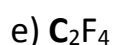
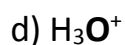
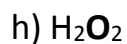
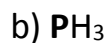
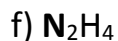
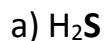


Hybridization

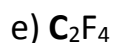
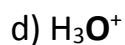
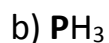
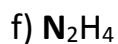
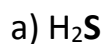
1) Describe the hybridization of the carbon atom in ethane, ethene and ethyne.

2) Describe the formation of the double carbon to carbon bond in ethene and the triple carbon to carbon bond in ethyne.

3) Determine the hybridization of the atom in bold in the following molecules:



4) Determine the bond angle around the atom in bold in the molecules.



Answers:

1) Ethane: the carbon atom in ethane is sp^3 hybridized. One 2s orbital and three 2p orbitals mix to form four sp^3 hybrid orbitals.

Ethene: the carbon atom in ethene is sp^2 hybridized. One 2s orbital and two 2p orbitals mix to form three sp^2 hybrid orbitals.

Ethyne: the carbon atom in ethyne is sp hybridized. One 2s orbital and one 2p orbital mix to form two sp hybrid orbitals.

2) The double carbon to carbon bond in ethene is made up of one sigma and one pi bond. The sigma bond is formed by the head on overlap of two sp^2 hybrid orbitals. The pi bond is formed by sideways overlap of unhybridized p orbitals.

The triple carbon to carbon bond in ethyne is made up of one sigma and two pi bonds. The sigma bond is formed by the head on overlap of two sp hybrid orbitals. The two pi bonds are formed by sideways overlap of unhybridized p orbitals.

3) To determine the type of hybridization, count the number of electron domains around the central atom.

sp^3 – 4 electron domains, sp^2 – 3 electron domains, sp – 2 electron domains

a) H_2S sp^3

f) N_2H_4 sp^3

b) PH_3 sp^3

g) $HCOOH$ sp^3

c) NH_4^+ sp^3

h) H_2O_2 sp^3

d) H_3O^+ sp^3

i) CO_3^{2-} sp^2

e) C_2F_4 sp^2

j) HCN sp

4)

a) H_2S **<109.5° bent**

f) N_2H_4 **<109.5° trigonal pyramidal**

b) PH_3 **<109.5° trigonal pyramidal**

h) CO_3^{2-} **120° trigonal planar**

c) NH_4^+ **109.5° tetrahedral**

h) HCN **180° linear**

d) H_3O^+ **<109.5° trigonal pyramidal**

e) C_2F_4 **120° trigonal planar**