
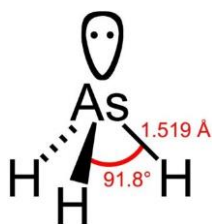


DPP-4  
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1.

The above rule is based upon the relation between hybridisation and bond angle for two or more equivalent  $s - p$  hybrid orbitals, where the fraction of  $s$  character ( $S$ ) or fraction of  $p$  character ( $P$ ) is given by the relationship:

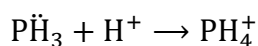
$$\cos \theta = \frac{S}{S-1} = \frac{P-1}{P}$$

2. The %  $s$ -character in one  $Sb-H$  bond in  $SbH_3$  is 1.0%.

3. Due to lone pair of fluorine there will be more steric repulsion and bond angle will increase which leads to decrease in the bond angle. So, correct option is B.

4. The hybrid orbitals thus formed by the mixing of atomic orbitals are more stable and have less energy than the atomic orbitals. the excess amount of energy is released in the stabilization of hybrid orbitals and is used in the excitation of one electron from low energy  $2s$  orbital to high energy  $2p_z$  orbital.Energy released is less than  $600 \text{ kJ mol}^{-1}$ 5. ...according to this theory, the position of the lone pair in  $XeF_6$  molecule should be in axial position and the shape should be pentagonal pyramidal. But this is not observed and the actual shape of molecule is octahedral. This implies that the lone pair is placed at equatorial position, and this explains the structure of  $XeF_6$  shown in figures 3 · 7a, b, c.

According to Figure 3.7,  $\mu_{\text{expected}}$  for  $XeF_6$  is not equal to zero. But  $\mu_{\text{real}}(XeF_6) \sim 0$ . To explain the above facts, it is considered that the actual molecule is in dynamic equilibrium of all the three structures shown in Figure 3.7. Here it is considered that the lone pair is present in the stereochemically active  $s$  orbital and similar structure is observed as  $IF_6^-$ . But anions like  $[SbX_6]^{3-}$ ,  $[TeX_6]^{2-}$  ( $X = Cl, Br, I$ ),  $[BrF_6]^-$ ,  $[ICl_6]^-$  have been assigned perfectly octahedral structure on the basis of X-ray crystallography and the lone pair is present in stereochemically inactive  $s$  orbital.

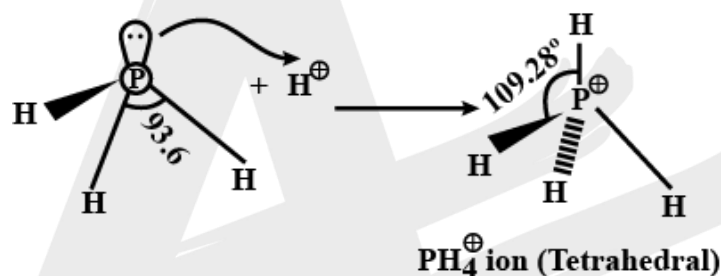
6.  $PH_3$  is very less polar compound and cannot form hydrogen bond with water. Therefore, it is not much soluble in water and escapes as gas, forming bubbles.

According to Drago's rule lone pair on phosphorous resides in almost pure  $s$  orbital, hence due to non-directional nature, its overlapping tendency is greatly reduced in comparison to a lone pair present in hybrid orbital, which is directional as present in  $NH_3$

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Thus,  $\text{NH}_3$  is a stronger Lewis base than  $\text{PH}_3$ . Consequently, the tendency of  $\text{NH}_3$  to form a complex by donating an electron pair to the metal ion is much higher than that of  $\text{PH}_3$ . Hence,  $\text{NH}_3$  is a better complexing agent than  $\text{PH}_3$ .

