This test consists of a combination of multiple choice and other questions. There should be a total of twelve questions on five pages; please check now to make sure that they are all here. Do not use your own tables, scratch paper or other information. Please turn off all cell phones, pagers and other communication devices; they will be confiscated if they make noise. No food. No water. No gum. No bathroom breaks. No templates. You may use models as follows: four carbons, ten other atoms (may include carbons) and enough bonds to connect them. No calculators. The test will end two hours after it starts. An information sheet will be handed out separately.

**Multiple Choice Questions**

These 5 questions are worth 4 points each, for a total of 20 points. Unless it is stated otherwise in a given problem, there is only one correct answer for each question. Answer each question by circling all letter(s) corresponding to the correct choice(s); in other words, if more than one answer *is* correct, you should circle all of the correct ones. It is not necessary to show work for these questions; however, you may write on the exam.

1. Which of the following compounds is expected to have the lowest boiling point?

   a.  
   b.  
   c.  
   d. it is impossible to tell

2. Which resonance structure is more stable?

   ![Resonance Structures]

   a. The one on the left  
   b. The one on the right  
   c. They are degenerate.  
   d. This is a trick question as they are not resonance structures.

3. Which is the most stable of the group below?

   a.  
   b.  
   c.  
   d. It is impossible to tell.

4. Which of the explicitly-drawn hydrogens is more acidic?

   ![Hydrogens]

   a.  
   b.  
   c. They are equally acidic.  
   d. It is impossible to tell.
5. The following reaction has \( K > 1 \). Which of the following is/are true statements based on this information and the reaction? More than one answer may be correct.

\[
\text{\ce{CH3CH2O\textsuperscript{-}}} + \text{\ce{CH3CH2OCH3}} \rightleftharpoons \text{\ce{CH3CH2O\textsuperscript{-}}} + \text{\ce{CH3CH2OH}}
\]

a. The ketone is a stronger acid than the thiol.
b. The conjugate base of the thiol is a stronger base than the conjugate base of the ketone.
c. The conjugate base of the ketone could deprotonate the thiol in a reaction with \( K > 1 \).
d. \( \text{\ce{CH3CH2O\textsuperscript{-}}} \) could deprotonate the ketone in a reaction with \( K > 1 \).
e. None of the above is correct.

Other Questions
Each of the following questions is worth the indicated number of points, for a total of 61 points. Please be sure to provide all of the information requested for each question.

6. 24 points Indicate the relationship between each of the following pairs of compounds as one of the following: constitutional isomers (CI), conformations (C), unrelated (U), cis-trans isomers (CT), or identical as far as can be determined from the structures (ID). Write your answers within each rectangle.

a. 

b. 

c. 

d. 

e. 

f. 

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7. 12 points Provide names for each structure, using one of the naming systems discussed in class. Please write the names on the lines provided and the structure below its name.

a. 

b. 

c. 

8. 9 points Do the following for each part (letter). 1-Add lone pair electrons where needed to the initial structure (you may also add hydrogens if you wish). 2-Draw the indicated number of additional significant resonance structure(s). Include lone pairs and formal charges in your structures. 3-Draw curved arrows to show electron movement.

a. 

b. 

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9. 21 points Provide the requested information about the indicated portions of the molecules below. The compounds are a toxin excreted by a species of frogs, a component of myrrh resin, and one of the compounds that contributes to the odor of pine trees. In case this isn’t obvious, the answers go on the lines, NOT next to the compounds.

a. Name of functional group that includes atom to which the arrow is pointing: ___________________

b. Name of functional group that includes atom to which the arrow is pointing: ___________________

c. Name of functional group that includes atom to which the arrow is pointing: ___________________

d. Name of functional group that includes atom to which the arrow is pointing: ___________________

e. Hybridization of the orbitals used by this atom _________

f. Hybridization of the orbitals used by this atom _________

g. Is this bond in the cis or the trans configuration? __________

h. Molecular formula of this entire compound: _________________

10. 8 points Please fit your answers in the space provided. Your explanations may incorporate structures.

a. Explain why the compound on the left is a stronger base than the compound on the right. Hint-it gets protonated on the nitrogen with the double bond to it.

b. Which of the following is expected to be more stable and why?

\[
\text{[Structures]} \quad \text{[Structures]}
\]
11. *8 points* Draw both chair conformations of the molecule below and circle the more stable one.

![Chair Conformation](image1)

12. *18 points* Draw all staggered and all eclipsed conformations of the molecule below, using Newman projections and sighting along the bond indicated. Put a 1 under the most stable conformation, a 2 under the second-most stable conformation and so on. If two or more structures are degenerate use the same number for all of them and then give the next-most stable structure the next number in the sequence.

![Newman Projections](image2)