Name _____ Test 1
PHYS 0201 (Organic) Fall 2004

1. Drawn below is an incomplete molecular orbital (MO) diagram for the molecule HF.

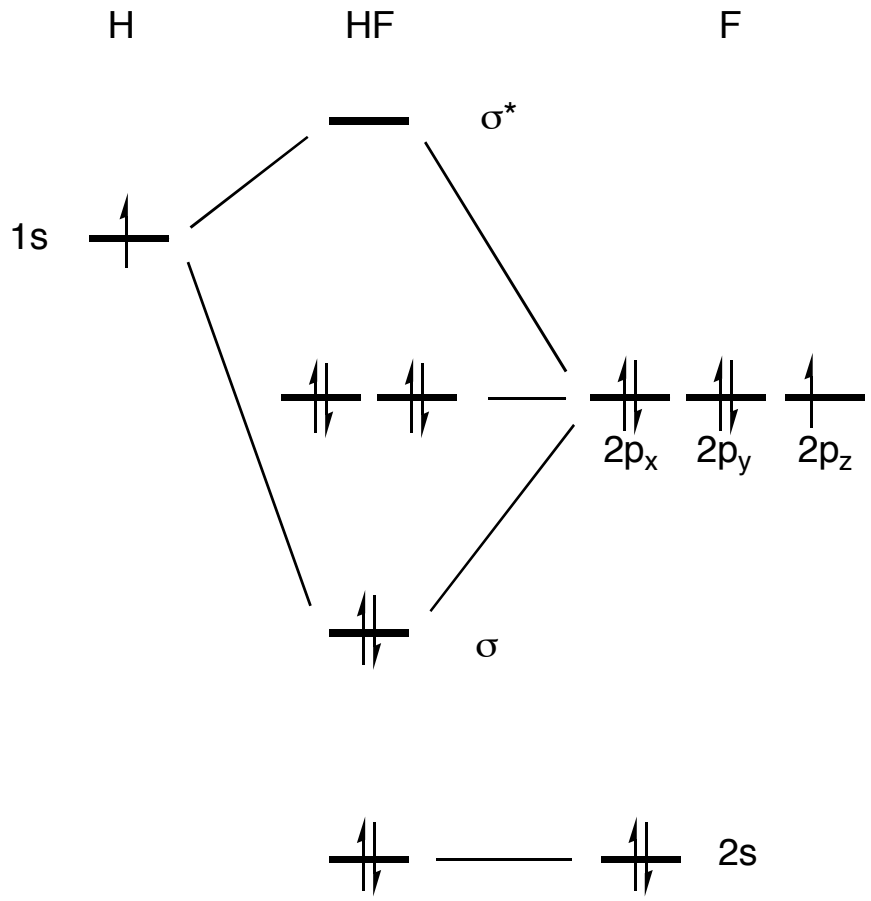
a. (3 pts.) Label the atomic orbitals.

b. (2 pts.) Label the bonding and antibonding molecular orbitals.

c. (3 pts.) Complete the diagram by adding electrons to the appropriate energy levels.

d. (2 pts.) Determine the bond order for HF.

BO = (2 – 0)/2 = 1



e. (2 pts.) Determine the effect that removing an electron would have on the strength of the HF bond.

No effect because a nonbonding electron is removed. BO = (2 – 0)/2 = 1

f. (2 pts.) Determine the effect that exciting an electron from the HOMO to the LUMO would have on the strength of the HF bond.

A nonbonding electron is promoted to an anti bonding orbital. BO = (2 – 1)/2 = 0.5. The bond strength is lower.

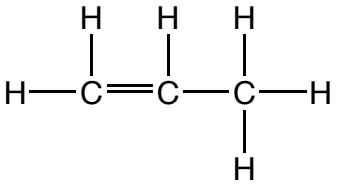
2. (4 pts.) Which of the following statements more accurately describes the reason for using orbital hybridization as a means for explaining bonding?

