

Chemistry 116 Sec. A (8:00-8:50)
Exam No. 1 ANSWER KEY
“Structure and Functionality”
September 22, 2000

Instructions: You will have 50 min. to complete the exam. At the 50 min. mark, I will request that all remaining test takers cease writing, turn their exams over, and pass them to their rightmost isle. If you finish within 45 min. you may turn in the exam at the front of the room prior to leaving. If you finish in the final 5 min. of class, please turn your exam over and remain seated until I call for the remaining exams to be turned in. *In fairness to all, anyone still working on the exam after “time” is called will receive a grade of zero!*

Be sure to read the instructions for each question. It may be helpful to skim the entire exam and solve the easier questions first.

Exam Agreement: I, _____, have read and agree to

(Please print)

abide by the instructions above. On my honor, I have neither given nor accepted any help on this exam.

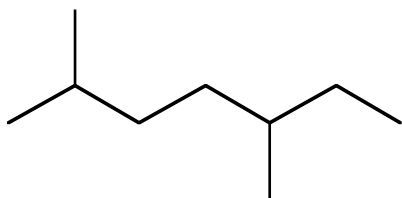
Signature: _____

College: _____

**DO NOT OPEN THIS EXAM UNTIL
INSTRUCTED TO DO SO**

1) Translate the following structures to the representation requested above each box.

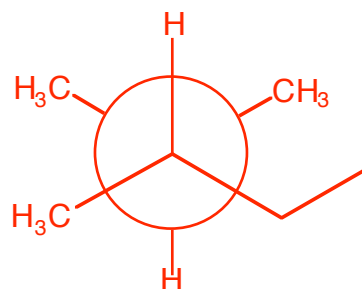
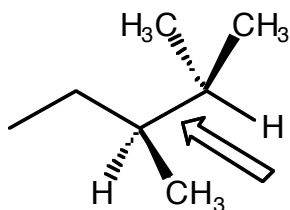
Condensed Structural Formula (6 points)



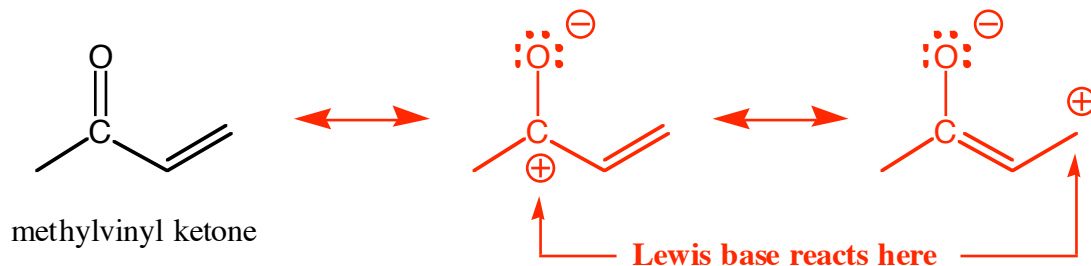
Name the molecule shown above (4 points)

2,5-dimethylheptane

The most stable **Newman Projection** looking down the indicated bond (6 points)



2) The following drawing represents the most stable Lewis structure for methylvinyl ketone, a molecule used in commercial paint strippers. Methylvinyl ketone has been found to react with various Lewis bases. Using your knowledge of resonance theory, show the position or positions on the molecule where a Lewis base might react and provide a rationale for your selection(s) using both pictures *and* words. (10 points)

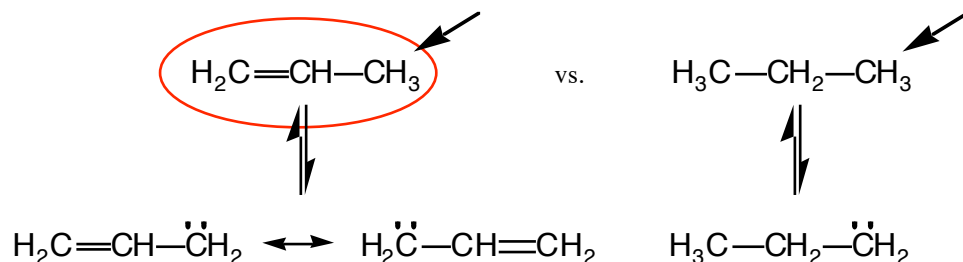


Lewis bases are electron donors and usually negatively charged or partially negative. Their negative character causes them to be attracted to positive centers.

