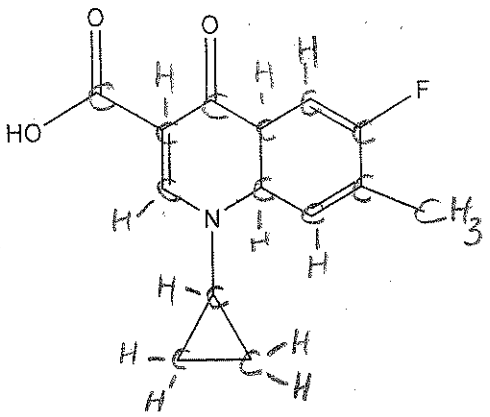
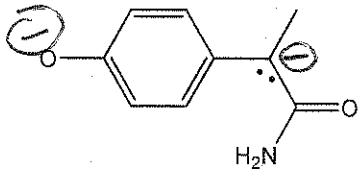
1. Convert the following from line angle notation to a Lewis structure (show all C's and H's). (5 pts, 2 minutes)



2. Fill in all missing, non-zero formal charges on the molecule shown below. (5 pts, 2 minutes)



3. Answer the following questions based on the molecule shown below: (10 pts, 6 minutes)

a. What is the hybridization of carbon 1? sp^2

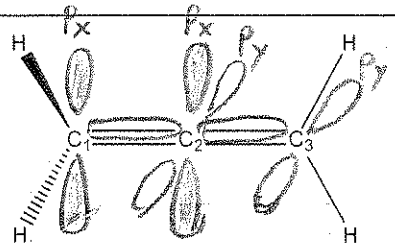
b. What is the hybridization of carbon 2? sp

c. Circle all pi bonds present in the molecule.

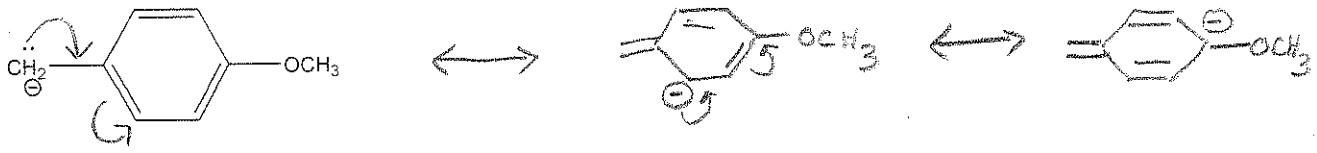
d. Draw in and label all unhybridized p orbitals present in the molecule.

e. Explain why the hydrogens on carbon 1 are not in the same plane as the hydrogens of carbon 3.

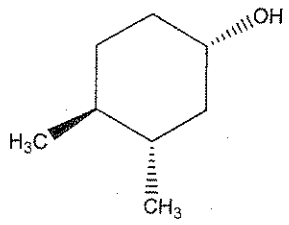
H's that bond to C_1 bond to sp^2 hybridized orbitals that result from hybridization of different p orbitals (e.g. p_y & p_z) from these three C_3 uses to form sp^2 hybridized orbitals (e.g. p_x & p_z)

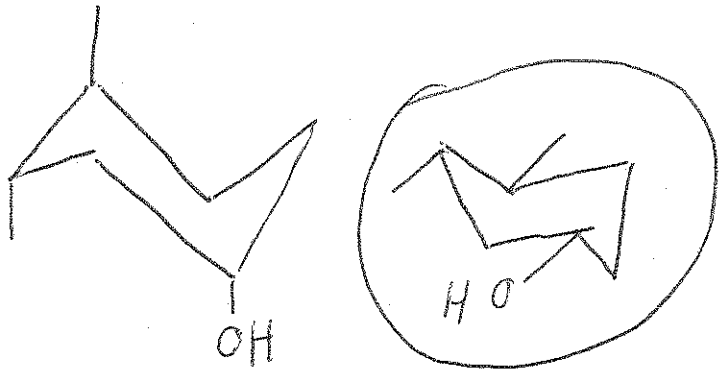


4. Draw **two** resonance structures for the molecule shown below. Make sure your resonance structures are **major** contributors. Use arrows to show how each of your resonance structures can be generated from the structure below. (8 pts, 5 minutes)



