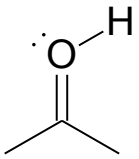
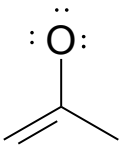
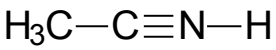
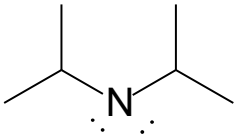
1. (4 pts) Calculate the formal charge on each **O,** and **N** in the structures below. All non-bonded electrons are shown.

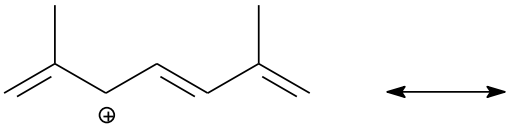




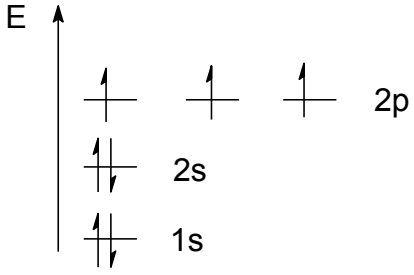




2. (6 pts) Draw **THREE** more Resonance Structures for the carbocation intermediate shown below. Use arrows to show "pushing of electrons". Each resonance structure you draw should have the Positive Charge on a Different Carbon.

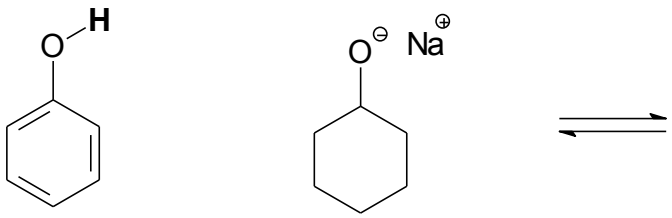


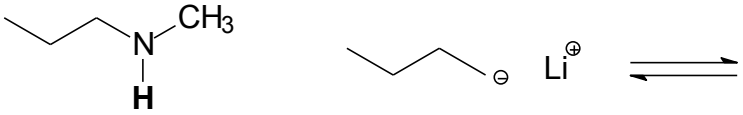
3. (5 pts) Draw an orbital energy level diagram for sp hybrid Nitrogen. The electron count for unhybridized Nitrogen is $1s^2 2s^2 2p^3$.

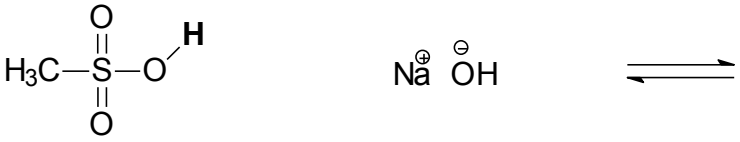


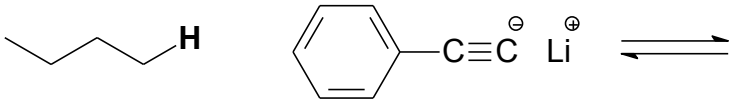
4. For each acid-base reaction shown below (the acid is on the left, the base is on the right, the proton which is of interest is drawn in **BOLD**):

A) (10 pts) Draw the structures of the conjugate acid and conjugate base.
B) (5 pts) Decide whether the equilibrium favors the FORWARD reaction, the REVERSE reaction, or NEITHER.









