

Chemistry 3A –Exam #1

Student Name: _____

Student ID Number: Key

TA or Section: _____

Point Breakdown

Problem 1 _____ / 18

Problem 2 _____ / 16

Problem 3 _____ / 21

Problem 4 _____ / 12

_____ / 15

_____ / 18

Problem 5 _____ / 18

Problem 6 _____ / 14

Problem 7 _____ / 18

Total _____ / 150

Average
107/150
~72%

StdDev
27/150

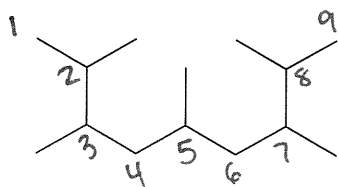
Check that you have 11 pages.

You will have 120 minutes for this exam.

REMEMBER: Opposites attract, the octet rule is super important and formal charges are necessary.

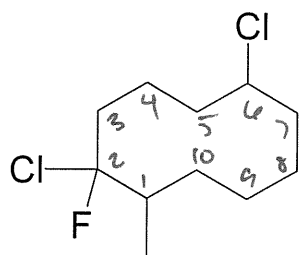
10

1. A. Provide systematic names for the following molecules. Use common names where appropriate. (6 pts)

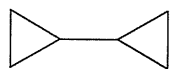


2,3,5,7,8-pentamethyl nonane

1 pt for root
1 pt for substitutive nts



1-methyl-2,6-dichloro-2-fluorocyclodecane



cyclopropyl cyclopropane

1. B. Match the names with the structure by placing the letter for the structure next to the name. Note: you can solve this problem without knowledge of each functional group. (12 pts)

