as intermolecular Lewis acid-base interaction as it is a  $\pi$  bond.  
In case of back bonding which normally involves donation of excess electrons on transition metal ions (mainly from its  $d\pi(yz&zx)$  orbitals) to vacant  $\pi$  orbitals of ligands (again  $p\pi/d\pi$  type) to have sideways overlap forming  $\pi$  bonds.  
When the back bonding is effective, the lack of electrons is balanced and the lewis acid character decreases. Due to this, acid strength decreases down the halogen group. Back bonding is effective only when the size of the valence shell matches.



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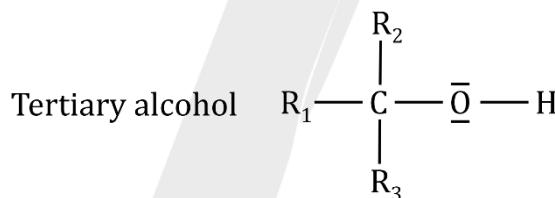
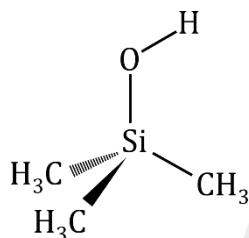


Vacant p - orbital is present in Al  $\therefore$  lone pair of oxygen participates in back - bonding, resulting in  $sp^2$  hybridisation of O. Hence bond angle is nearly  $120^\circ$ .

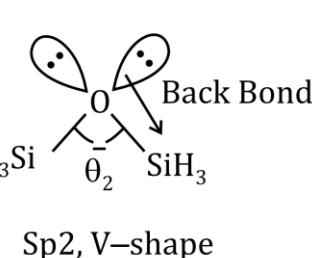
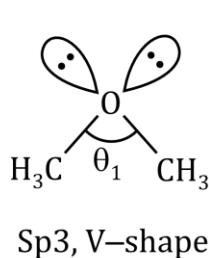
8. in Silyl isocyanate, the lone pair of N is forming back bond with the vacant d orbital of Si i.e.  $d\pi - p\pi$  back bonding and its shape becomes linear.

$N(SiH_3)_3$  and  $(GeH_3)_3 N$  is planar because in  $N(SiH_3)_3$  lone-pair on N-atom is transferred to the empty d – orbitals of silicon ( $p\pi - d\pi$  overlapping)

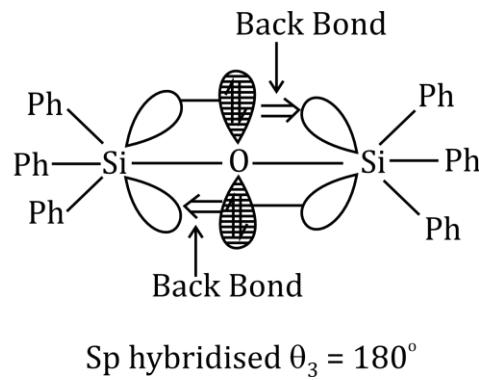
As from structure it can be seen that  $\angle CNC$  and  $\angle HNN$  in  $\angle CH_3NCS_N$  and  $HN_3$  respectively are greater than  $120^\circ$  and less than  $120^\circ$



9. In  $(Ph)_3Si-O-Si(Ph)_3$  compounds Si – O – Si bond angle is Approx 180 due to back bonding and hybridisation is  $sp$ .



$$\theta_1 < \theta_2 < \theta_3$$



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10. Back bonding in  $\text{OCl}_2$  occurs from the centre atom to the surrounding atom. The fact that chlorine already contains a lone pair of electrons prevents the p pi-d pi back bonding from being possible in the  $\text{OCl}_2$  molecule.

Back bonding in  $\text{NCl}_3$

However, the free orbital of chlorine is not empty, but it is occupied by an electron pair donated by nitrogen. Thus, the free orbital of chlorine cannot participate in back bonding. Therefore, back bonding is not present in  $\text{NCl}_3$ .

Yes back bonding occurs in  $\text{PF}_3$ , (it is one of the most common examples) as Phosphorus has vacant d-orbitals and each fluorine has 3 lone-pairs of electron.

In CO it is  $\text{p}\pi - \text{p}\pi$ .