5. (12 pts) Draw an acceptable structure for each of the following:

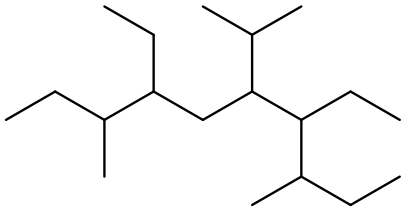
A) 4-ethyl-7-isopropyl-3,5,8-trimethyldecane

B) 1,1-diethyl-6-isobutyl-2-methylcycloheptane

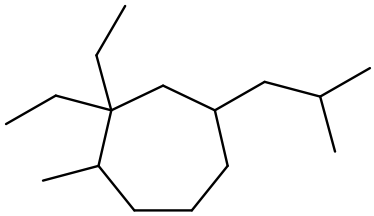
C) bicyclo[5.2.0]nonane

6. (12 pts) Provide an acceptable name for each of the following structures:

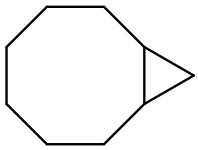
A)



B)



C)



7. (9 pts) Draw and Name all 9 alkanes with the formula C_7H_{16}.

8. (8 pts) Draw a 3-D representation of each of the following molecules. Use wedges and dashes where needed to clearly indicate geometry. Indicate the direction of the Dipole () for each molecule.

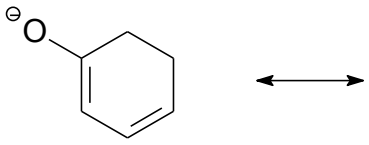
NH_3

CHF_3

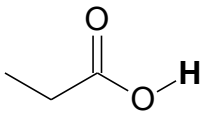
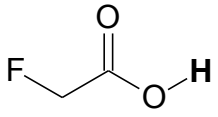
$H_2C{=}CCl_2$

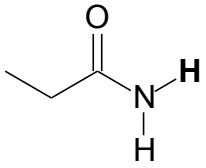
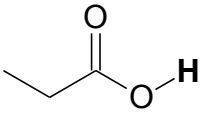
$H_2C{=}C{=}CF_2$

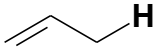
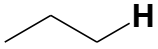
9. (6 pts) Draw two more resonance structures for the reactive intermediate shown below: Use arrows to show "pushing of electrons".



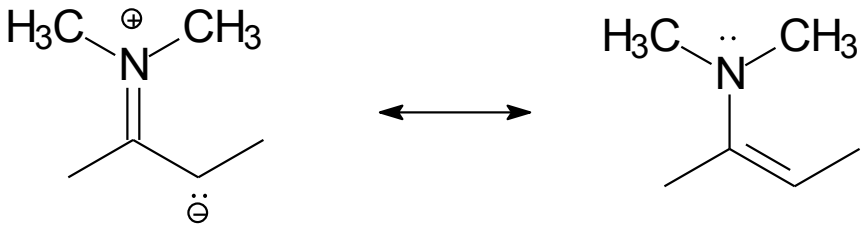
10. (12 pts) For each pair of compounds, indicate which one is the stronger acid (*i.e.* – the **H** in **BOLD**). For full credit, draw the structure of each conjugate base, and provide a brief explanation.

A)  vs. 

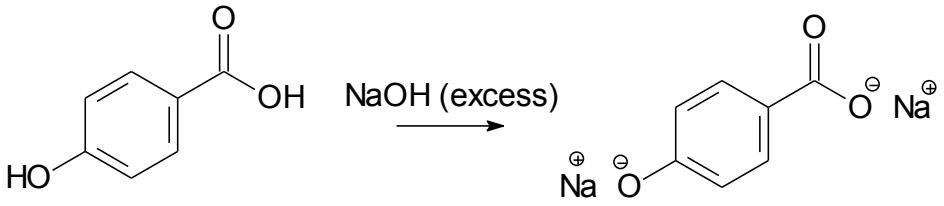
B)  vs. 

C)  vs. 

11. (4 pts) Draw the Resonance Hybrid (the weighted average of the available resonance forms) of the resonance structures shown below:



12. (4 pts) Treatment of 4-hydroxybenzoic acid with an excess of sodium hydroxide produces the salt shown below. Draw the structure of the product that would be formed from treatment of 4-hydroxybenzoic acid with 1 equivalent of sodium hydroxide.



13. (3 pts) Circle all of the atoms in the structure below that are sp^2 hybrid.