

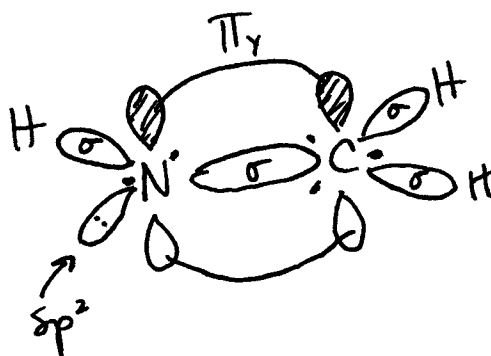
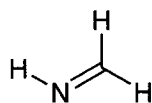
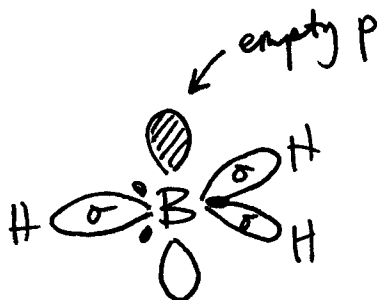
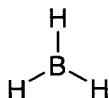
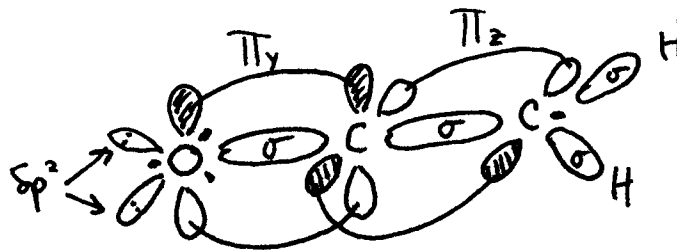
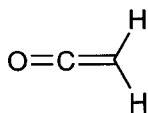
(out of 20 pts.)

Problem Set #2, 5.12 Spring 2003
Due Tuesday, February 18, 4pm

Key

1. Draw a molecular orbital picture for each of the following molecules. Include all bonding and non-bonding orbitals, and label each clearly.

3 pts.

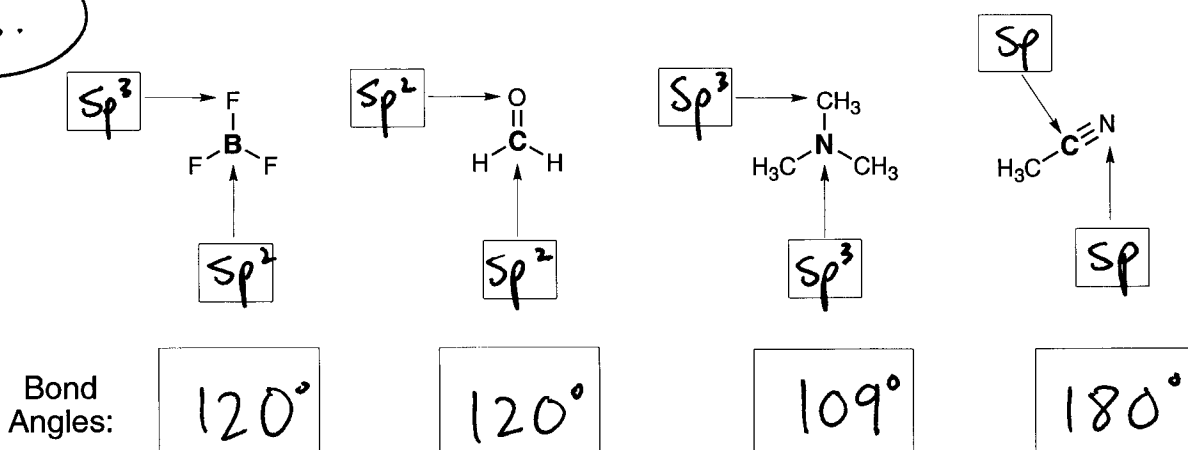


Note: It is also acceptable to show hybridized orbitals overlapping to form σ -bonds.



