

ORGANIC CHEMISTRY
CHEM 12A (L1/L1L)
EXAM 1 (175 points, 15 EC points)

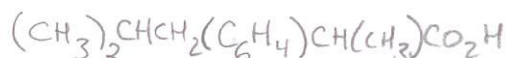
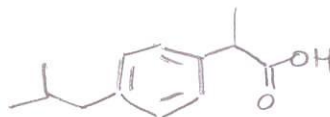
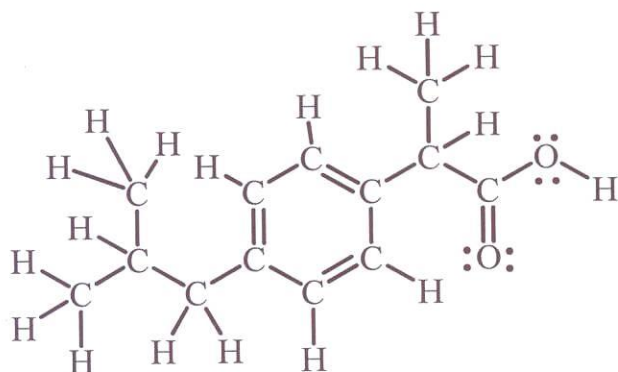
FALL 2013, LANEY COLLEGE
INSTRUCTOR: S. CORLETT
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NAME _____

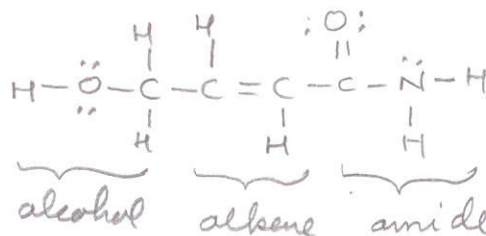
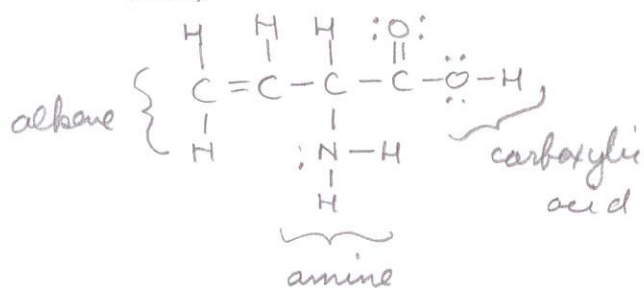
Key

1. For the compound ibuprofen, shown below, draw a bond-line structure. (10 points)

EXTRA CREDIT Write a condensed formula for the structure (5 EC points)

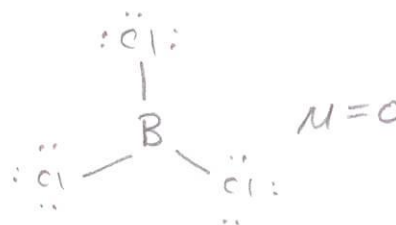
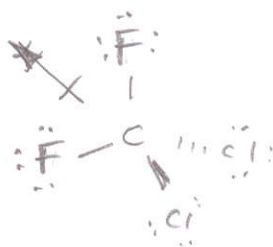


2. Draw two (2) different Lewis structures for molecules with the formula $\text{C}_4\text{H}_7\text{NO}_2$. There are very many possibilities, but limit your molecules to ones in which you can name the functional groups and of course show these names on your structures! (Show any lone pairs of e^- , and remember, no dots for bonds) (20 points)

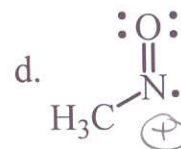
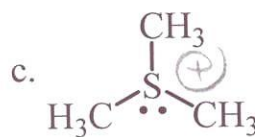
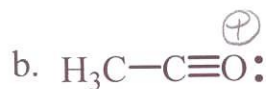
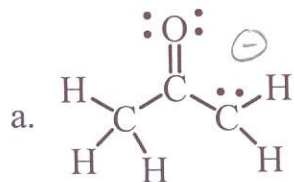


3. For the following molecules:

- Draw bond-line drawings that show the expected geometry (use dashes and wedges where necessary)
- Show all of the lone pairs of electrons
- If the molecule has a permanent dipole moment ($\mu \neq 0$), then show the direction of the overall dipole, otherwise write $\mu = 0$ below the structure. (15 points)

