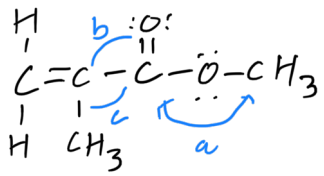
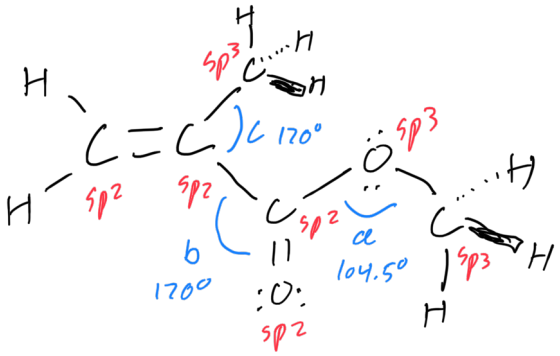
06/23/23

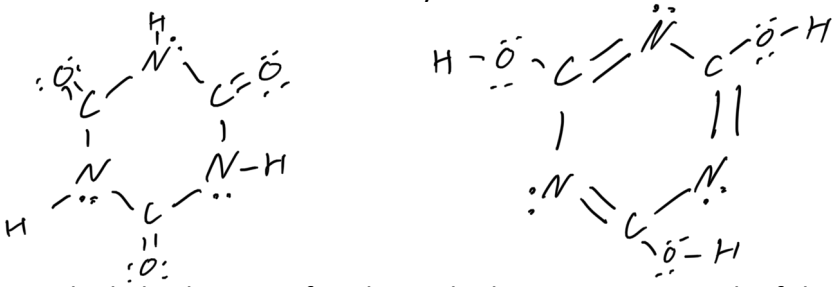
Methyl methacrylate has this Lewis structure:



Draw the 3-D structure for the molecule and indicate the hybridization at each non-hydrogen atom. Also, determine the approximate values of the bond angles noted on the Lewis structure



These are two Lewis structures for cyanuric acid:



What is the hybridization of each non-hydrogen atom in each of these structures?

Left

All C sp^2
All O sp^2
All N sp^3

Right

All C sp^2
All O sp^3
All N sp^2

Using the table of bond dissociation energies from class, which structure is more stable?

Left

6 C-N	6×305
3 C=O	3×745
3 N-H	3×391

5238 kJ/mol to break all bonds

More stable

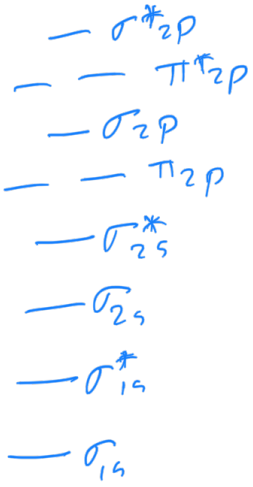
Right

3 C=N	3×615
3 C-N	3×305
3 C-O	3×358
3 O-H	3×463

5223 kJ/mol to break all bonds

Less stable

Using molecular orbital theory, write the electron configuration for N_2 as well as for the N_2^{-1} anion and the N_2^{+1} cation. Which of these three molecules has the strongest bond and which has the weakest? Justify your answer. Also, which of these three molecules is paramagnetic?



N_2 $\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2p}^4 \sigma_{2p}^2$ $BO = \frac{10-4}{2} = 3$

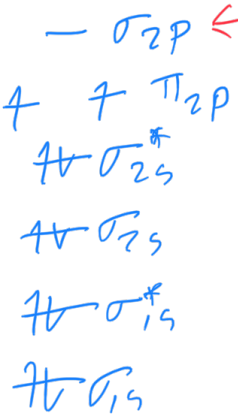
N_2^{-1} $\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2p}^4 \sigma_{2p}^2 \pi_{2p}^{*1}$ $BO = \frac{10-5}{2} = 2\frac{1}{2}$

N_2^{+1} $\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2p}^4 \sigma_{2p}^1$ $BO = \frac{9-4}{2} = 2\frac{1}{2}$

N_2 strongest, diamagnetic

N_2^{-1}, N_2^{+1} equal and both paramagnetic

For the B_2 molecule describe the lowest energy molecular orbital that does **not** have electrons in it. Describe this orbital both in words and by making a drawing that shows the molecular orbital as well as the atomic orbitals from which it is derived



← lowest energy unoccupied orbital

constructive (since bonding) overlap of 2p orbitals "pointing" at each other

Red ones overlap to make σ_{2p} and σ^*_{2p}