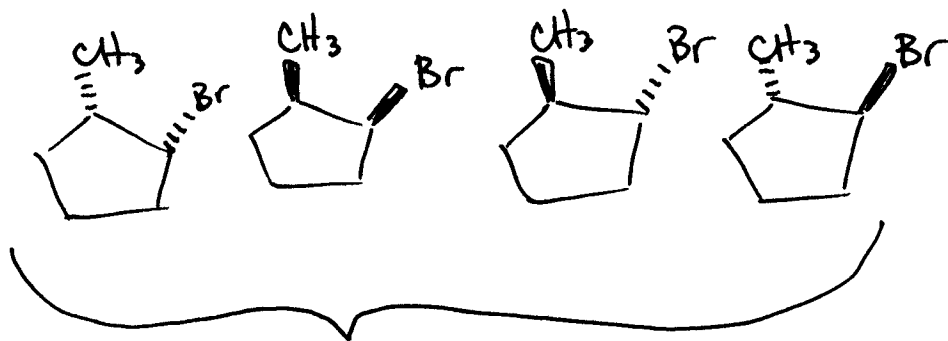
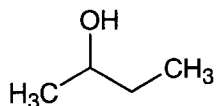
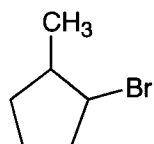
2. a) Assign the appropriate hybridization to each of the indicated atoms.
 b) Label the approximate bond angle around the central bolded atom in each structure.

2 pts.

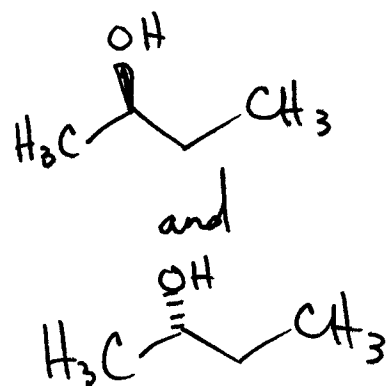


3. Using dashes and wedges, draw two **different** 3-D structures for each molecule.

2 pts.



