

CHEM 3311 Spring 2006

Exam 1

February 16, 2006
Professor Rebecca Hoenigman

Average Score = 55

High Score = 96

Low Score = 13

I pledge to uphold the CU Honor Code:

Signature _____

Name (printed) _____

Last four digits of your student ID number _____

Recitation TA _____

Recitation number _____

Recitation day, and time _____

You have 1 hour and 15 minutes to complete this exam.
No model kits or calculators allowed; periodic table and scratch paper are attached.

PUT YOUR NAME ON ALL PAGES OF THE EXAM.

DO NOT TURN THIS PAGE UNTIL INSTRUCTED TO DO SO.

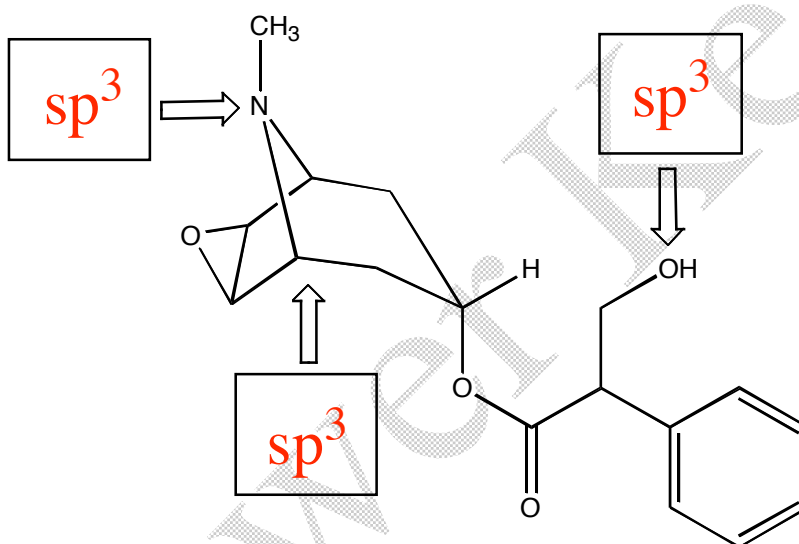
Recitation Sections:

Number	Day	Time	TA
121	Tuesday	8 am	Andrew
131	Tuesday	1 pm	Heather
141	Wednesday	8 am	Chris
151	Wednesday	12 pm	Andrew
153	Wednesday	12 pm	Nicole
152	Wednesday	5 pm	Chris
171	Thursday	12 pm	Heather

1. (5 pts) Define organic chemistry in one or two sentences.

Organic chemistry is the study of carbon compounds.

2. (9 pts) Devil's apple is a flowering plant (of the *Datura stramonium* family). This plant produces delirium when consumed in small amounts, and coma or death in large amounts. One of the active ingredients in devil's apple is scopolamine, shown below.



scopolamine

A. Circle **all** of the terms below that describe one or more structural feature of scopolamine.

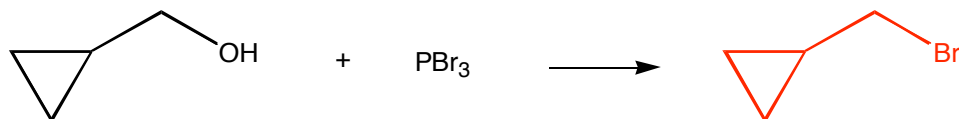
- | | | |
|----------|---------------|-------------------|
| 1° Amine | Alkene | Non-aromatic ring |
| 2° Amine | Amide | Ester |
| 3° Amine | Aromatic ring | Epoxide |
| Alcohol | Halide | Ketone |
| Thiol | Ether | Aldehyde |

(1 pt correct circle, -1 pt missing or incorrect circle)

B. In the boxes above, write the hybridization of the indicated atom.

3. (8 pts) Give the products for the following reactions. If no reaction, write NR.
(2 points each)

A.