Hybridization is absolutely necessary in order to create orbitals to hold the electrons that are used to make a molecule. (incorrect)

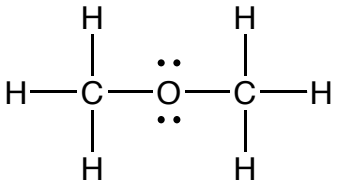
Hybridization is a simple but useful model for accounting for the arrangement of electrons around an atom in a molecule. (correct)

3. (4 pts. ea.) Draw Lewis Structures for the following molecules.

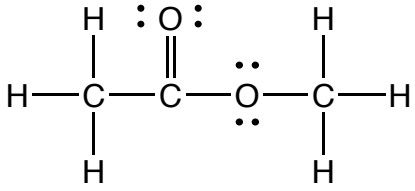
a. CH_2CHCH_3



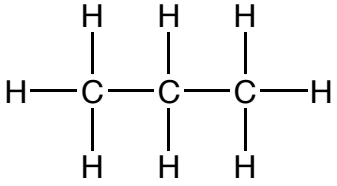
b. CH_3OCH_3



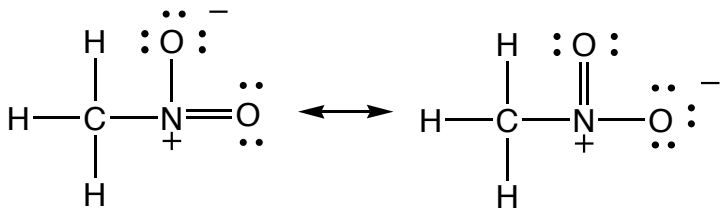
c. $CH_3C(O)OCH_3$



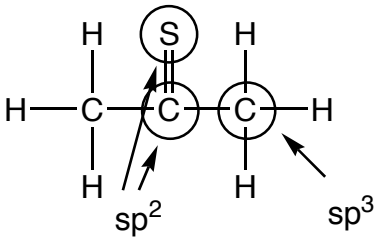
c. $CH_3CH_2CH_3$

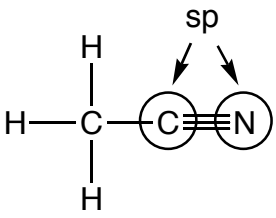


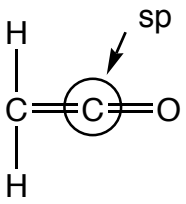
4. (8 pts.) Draw the Lewis Structures for the two resonance forms of CH_3NO_2.



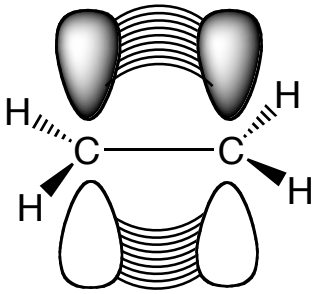
5. (2 pts. ea.) Determine the hybridization at the indicated atoms (the circled atoms) in the following molecules. Note: the structures that are drawn are **incomplete** Lewis structures.





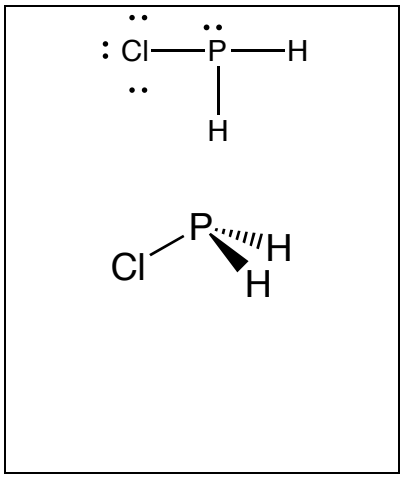


6. (6 pts.) Draw the orbitals that are responsible for forming the π bond in ethylene (CH_2CH_2). Draw the σ bonds as lines.