any two of these

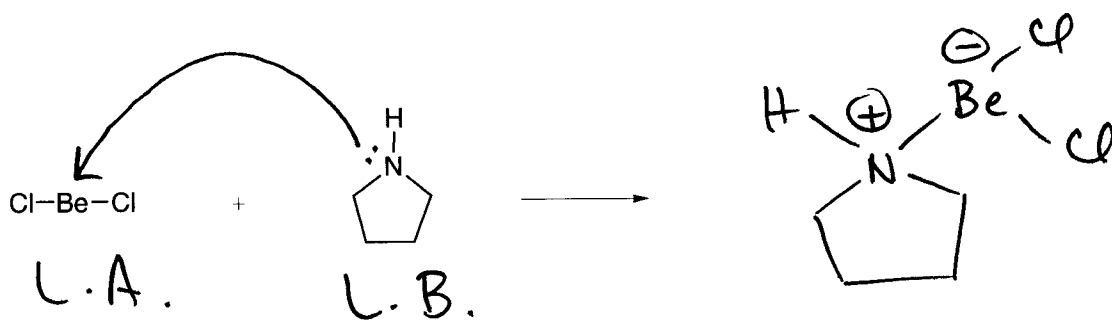
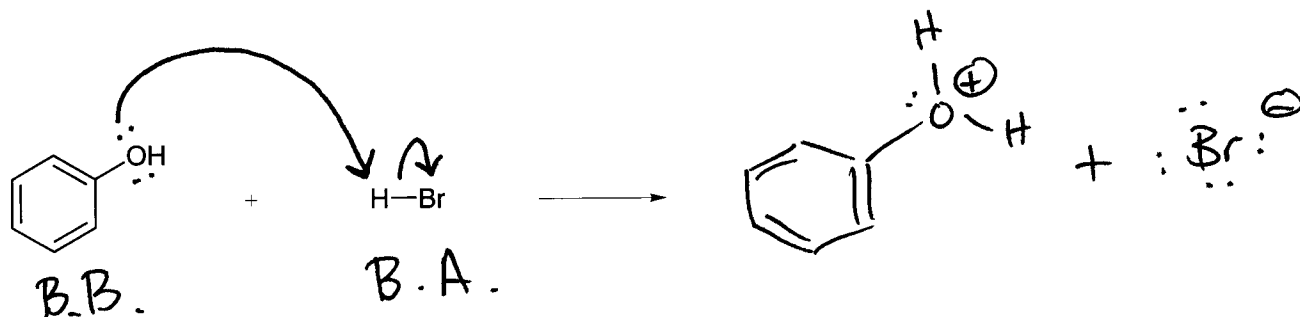
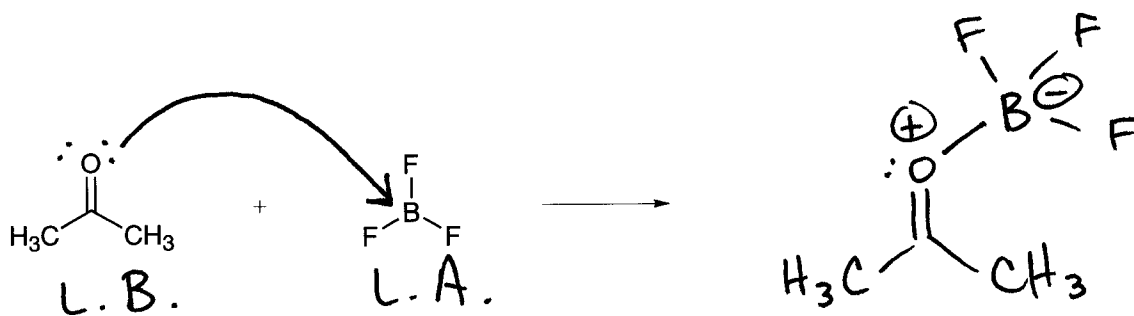
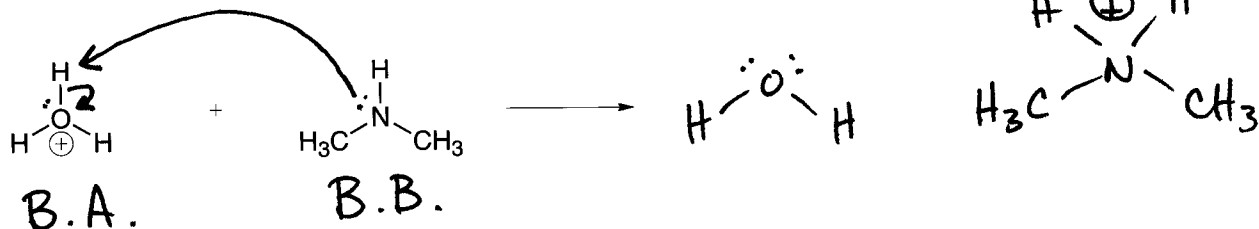


4. a) Provide the products for each of the following acid/base reactions.

b) Use curved arrows to show the mechanism for each reaction. **Don't forget lone pairs and formal charges!**

c) Label each reactant as a Lewis acid (LA), Lewis base (LB), Bronsted acid (BA), or Bronsted base (BB).

4 pts.

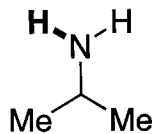
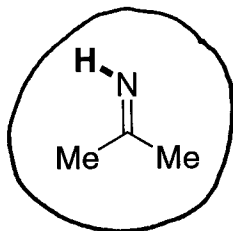


5. For each pair, circle the molecule with the lowest pK_a , and give a short (1-2 word) explanation.

(most acidic)

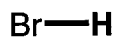
3 pts.

a)



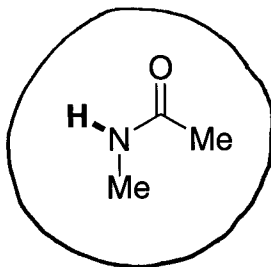
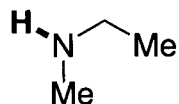
hybridization

b)



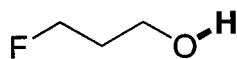
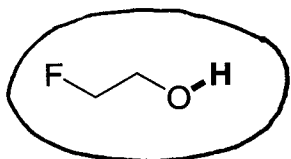
atom size

c)



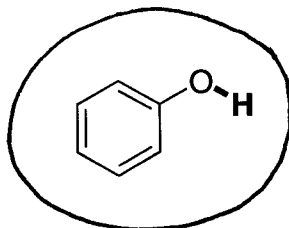
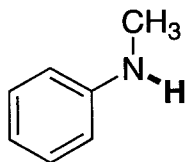
resonance

d)