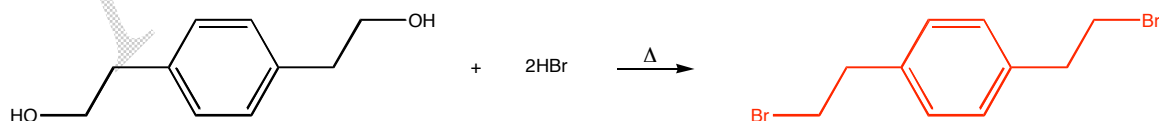
B. Book problem 4.35a



C. Book problem 4.36b

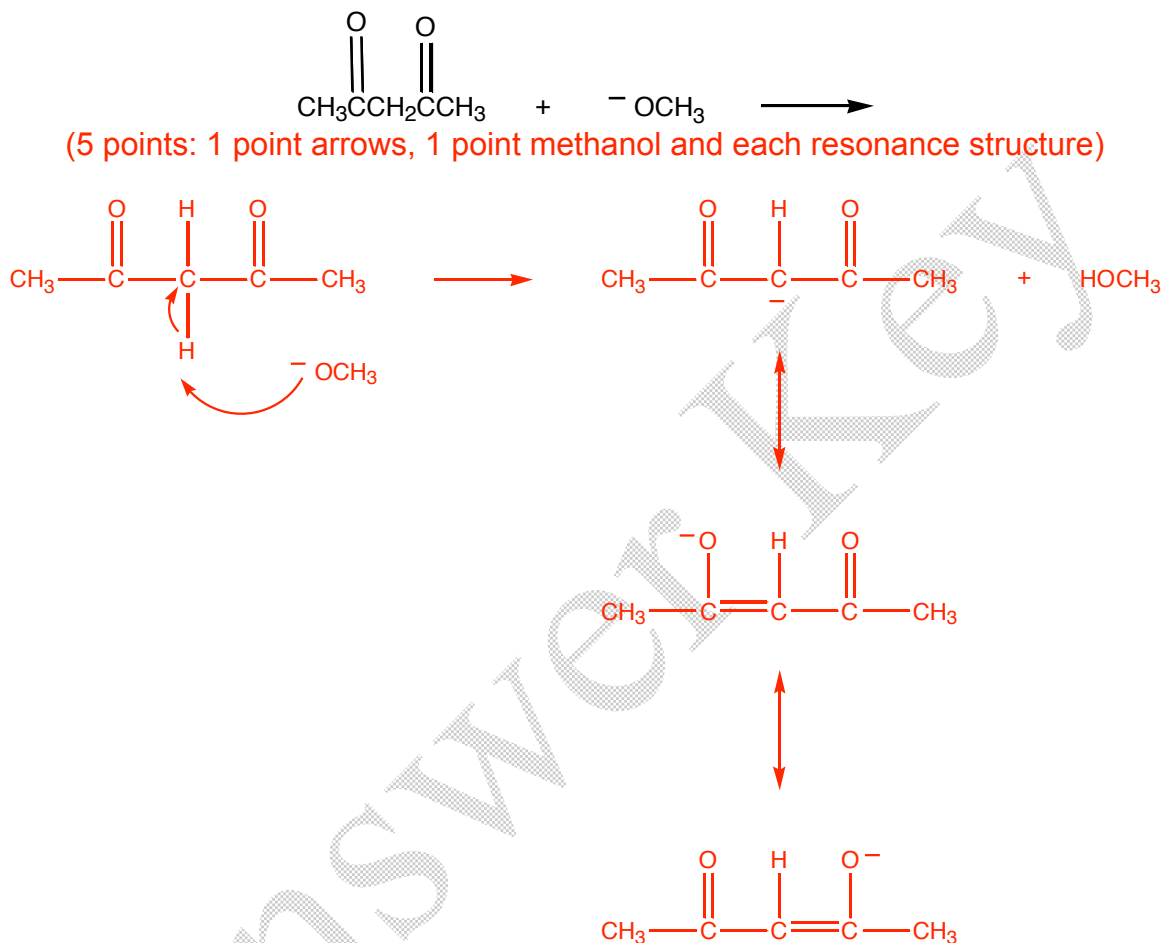


D. Book problem 4.36d



4. (10 pts) [Book problem 1.71c](#)

- A. For the following acid-base reaction, use curved arrows to show the formation of products. Show all major resonance structure(s) of the conjugate base. Be sure to include all non-zero formal charges.