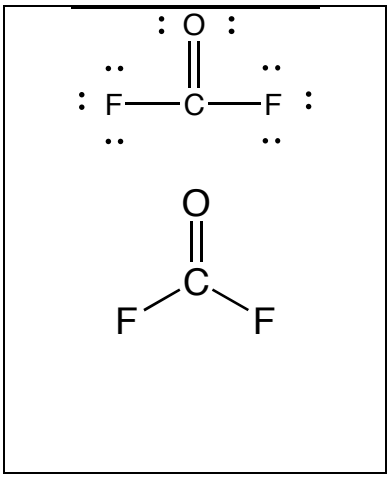


7. (6 pts. ea.) Draw three dimensional representations of the following molecules. Lewis structures have been provided. Remember to use ····· and ◥ bonds when necessary.

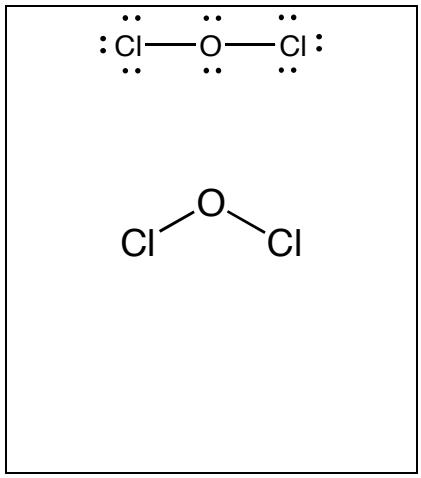
a.



b.

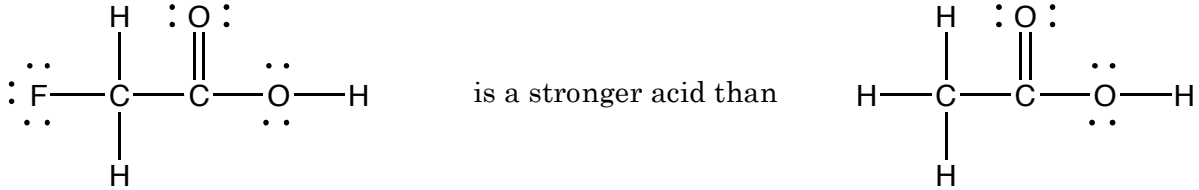


c.



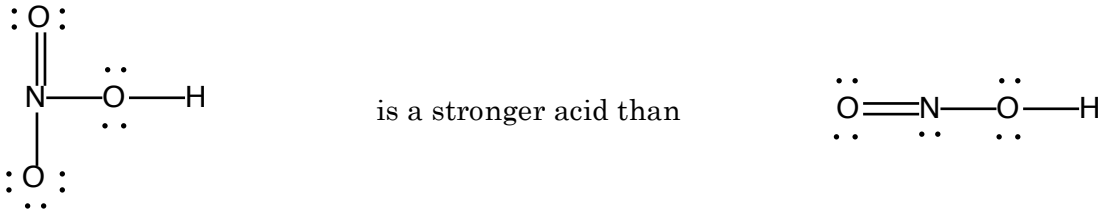
8. (4 pts. ea.) For each of the following pairs of acids explain why one is more acidic.

a.



The electronegative F atom draws electron density away from the oxygen atoms, and since the electron density is more spread out, the conjugate base of CFH_3CO_2H is less likely to attract a proton than the conjugate base of CH_3CO_2H. Thus, CFH_2CO_2H is a stronger acid.

c.



The conjugate base of HNO_3 has more resonance forms to distribute the negative charge onto more oxygen atoms than the conjugate base of HNO_2. Since the electron density is more spread out, the conjugate base of HNO_3 is less likely to attract a proton than the conjugate base of HNO_2. Thus, HNO_3 is a stronger acid.

9. (8 pts.) Explain why 1,2-dichloroethane is not polar. The Lewis structure is drawn below.

Since there is free rotation around the single bond, the δ^- Cl atoms are, on average, directly opposite each other thus there is no + or – side.