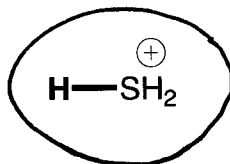
inductive effects

e)



electronegativity

f)

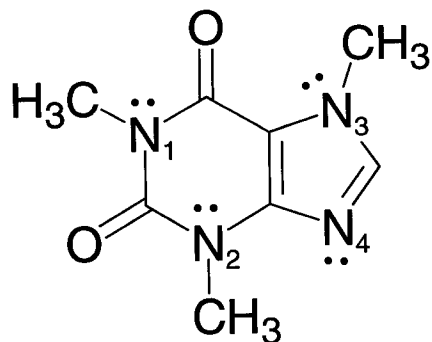


charge

6. Alkaloid **A** is extremely popular on college campuses all over the world. In fact, it is possible that you are consuming some while you work on this problem set. (Can you guess what it is?)

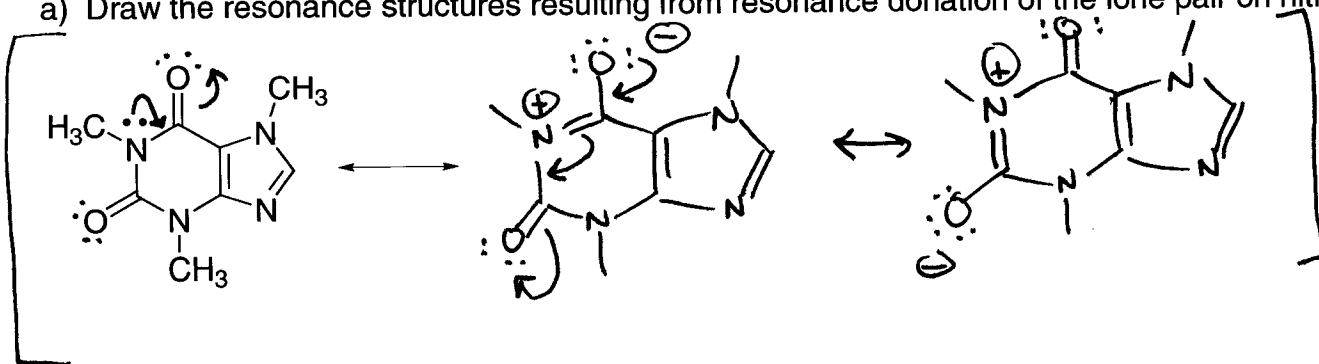
The lone pairs on three of the four nitrogen atoms in **A** can participate in resonance (N_1-N_3). Nitrogen 4 cannot donate its lone pair because it sits in an orbital orthogonal to the rest of the π -system.

6 pts.