~~A. A~~ 2 each

fluoroneopentane

dimethylsulfoxide

tertbutylthiol

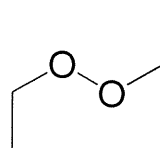
diethylperoxide

isobutylazide

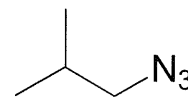
trimethyloxonium



A



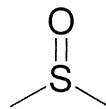
B



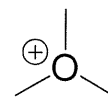
C



D



E

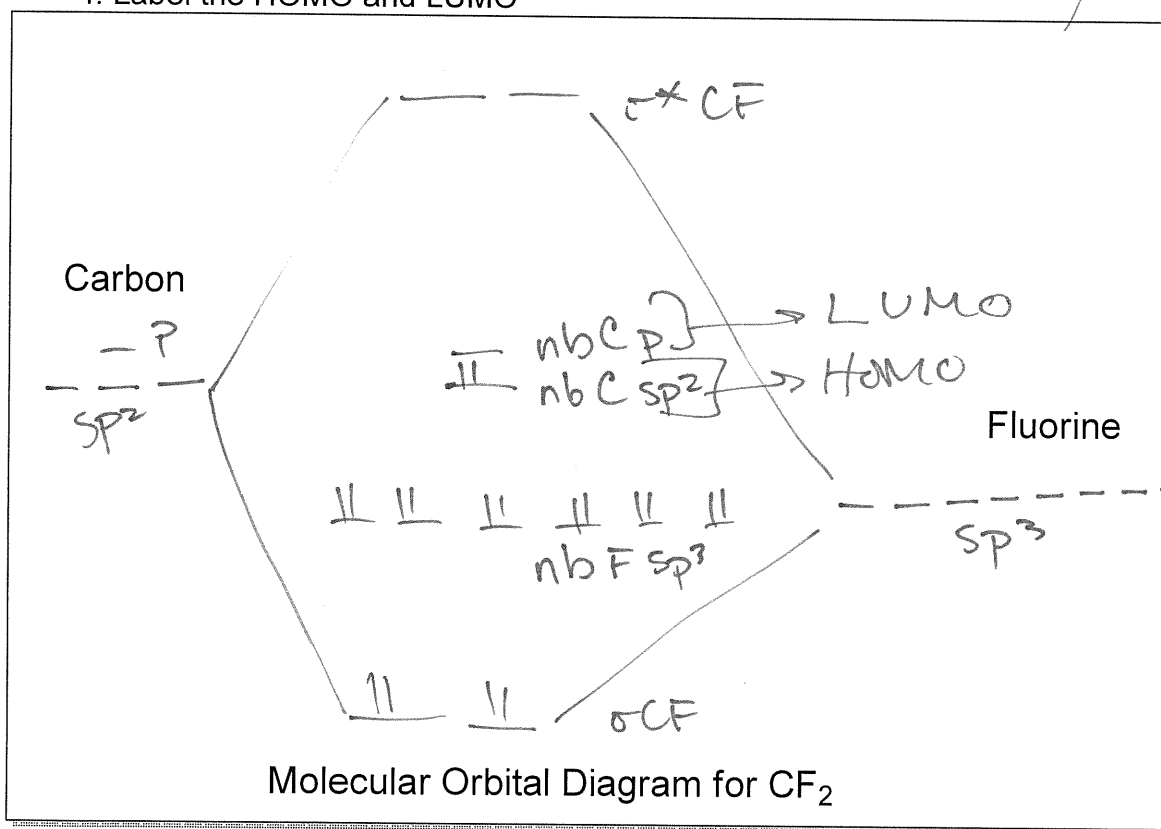


F

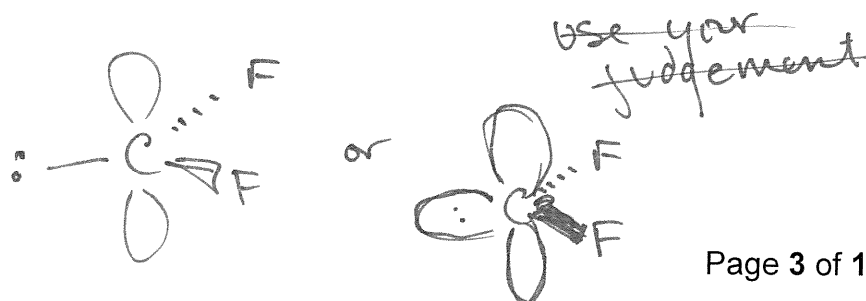
2. A. Construct the molecular orbital diagram for the neutral species CF_2 . Use the following guidelines and labeling schemes. Please be sure to include everything asked for below. (12 pts)

- Assume the carbon atom is sp^2 hybridized and the fluorine atoms are each sp^3 hybridized
- Indicate the relative energy levels of any atomic and hybrid orbitals on both the left and right of the diagram
- Clearly indicate which orbitals are being combined to make MOs
- Fill in all of the electrons
- Label all of the levels (σ , π , π^* , non-bonding, etc.)
- Label the HOMO and LUMO

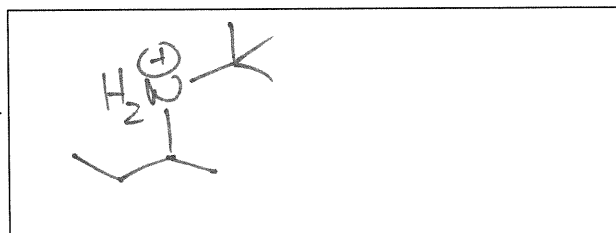
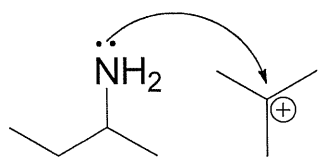
2 pts each



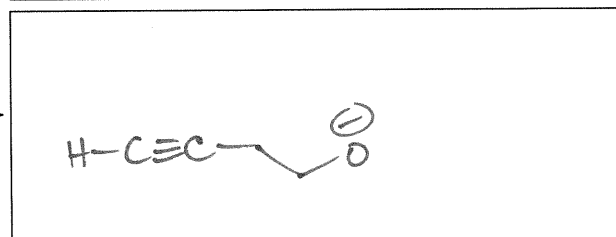
2. B. Draw a 3D image of CF_2 , clearly showing any empty orbitals. You may use our template to show the directionality of any lone pairs of electrons on carbon. You may ignore the lone pairs on the fluorine atoms. (4 pts)



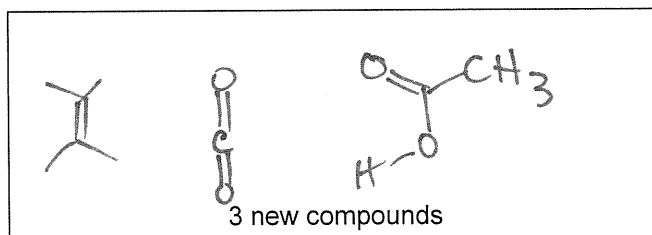
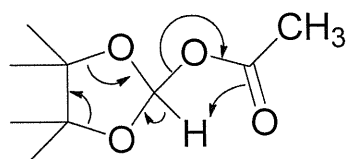
3. A. Provide the products following the electron-pushing arrows shown.
(9 points)



