Question 21. Apart from tetrahedral geometry, another possible geometry for CH_4 is square planar with the four H atoms at the comers of the square and the C atom at its centre. Explain why CH_4 is not square planar?
Answer: According to VSEPR theory, if CH_4 were square planar, the bond angle would be 90°. For tetrahedral structure, the bond angle is 109°28′. Therefore, in square planar structure, repulsion between bond pairs would be more and thus the stability will be less.

Question 22. Explain why BeH_2 molecule has a zero dipole moment although the Be—H bonds are polar.
Answer:
BeH_2 is a linear molecular (H—Be—H), the bond angle = 180°.
Be—H bonds are polar due to difference in their electronegativity but the bond polarities cancel each other. Thus, molecule has resultant dipole moment of zero.

Question 23. Which out of NH_3 and NF_3 has higher dipole moment and why?
Answer:
In NH_3 and NF_3, the difference in electronegativity is nearly same but the dipole moment of NH_3 = (1.46D) For Example, NH_3 = (0.24D)
In NH3, the dipole moments of the three N—H bonds are in the same direction as the lone pair of electron. But in NF_3, the dipole moments of the three N—F bonds are in the direction opposite to that of the lone pair. Therefore, the resultant dipole moment in NH_3 is more than in NF_3.

Question 24. What is meant by hybridisation of atomic orbitals? Describe the shapes of sp, sp^2, sp^3 hybrid orbitals.
Answer:
Hybridisation: It is defined as the process of intermixing of atomic oribitals of slightly different energies to give rise to new hybridized orbitals having equivalent energy and identical shapes.
Shapes of Orbitals:
sp hybridisation: When one s-and one p-orbital, intermix then it is called sp-hybridisation. For example, in BeF2, Be atom undergoes sp-hybridisation. It has linear shape. Bond angle is 180°.
sp^2 hybridisation: One s-and two p-orbitals get hybridised to form three equivalent hybrid orbitals. The three hybrid orbitals directed towards three corners of an equilateral triangle. It is, therefore, known as trigonal hybridisation.
sp^3 hybridisation: One s-and three p-orbitals get hybridised to form four equivalent hybrid orbitals. These orbitals are directed towards the four corners of a regular tetrahedron.

Question 25. Describe the change in hybridisation (if any) of the Al atom in the following reaction. $AlCl_3 + Cl^-$ ------>$AlCl^{4-}$.
Answer: Electronic configuration of $_{13}Al$ =
$1s^2\ 2s^2\ 2p^6\ 3s^1\ 3p_x^1 3p_y^1$ (excited state)
Hence, hybridisation will be SP^2
In $AlCl^-_4$, the empty $3p_z$ orbital is also involved. So, the hybridisation

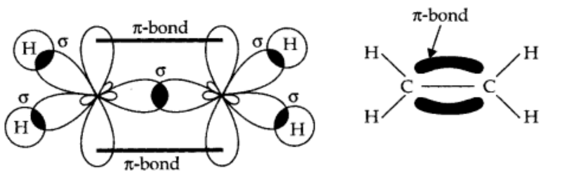
is sp^3 and the shape is tetrahedral.

Question 26. Is there any change in the hybridisation ofB and N atoms as a result of the following reaction ? $BF_3 + NH_3$ -------> $F_3 B.NH_3$

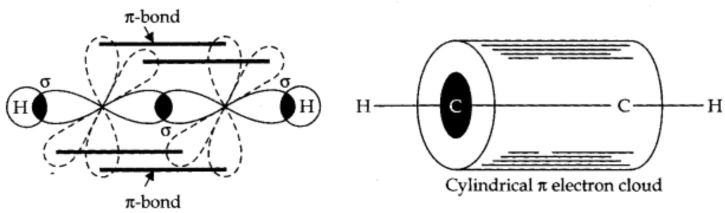
Answer: In BF_3, B atom is sp^2 hybridised. In NH_3, N is sp^3 hybridised. After the reaction, hybridisation of B changes from sp^2 to sp^3.

Question 27. Draw diagrams showing the formation of a double bond and a triple bond between carbon atoms in $C_2 H_4$ and $C_2 H_2$ molecules.

Answer:



Oribital picture of ethene molecule



Oribital picture of ethyne molecule

Question 28. What is the total number of sigma and pi bonds in the following molecules?

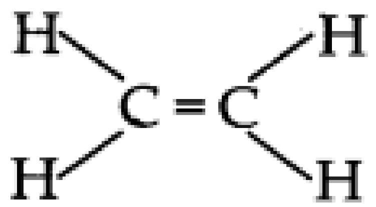
(a) $C_2 H_2$ (b) $C_2 H_4$

Answer:

(a) H—C = C—H

Sigma bond = 3 Π bonds = 2

(b)



Sigma bond = 5

π bonds = 1

Question 29. Considering X-axis as the intemuclear axis which out of the following will not form a sigma bond and why? (a) Is and Is (b) Is and $2p_x$ (c) $2p_y$ and $2p_y$ (d) Is and 2s

Answer: (c) It will not form a s-bond because taking x-axis as the intemuclear axis, there will be lateral overlap between the two $2p_y$ orbitals forming a Π -bond.

Question 30. Which hybrid orbitals are used by carbon atoms in the following molecules?

(a) CH_3-CH_3

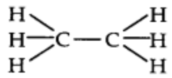
(b) CH_3-CH = CH_2

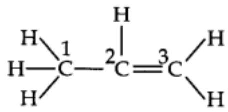
(c) CH_3-CH_2-OH

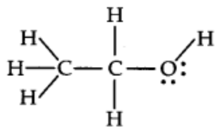
(d) CH_3-CHO

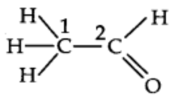
(e) CH_3COOH.

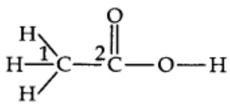
Answer:

(*a*)  Both C—atoms use sp^3 hybrid orbitals.

(*b*)  $C_1 = sp^3$, $C_2 = sp^2$, $C_3 = sp^2$

(*c*)  Both C—atoms use sp^3 hybrid orbitals.

(*d*)  $C_1 = sp^3$, $C_2 = sp^2$

(*e*)  $C_1 = sp^3$, $C_2 = sp^2$

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