7. The larger angles can simply be explained as a result of repulsion between the larger atoms of Br and Cl. Hydrogen atoms in  $\text{PH}_3$ , as they are so small, experience less repulsion as compared to Br atoms in  $\text{PBr}_3$  or Cl atoms in  $\text{PCl}_3$ , therefore the larger bond angles in  $\text{PBr}_3$  and  $\text{PCl}_3$ .  $\text{PH}_3$  (Phosphine) is a hydride of phosphorous. Phosphine is a gas and has pyramidal structure. Phosphorous involved  $\text{sp}_3$  hybridized. Both  $\text{PH}_4^+$  and  $\text{PH}_3$  have  $\text{sp}_3$  hybridisation state for phosphorous. In  $\text{PH}_4^+$ , all the four orbitals are bonded, whereas in  $\text{PH}_3$ , there is a lone pair of electrons on phosphorous. In  $\text{PH}_4^+$ , the H-P-H bond angle is tetrahedral angle of  $109.5^\circ$ . But in  $\text{PH}_3$ , lone pair-bond pair repulsion is more than bond pair-bond pair repulsion so, that bond angles become less than normal tetrahedral angle. The bond angle in  $\text{PH}_3$  is about  $93.6^\circ$ .

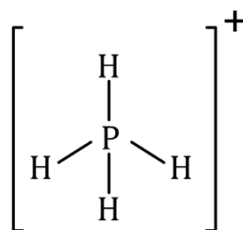
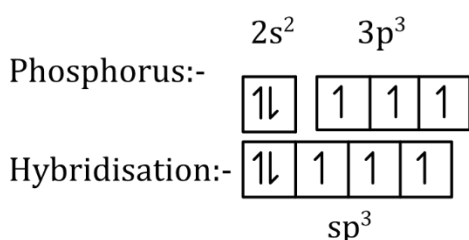
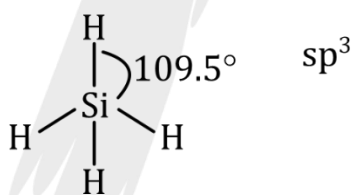


8. Due to more lone pairs on fluorine there will be greater repulsion causes greater angle.


4 bonding pair  $\rightarrow$  Tetrahedral

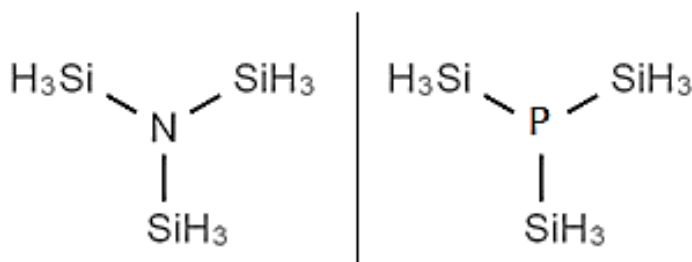


9.



10. N atom in  $\text{N}(\text{SiH}_3)_3$  and P in  $\text{P}(\text{SiH}_3)_3$  are both  $\text{sp}^2$  hybridised. It has lone pair of electron ( $2p$  orbital in the case of N and  $3p$  orbital in the case of P) which is forming a bond with d orbital of Si atom forming  $d\pi - p\pi$  bonding. So it has planar structure. The structure is

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In forming  $P_4$  molecule, P atom uses  $sp^3$  hybrid orbitals. Thus, p-character in hybrid orbitals is 75%. S character is 25%

$sp^3$

Hybridization: The central atom in  $GeH_4$  is germanium (Ge). It has 4 valence electrons and forms 4 sigma bonds with 4 hydrogen atoms. Therefore, the hybridization of the central atom in  $GeH_4$  is  $sp^3$ .

There are three bonded atoms and one lone pair on the central P atom. Thus, the steric number of P in  $P_3$  is  $3 + 1 = 4$ . We conclude that P must be  $sp^3$  – hybridized. One of the  $sp^3$  hybrid orbitals is used to accommodate the lone pair on P while the other three  $sp^3$  hybrid orbitals from covalent P – F bonds with the  $2p$  orbitals of F. We predict the shape of the molecule to be pyramidal and the

F – P – F bond angle should be somewhat less than  $109.5^\circ$ .