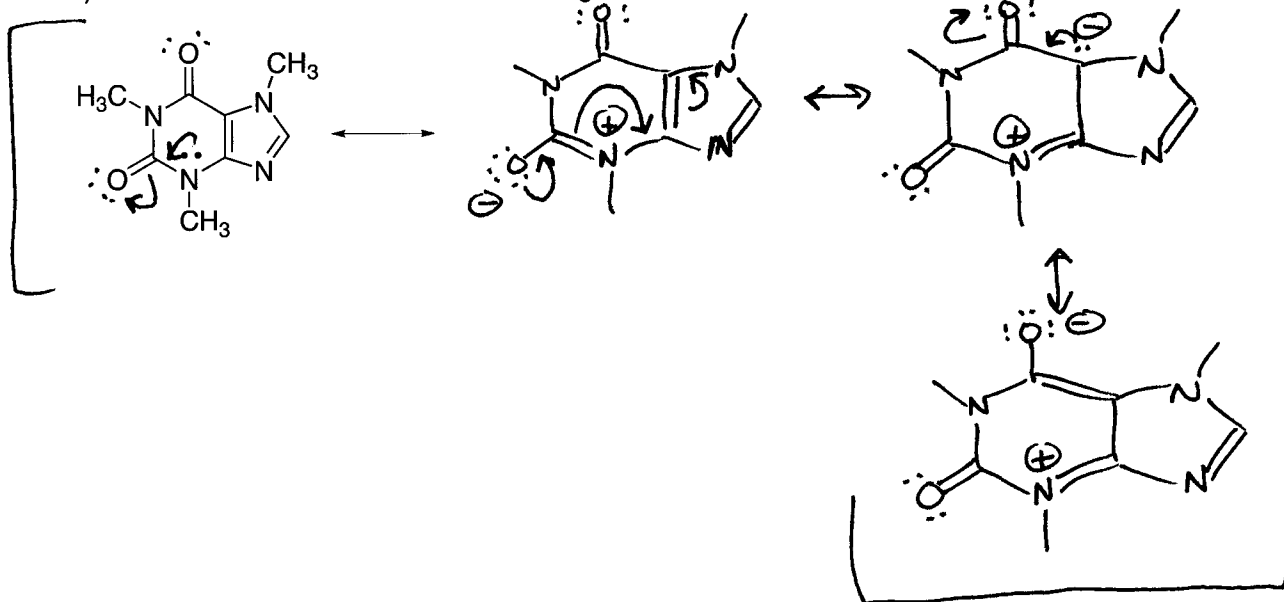


A

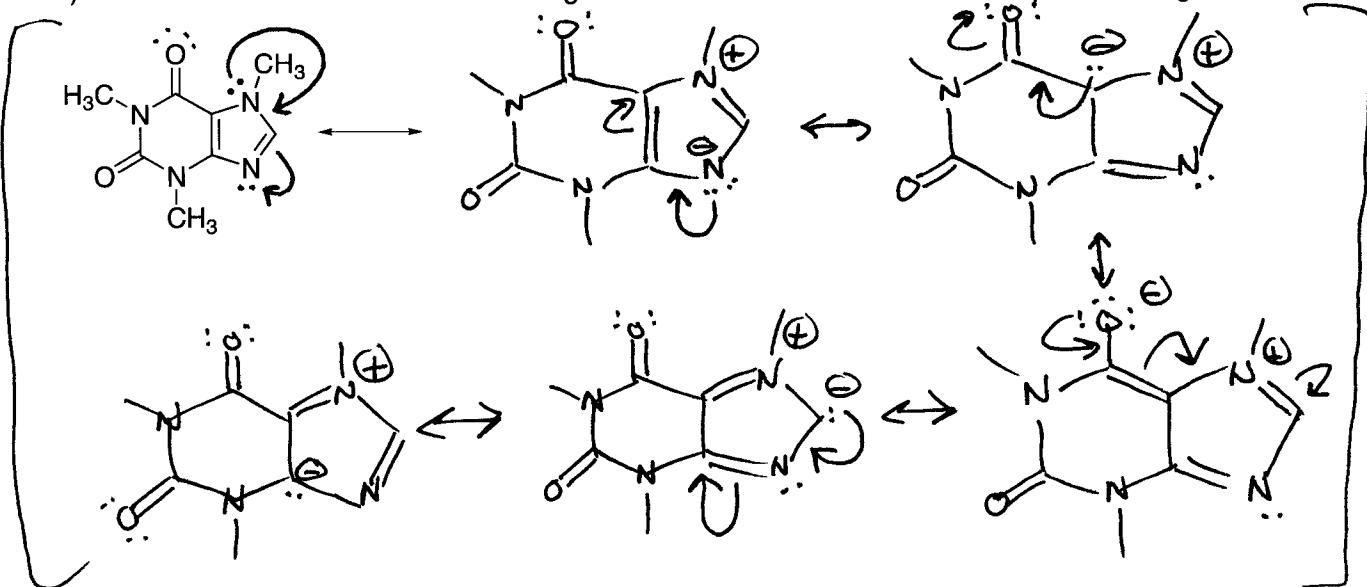
a) Draw the resonance structures resulting from resonance donation of the lone pair on nitrogen 1.



b) Draw the resonance structures resulting from resonance donation of the lone pair on nitrogen 2.



c) Draw the resonance structures resulting from resonance donation of the lone pair on nitrogen 3.



d) Based on the resonance structures in parts a–c, which nitrogen atom would you expect to be the most nucleophilic? Why?

NITROGEN 4 : It is the only nitrogen that does not have a positive charge in any of the resonance structures, and it has a negative charge in one resonance structure. It has the most electron density \rightarrow most nucleophilic.