5. Draw both chair conformations of the following molecule and circle the one that is **lower** in energy. (8 pts, 5 minutes)

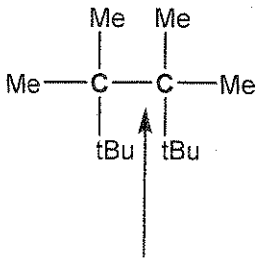




6. (8 pts, 5 minutes)

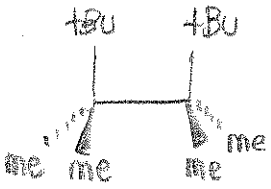
a. For the molecule given below, draw the **highest energy sawhorse** projection about the indicated bond.

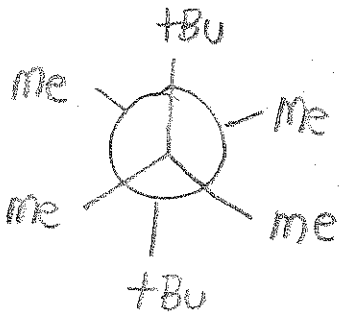
b. For the same molecule, draw the **lowest energy Newman** projection about the indicated bond.



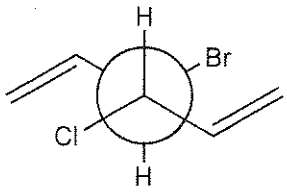
Me = methyl = CH_3

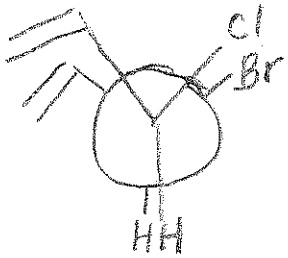
tBu = tertButyl = $(CH_3)_3C$

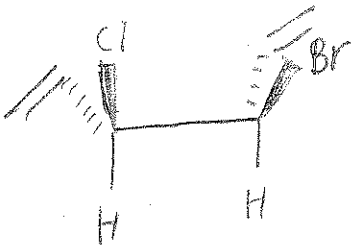




7. Redraw the molecule below in a **sawhorse** projection in the **highest** energy conformation. (8 pts, 5 minutes)

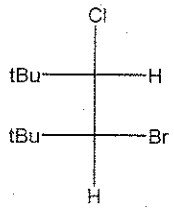


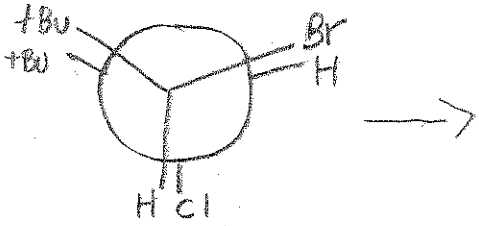


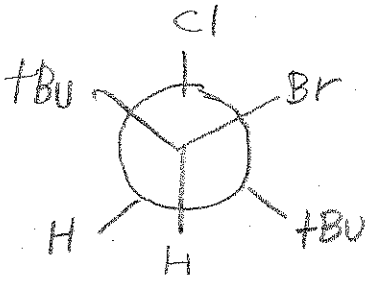


8. Redraw the molecule below in a **Newman** projection and in the **lowest** energy conformation. (8 pts, 5 minutes)

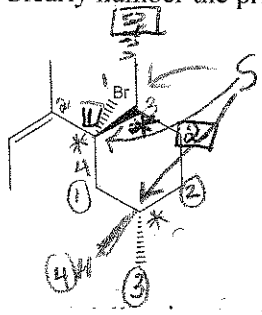
tBu = $(CH_3)_3C$







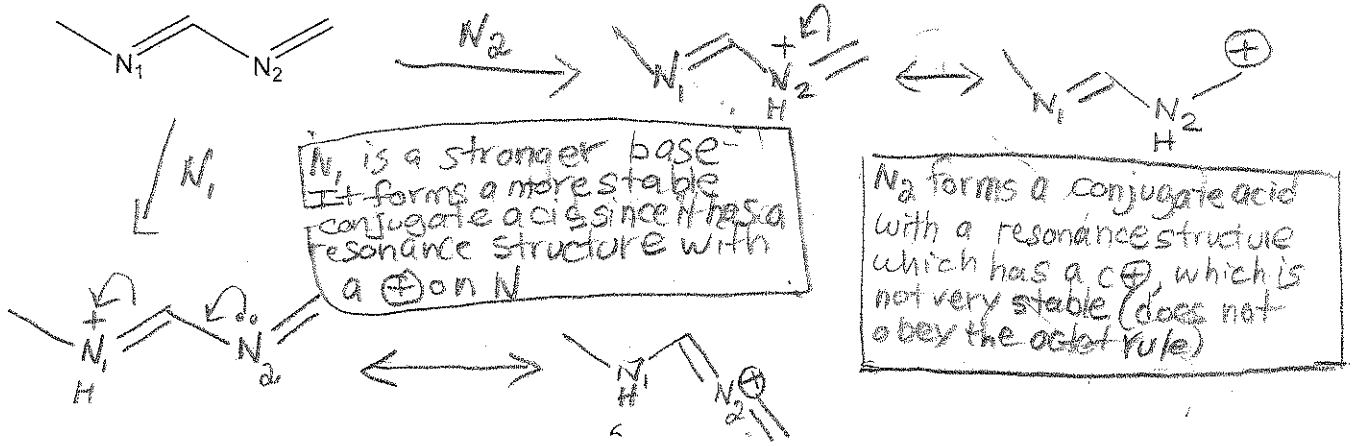