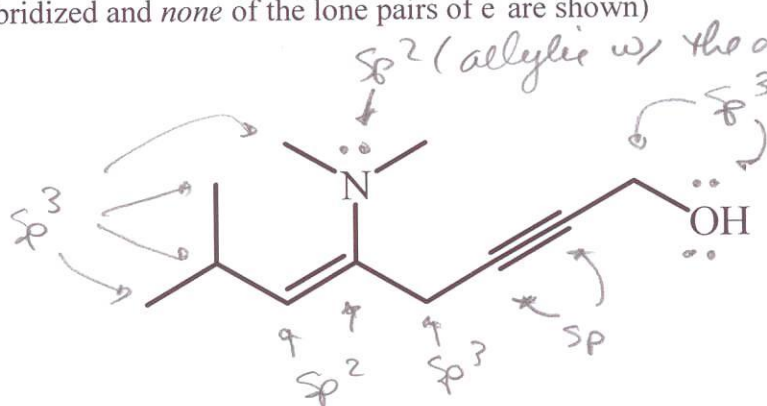


4. Assign formal charges (if non-zero) to the appropriate atoms in the following molecules (or ions).
 (Note that *all* non-bonded electrons are shown in each structure) (12 points)

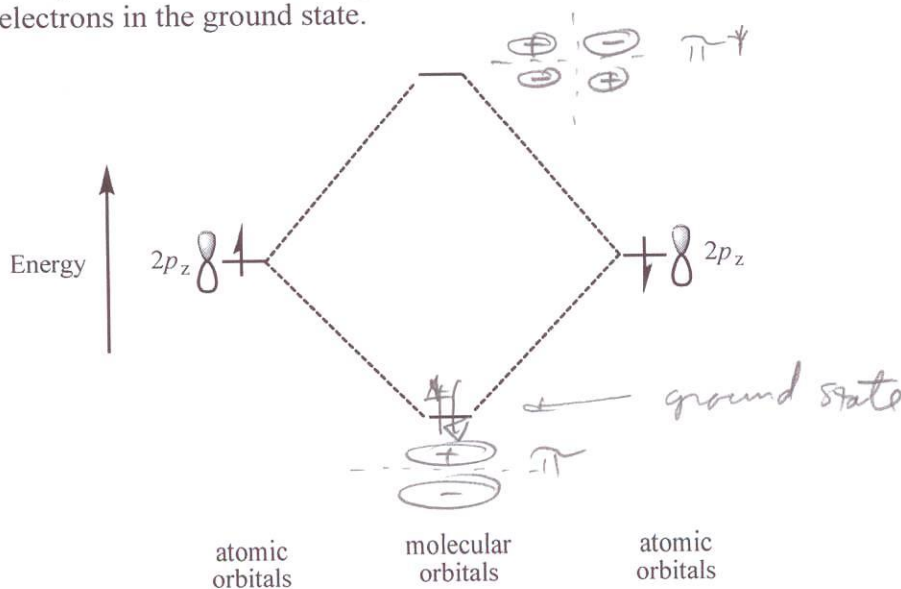


5. Consider the molecule below:

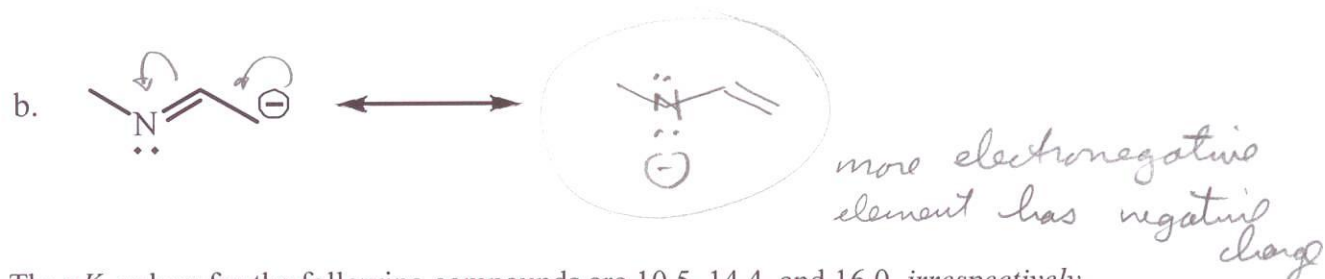
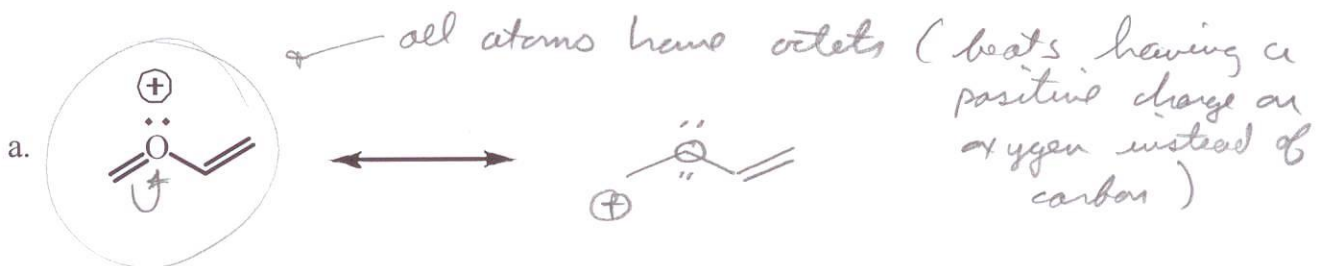
- a. Identify the hybridization of each atom of the following molecule (note there are 13 atoms that are hybridized and *none* of the lone pairs of e^- are shown) (26 points)



6. Complete the following energy diagram: Provide the name and sketch the shape of the molecular orbitals that are formed (in the center of the diagram) from the indicated atomic orbitals and show how they are filled with electrons in the ground state. (10 points)

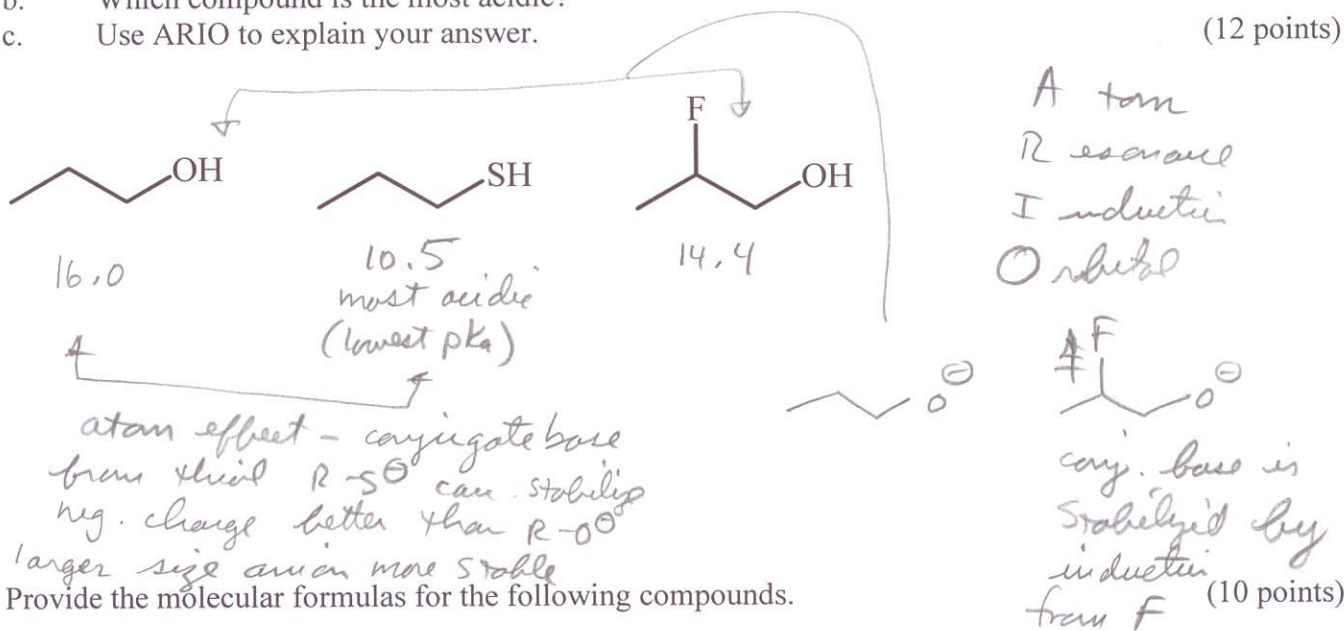


7. By "pushing" electrons, show the other resonance form for each ion shown below. In each case, circle the *major* resonance form and the reason for your choice. (10 points)

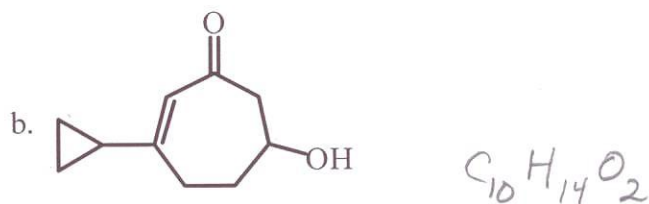
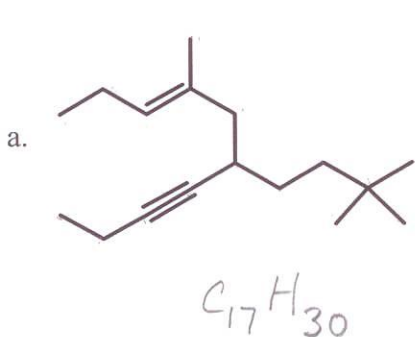


8. The pK_a values for the following compounds are 10.5, 14.4, and 16.0, *irrespectively*.

- a. Assign these values to the corresponding compounds.
 b. Which compound is the most acidic?
 c. Use ARIO to explain your answer. (12 points)



9. Provide the molecular formulas for the following compounds.



10. Ammonia (NH_3) has a dipole moment (μ) of 1.42 D, whereas nitrogen trifluoride (NF_3) has a value of 0.234 D. Suggest a reason for the dramatic difference between these two otherwise similar molecules. (Hint: carefully consider the structure and geometry)

Smaller overall dipole (10 points)

dipoles of N-F bonds are directed away from lone pair - partially cancel



Larger dipole

dipoles of N-H bonds

all reinforce in the direction of the lone pair



11. Pentane and 2,2-dimethylbutane have boiling points of 36°C and 10°C , even though they have the same formula and molecular weight. Provide an explanation for the difference in boiling point. (5 points)



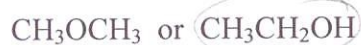
pentane
bp 36°C



2,2-dimethylpropane
bp 10°C

Same formula for both, but pentane has greater surface area than 2,2-dimethylpropane. Greater surface area leads to more London dispersion forces and more chances

12. Which of the compounds shown below would be expected to be more soluble in water? Explain your choice. (5 points)

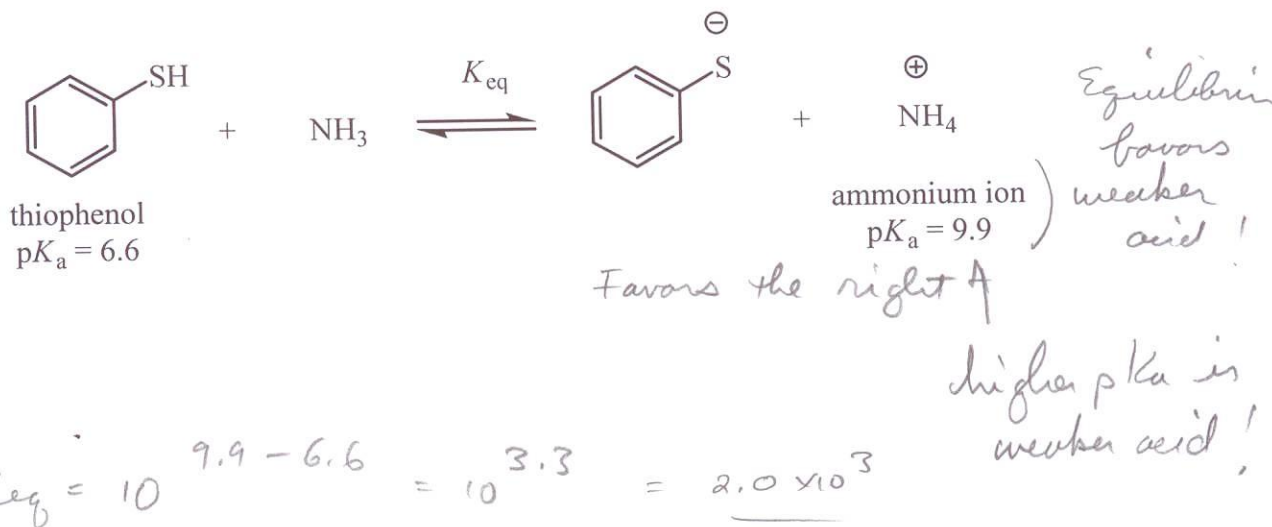


this is an alcohol and can be both a hydrogen bond donor and acceptor - it can H-bond with H_2O which is also a donor and acceptor

this is an ether and although it doesn't act as an H-bond donor it can be an acceptor, the lack H-bonding relative to the alcohol isomer

13. Given the pK_a data below, indicate which side of the equilibrium is favored (i.e., right or left). Also, explain why the data indicate this – be clear about this. (10 points)

EXTRA CREDIT calculate the equilibrium constant (K_{eq}) – show your calculation. (10 points)



14. For the following chemical reactions, identify the Lewis base and the Lewis acid. Use electron-pushing to show how the reactions take place. (20 points)