3) For each pair of molecules shown below, select the one that best fits the accompanying description by circling it. Provide a concise rationale for each of your decisions. (6 points each)

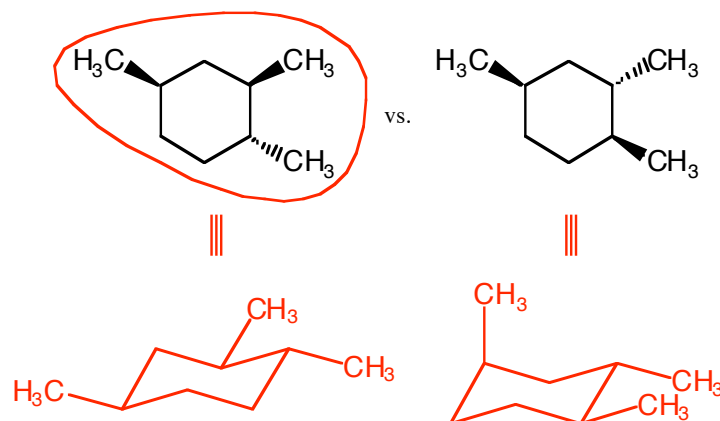
Rationale

The most acidic proton?



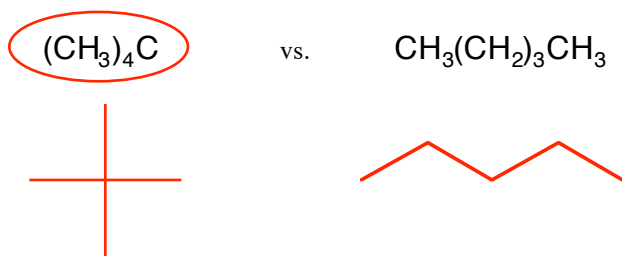
In the 1st acid, resonance can delocalize the negative charge formed in the conjugate base. This delocalization makes the conjugate base more stable. Therefore, the original acid is strengthened by its "desire" to populate the products side of the reaction.

The most stable molecule?



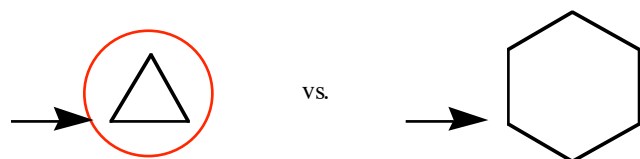
This isomer has an axial methyl group which leads to two unfavorable 1,3-diaxial interactions

The molecule with the highest melting point?



The circled molecule is more symmetrical so it can pack more efficiently in the solid phase. This will make it harder to break the intermolecular forces and melt the molecule.

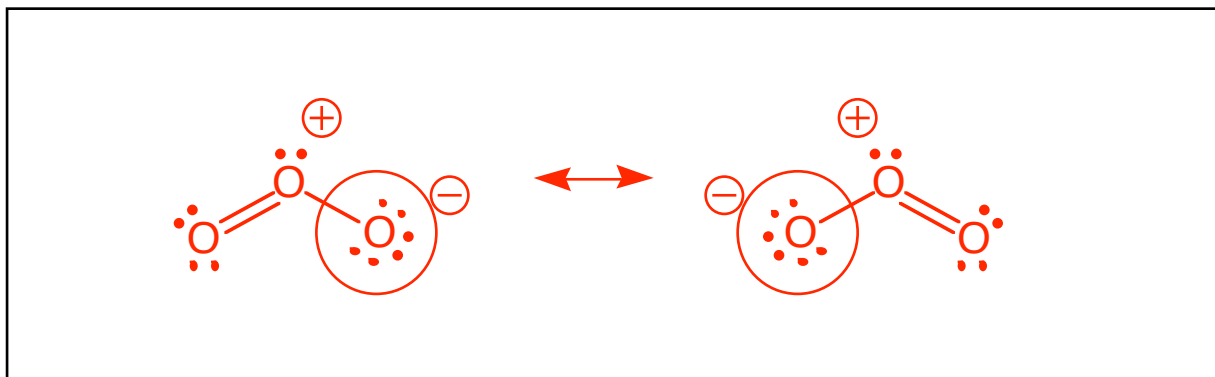
The carbon with the greatest "s" character?



The highly strained cyclopropane ring contains shorter C-C bonds. The shorter the bond, the greater the "s" character because s orbitals are closer to the nucleus and thus contribute to bringing atoms involved in such bonds closer to each other.

4) Ozone (O_3), a molecule found in the stratosphere, is vital in protecting the earth's inhabitants from the sun's harmful UV rays. Draw the Lewis structure of ozone in the box provided showing all lone pairs of electrons and charges where applicable. If any resonance contributors exist for ozone, draw those as well. Then answer the questions that follow:

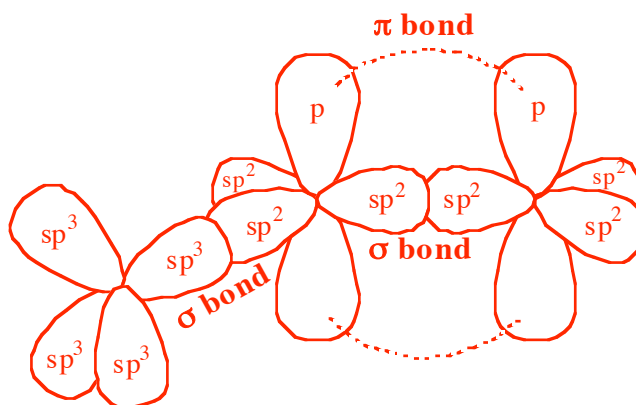
Lewis Structure(s) for Ozone (6 points)



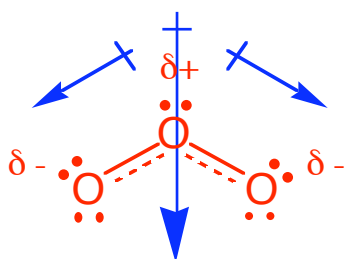
a) Circle the oxygen or oxygens in ozone that is/are *most* likely to react with a Lewis acid. (4 points)

A Lewis acid is an electron acceptor. The negatively charged oxygen atoms in ozone are richest in electrons and thus most likely to donate electrons. See circled atoms above.

b) Draw the orbital picture for ozone. Be sure to label the orbital types and bond types in your picture. (8 points)

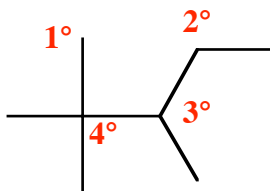


c) Does ozone have a permanent dipole moment? Why or why not? (6 points)

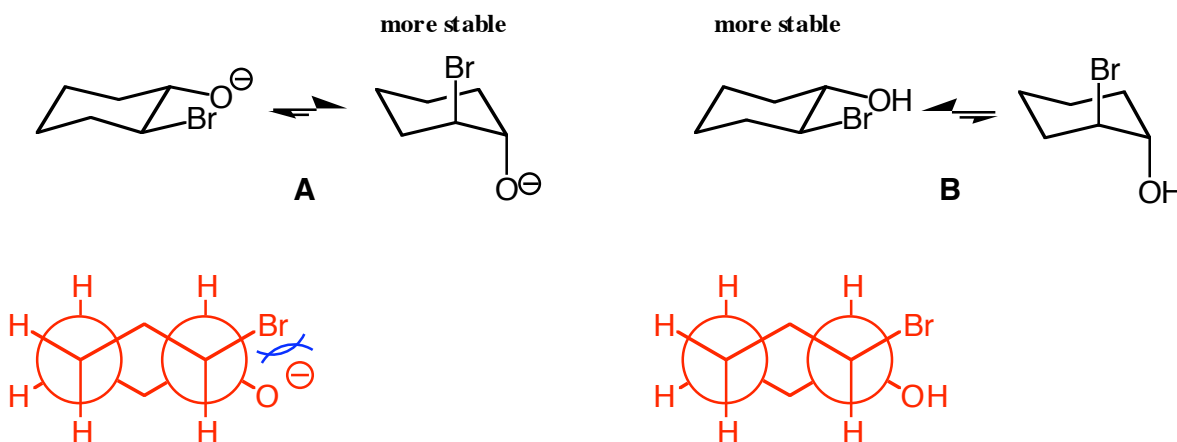


Yes. Based on the resonance picture of ozone, we can expect ozone to exist as a hybrid as shown in the diagram on the left. The partial charges cause individual dipoles to exist which in turn create a permanent dipole moment as drawn.

5) Provide an example of a molecule that contains a 1°, 2°, 3° and 4° carbon. Label each carbon type in your drawing. (8 points)

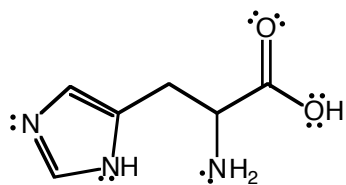


6) Molecular modeling calculations show that molecule **A** is actually more stable when both substituents are axial whereas molecule **B** is more stable when both substituents are equatorial. Using words and at least one Newman projection, provide an explanation for this unusual result. (10 points)



An increased electrostatic repulsion is created when the oxygen is deprotonated because one negatively charged atom is placed gauche to a partially negative bromine. This situation does not exist in compound **B**.

7) Medical evidence suggests that some speech deficiencies in children are caused by a lack of the amino acid histidine. Histidine is shown below in its uncharged form along with a table of pK_a 's. Draw the predominant form of histidine at $pH = 8$ and indicate its overall charge (**CHARGE=0**). (8 points)



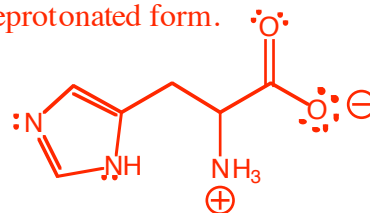
Histidine (Uncharged Form)

Functional Group	pK_a
	6.04
	9.17
	1.82

The Henderson-Hasselbalch equation yields the following relationships between pH and pK_a .

When $pK_a > pH$, an acid is in its protonated form.

When $pK_a < pH$, an acid is in its deprotonated form.



Grading Summary

Page	Point Value	Points Earned
2	26	
3	24	
4	24	
5	26	
	Total Score =	