9. Mark each chiral center in the molecule shown below with a star. Determine the R or S configuration of each of the chiral center. Clearly number the priority of each group. (10 pts, 6 minutes)



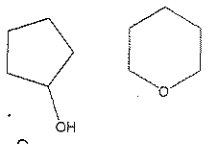
Middle carbon is R not S

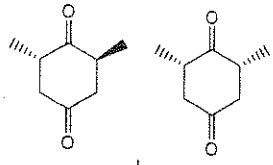
full credit for 2 chiral centers
extra credit for 3 chiral centers
(up to 5 pts)

10. Two nitrogen atoms (N1 & N2) are present in the molecule below. Which nitrogen is a stronger Bronsted base? Justify your answer using both structures AND a written explanation. (10 pts, 6 min)



11. State the relationship of each of the following pairs of molecules (identical, constitutional isomers, conformers, enantiomers, diastereomers, unrelated): (10 pts, 6 minutes)

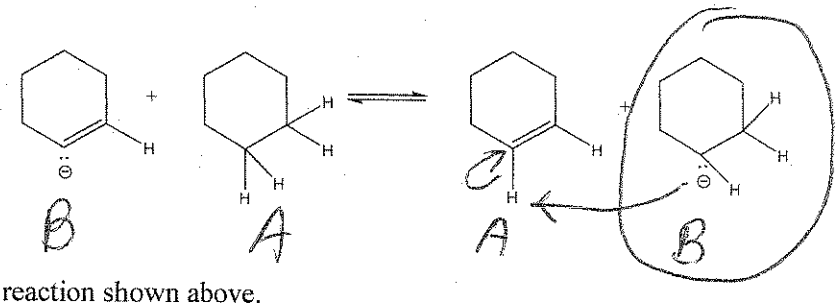
a  constitutional

b  diastereomers

c  enantiomers

d  ~~constitutional~~ unrelated

12. (10 pts, 6 minutes)



a. Label all the acids and bases in the reaction shown above.

b. Circle the strongest base.

c. Explain why it is the strongest.

sp^3 hybridized C is a stronger base than sp^2 hybridized C (sp^3 C is less electroneg / has less "s character")

d. Does the reaction go to the right or to the left? left

e. Draw mechanistic arrows (above) to show how the reaction proceeds: