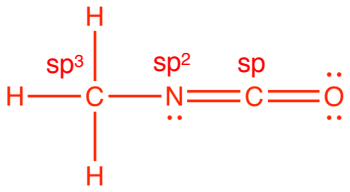
1. Methyl isocyanate (CH_3NCO) is a toxic compound commonly used in the production of pesticides.

   (a) Draw the Lewis structure for CH_3NCO. Include all bonds, lone pairs, and any formal charges.



   (b) Estimate the C—N—C bond angle and explain why.

   Less than 120° because the lone pair on N pushes the two C atoms closer together.
   The electron-pair geometry is trigonal planar, but the molecular geometry is bent (angular).

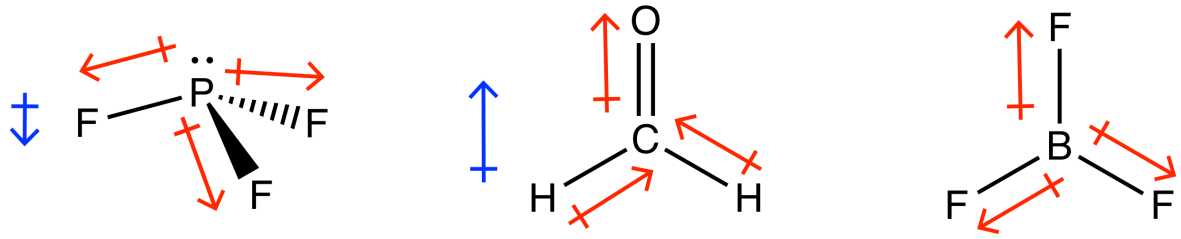
   (c) On your Lewis structure, indicate the hybridization of the C and N atoms.

   (d) How many σ-bonds and π-bonds are present in CH_3NCO.

   6 σ bonds (3×C–H + C–N + N=C + N=O) and 2 π bonds (N=C + N=O)

2. Draw each of the following molecules showing their geometry clearly. Indicate all bond dipoles on your pictures.

PF_3 CH_2O BF_3



   RED = bond dipole
   BLUE = molecular dipole

   Which molecule(s) are polar?

   PF_3 and CH_2O

3. The species NO_2, NO_2^+, and NO_2^- have different bond angles. Arrange the three compounds in order of decreasing bond angle. Drawing the Lewis structures will help.

   Consider impact of one (radical) vs. two electrons (lone pair) on bond angle.

4. Draw an MO diagram of the cyanide anion. What is the bond order of the CN bond? Is the cyanide anion paramagnetic or diamagnetic?

Bond Order (CN) = ½ (8 – 2) = 3

CN^- is diamagnetic because all electrons are paired.