3 each
1 for charge
2 for strxr

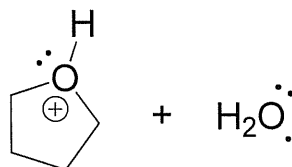
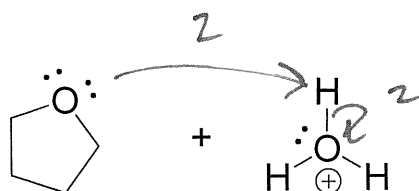


1 for charge
2 for strxr

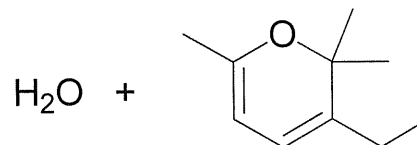
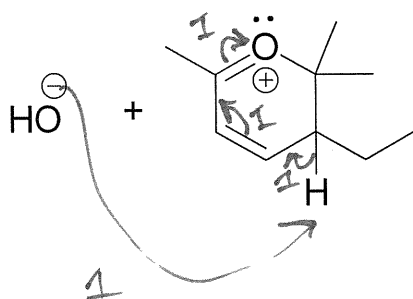
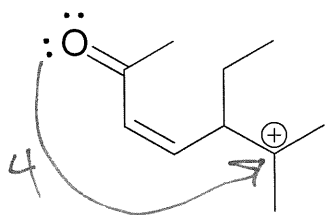


1 pt each
strxr

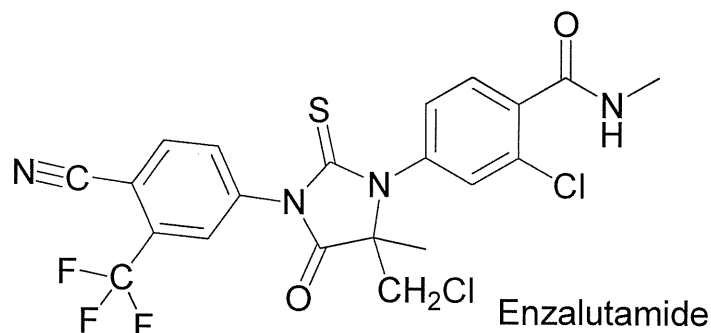
3. B. Add appropriate electron-pushing arrows for the following reactions.
(12 points)



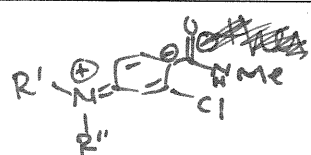
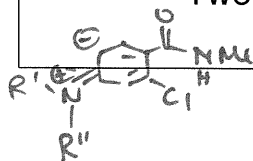
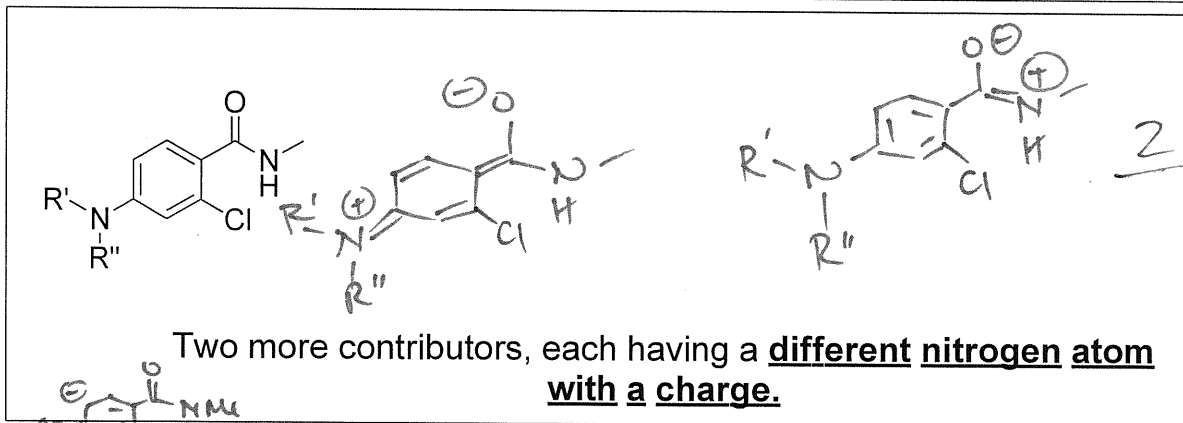
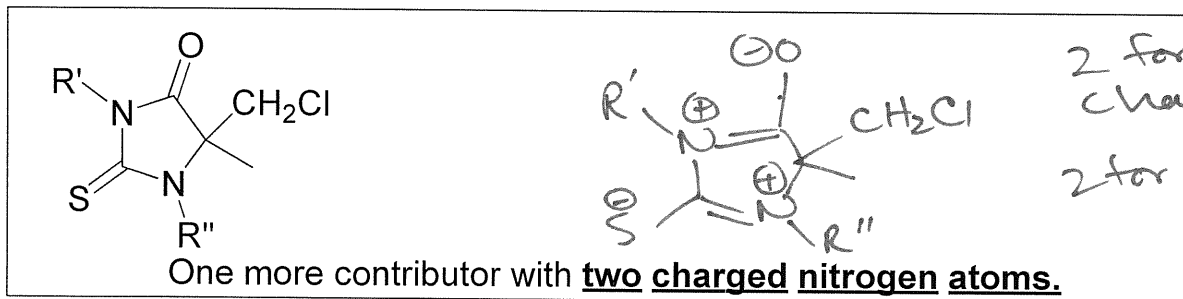
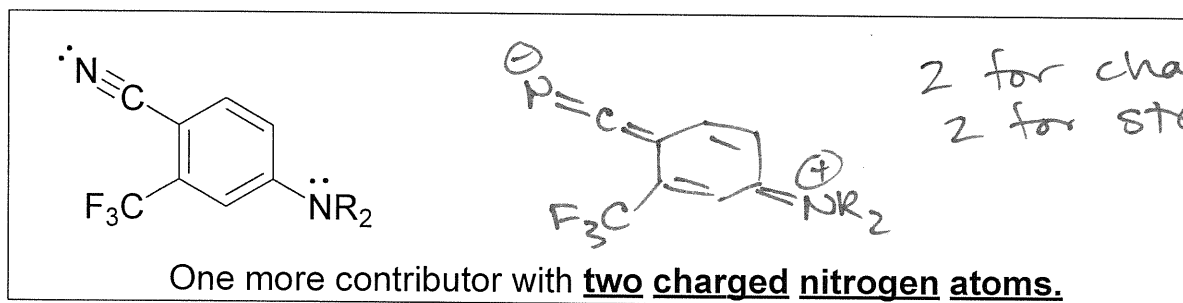
~~2 pts each~~



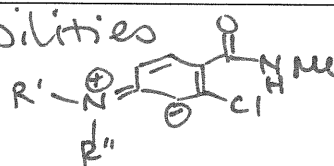
4. Enzalutamide is a recently approved prostate-cancer drug. This molecule interacts with an androgen receptor which is responsible for transporting testosterone in cells. The following questions will help you understand its reactivity. (45 points)



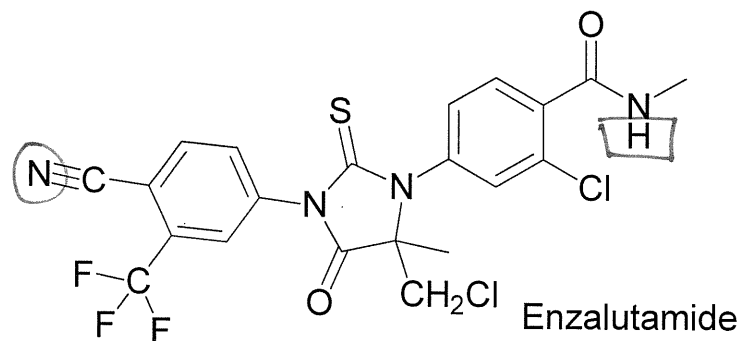
4. A. Provide resonance structures where all atoms have filled octets for the following portions of Enzalutamide. Pay special attention to directions in each box. (12 points)



possibilities



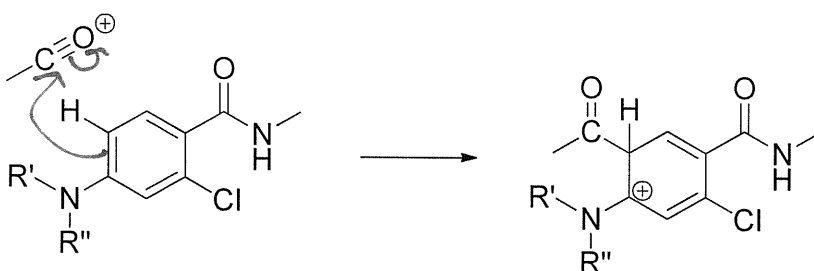
4. B. Using your resonance structures from 4.A., determine which nitrogen atom in Enzalutamide has the most partial negative charge. Circle it on the structure below. (2 points)



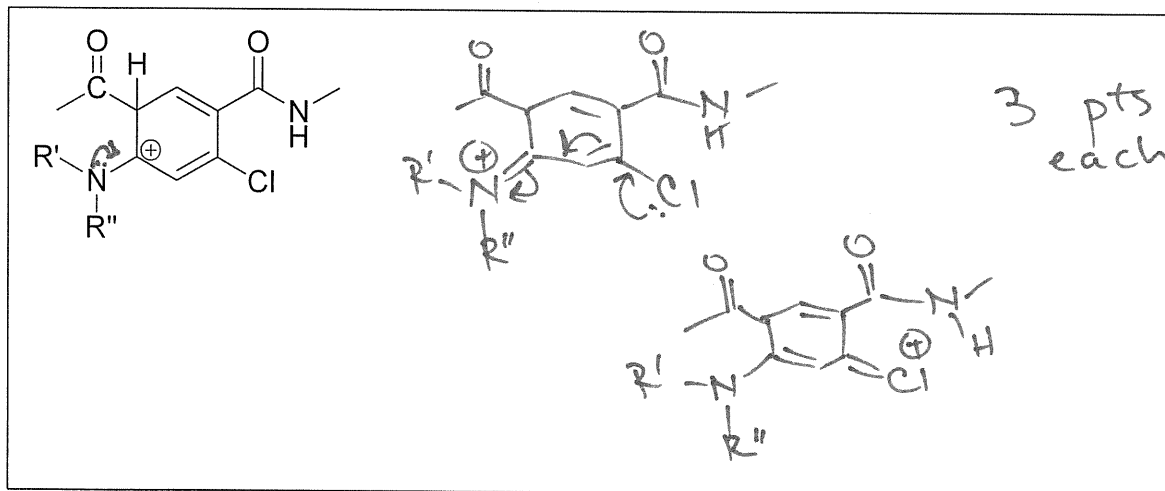
4. C. Using your resonance structures from 4.A., determine the hydrogen atom in Enzalutamide that is the most acidic. Draw a square around it on the structure above. (2 points)

4. D. How many **sp** hybridized atoms are there in Enzalutamide? 2 A o N (2 points)

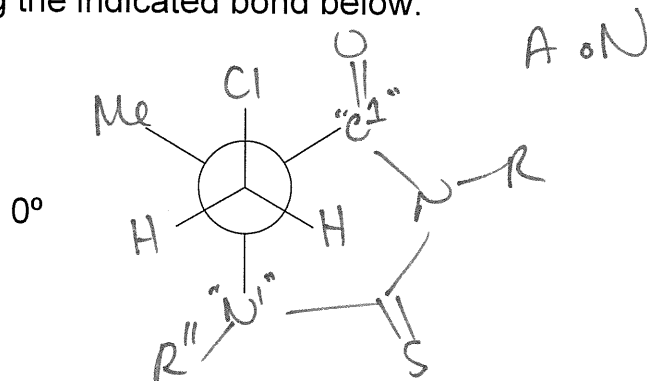
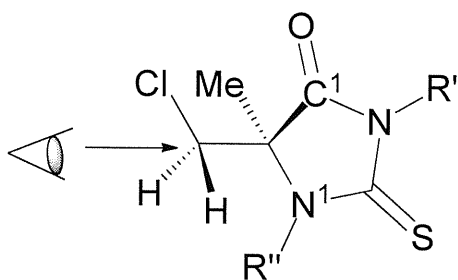
4. E. Add electron-pushing arrows to the following reaction sequence. (3 points)



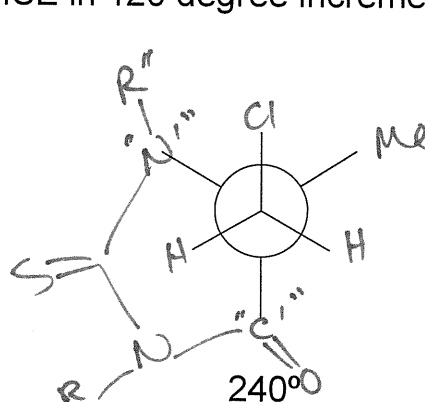
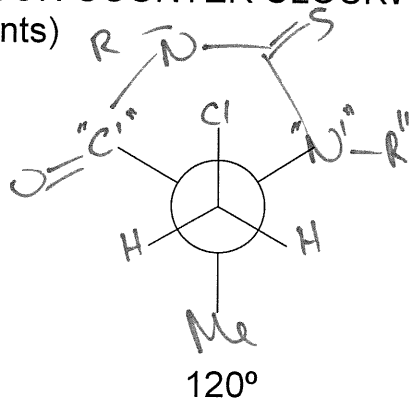
4. F. Provide 2 more resonance structures with filled octets for the cation below that clearly show relocation of the positive charge. (6 points)



4. G. Draw a Newman Projection along the indicated bond below.
(3 points)



4. H. Starting from the Newman Projection above as 0° , rotate the BACK CARBON COUNTER CLOCKWISE in 120° degree increments.
(6 points)



can be correct based on the drawing for 0° .

4. I. For each of the three Newman Projections that you have drawn, (0° , 120° , 240°), clearly describe any steric interactions among non-hydrogen substituents in the chart below. Use the word *Gauche* when describing the interactions. (6 points)
Please use the abbreviations "C¹" and "N¹" when describing the interactions.

Steric Interactions

0°	Cl Me, Cl "C ¹ "
120°	Cl "C ¹ ", Cl "N ¹ "
240°	Cl Me, Cl "N ¹ "

2 each based on THEIR DRAWINGS

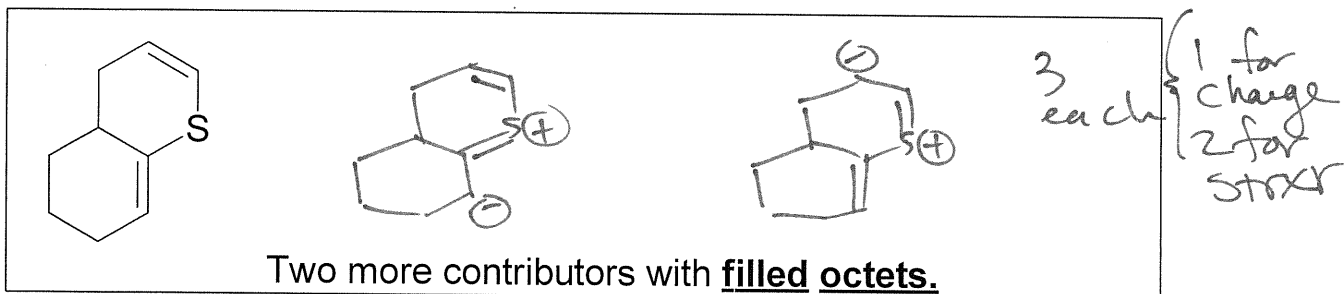
4. J. If the relative size of the groups is $\text{Cl} < \text{Me} < \text{"C}^1\text{"} < \text{"N}^1\text{"}$, which conformational isomer is the lowest energy? (3 points)

LOWEST ENERGY : 0 °

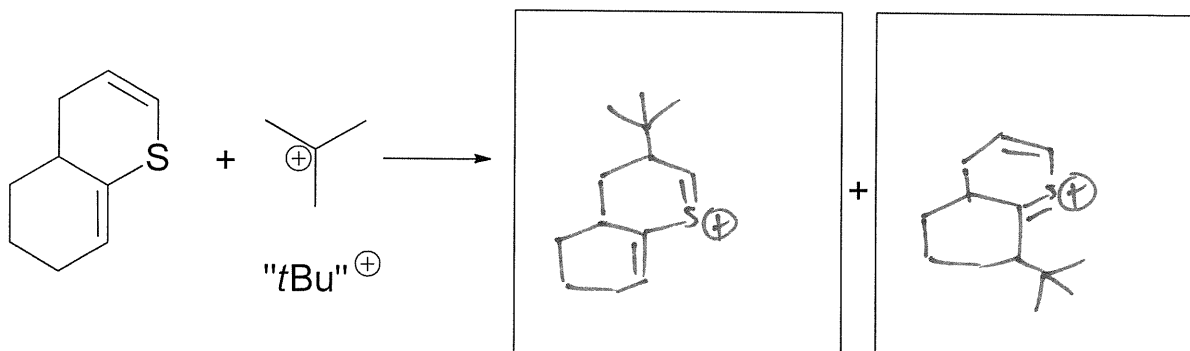
Based on THEIR DRAWINGS

5. Sulfonium ions contain a positively charged sulfur atom. Let's play with a couple of them, below. (18 points)

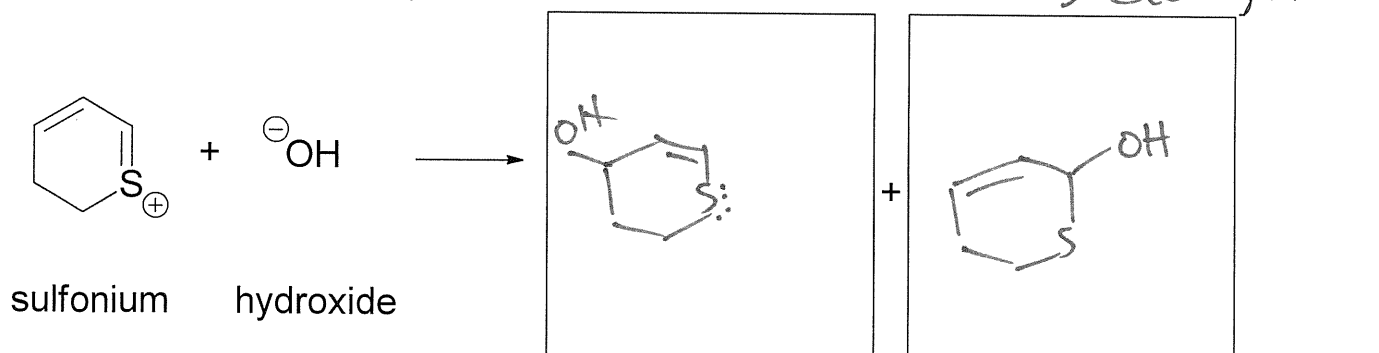
5. A. Provide 2 more resonance structures of the compound shown below. (6 points)



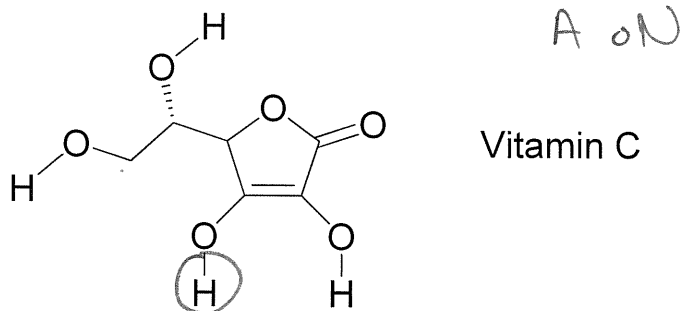
5. B. Based on the resonance contributors that you drew, predict the two products where new carbon-carbon sigma bonds are formed in the reaction below. You may use the abbreviation *tBu* when drawing the new products. Be sure to show the products such that each atom has a filled octet. (6 pts)



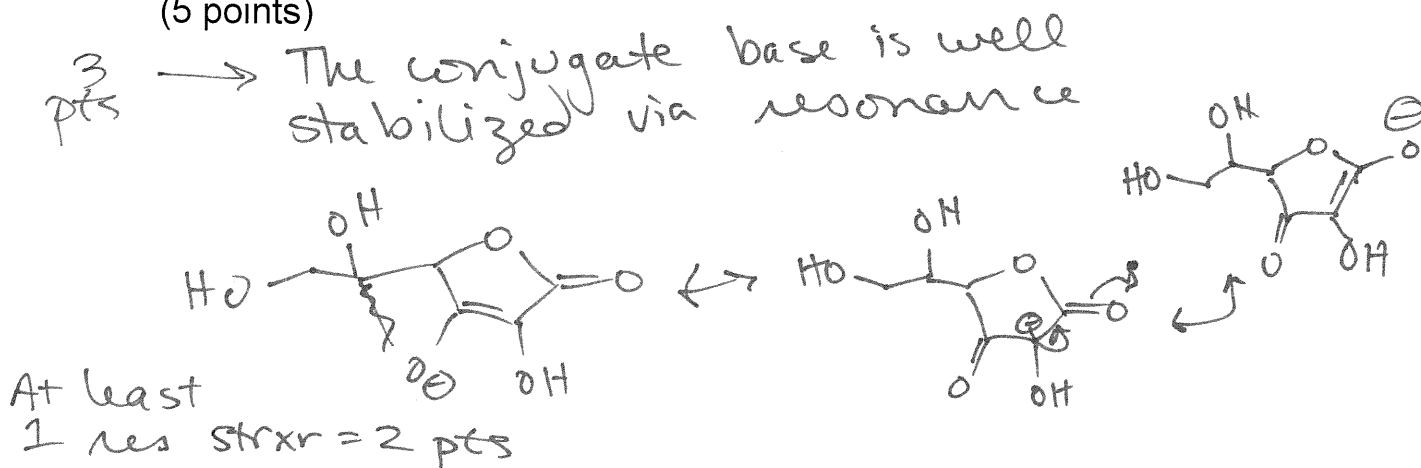
5. C. Predict the two products where new carbon-oxygen sigma bonds are formed in the reaction between the hydroxide anion and the sulfonium ion below. (6 points)



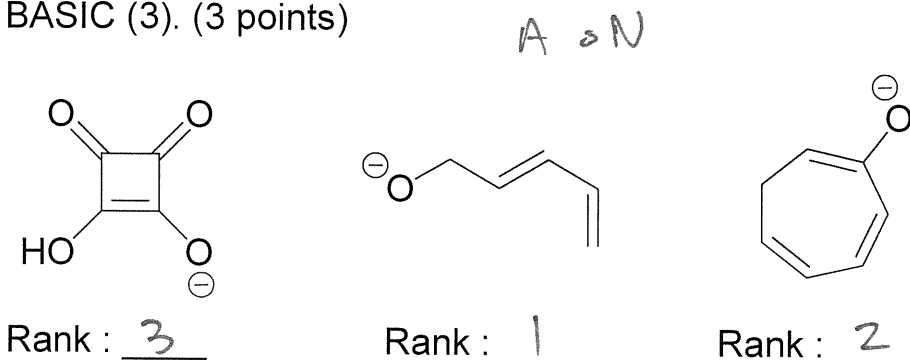
6. A. There are four different OH bonds in ascorbic acid (vitamin C). Which of those hydrogens is the most acidic? Circle it on the structure below. (3 points)



6. B. Justify your answer to 6.A. using words and resonance structures. (5 points)



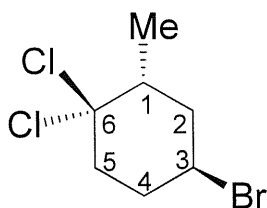
6. C. Order the following compounds from MOST BASIC (1) to LEAST BASIC (3). (3 points)



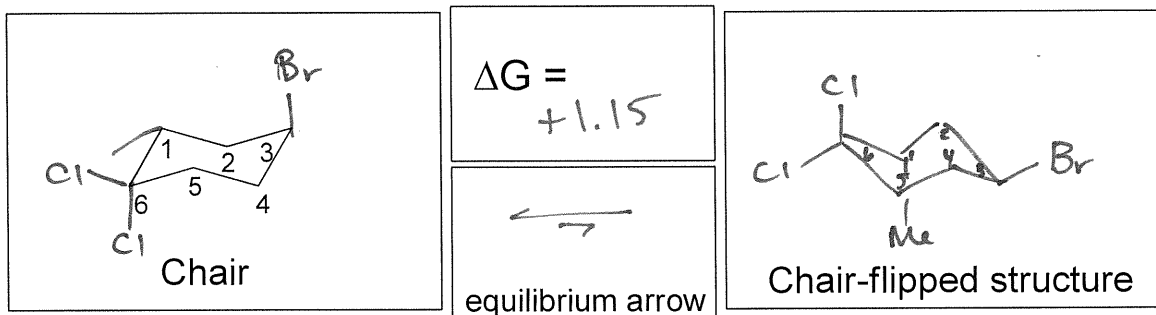
6. D. Explain your choice for the MOST BASIC compound. (3 points)

no resonance stabilization of negative charge A o N

7. For this question, you will be analyzing the chair structure of the following molecule. (18 pts)



7. A. Draw the substituents in the proper orientation on the chair structure provided below. (4 pts)
7. B. Draw the chair-flipped structure in the box on the right. (4 pts)
7. C. Using the data provided on the last page of the exam, calculate the ΔG for the chair-flip and write the answer in the appropriate box. Be sure to show your work. (5 pts)
7. D. Based on your ΔG , draw in the equilibrium arrow for this chair flip in the appropriate box. (2 pts)



Show work:

$$\begin{array}{r}
 \text{Cl}_{eq} \rightarrow \text{ax} \quad +0.52 \\
 \text{Cl}_{ax} \rightarrow \text{eq} \quad -0.52 \\
 \text{Br}_{ax} \rightarrow \text{eq} \quad -0.55 \\
 \text{Me}_{eq} \rightarrow \text{ax} \quad +1.7 \\
 \hline
 \qquad \qquad \qquad +1.15
 \end{array}$$

7. E. Would you expect the experimental ΔG to be higher, lower, or the same as the one you calculated? Explain. (3 pts)

Should be lower due to
 loss of a Me-Cl gauche
 interaction