- B. Predict whether the equilibrium lies to the left or right. Explain why. (5 points: 1 point direction, 4 points explanation)

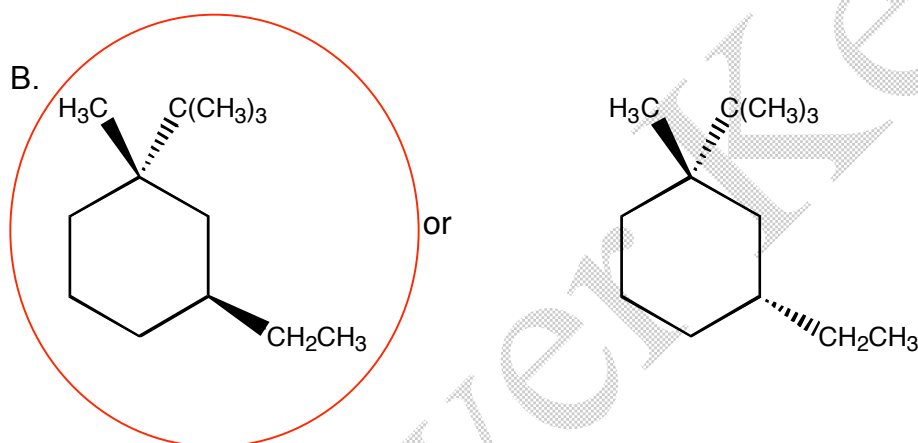
The weaker base is the more stable anion. The conjugate base of the anhydride has three resonance structures, while there is only one resonance structure for methoxide. Reactions go from strong base/acid to weak base/acid. Therefore, the equilibrium lies to the right.

5. (15 pts) For each of the following pairs, circle the compound that has the higher heat of combustion. Give the reason for your choice.

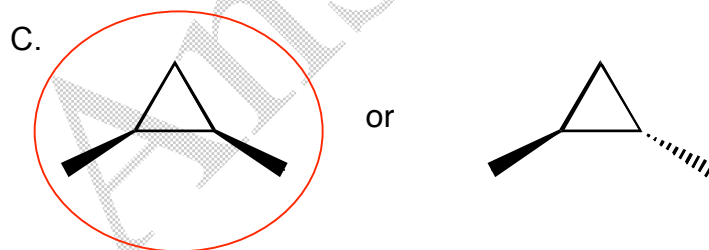
Higher heat of combustion = less stable
(2 points for each circle, 3 points for each explanation)

A. cis-1-*t*-butyl-2-propylcyclohexane or trans-1-*t*-butyl-2-propylcyclohexane

In the most stable chair conformation, the *cis* isomer will have the propyl group in an axial position, while the *trans* isomer will have the propyl group in an equatorial position. The axial position for the propyl group is higher in energy due to 1,3-diaxial interactions.

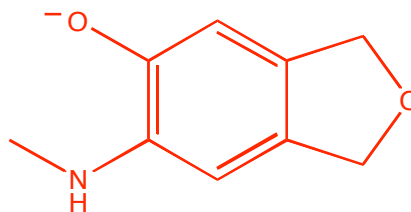
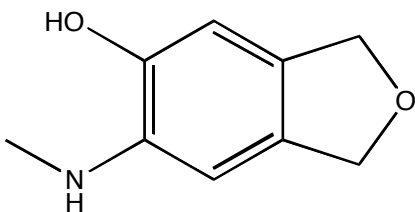


In the most stable chair conformations, the circled compound has the ethyl in an axial position. Again, this is the high energy isomer, due to methyl-ethyl 1,3-diaxial interactions.



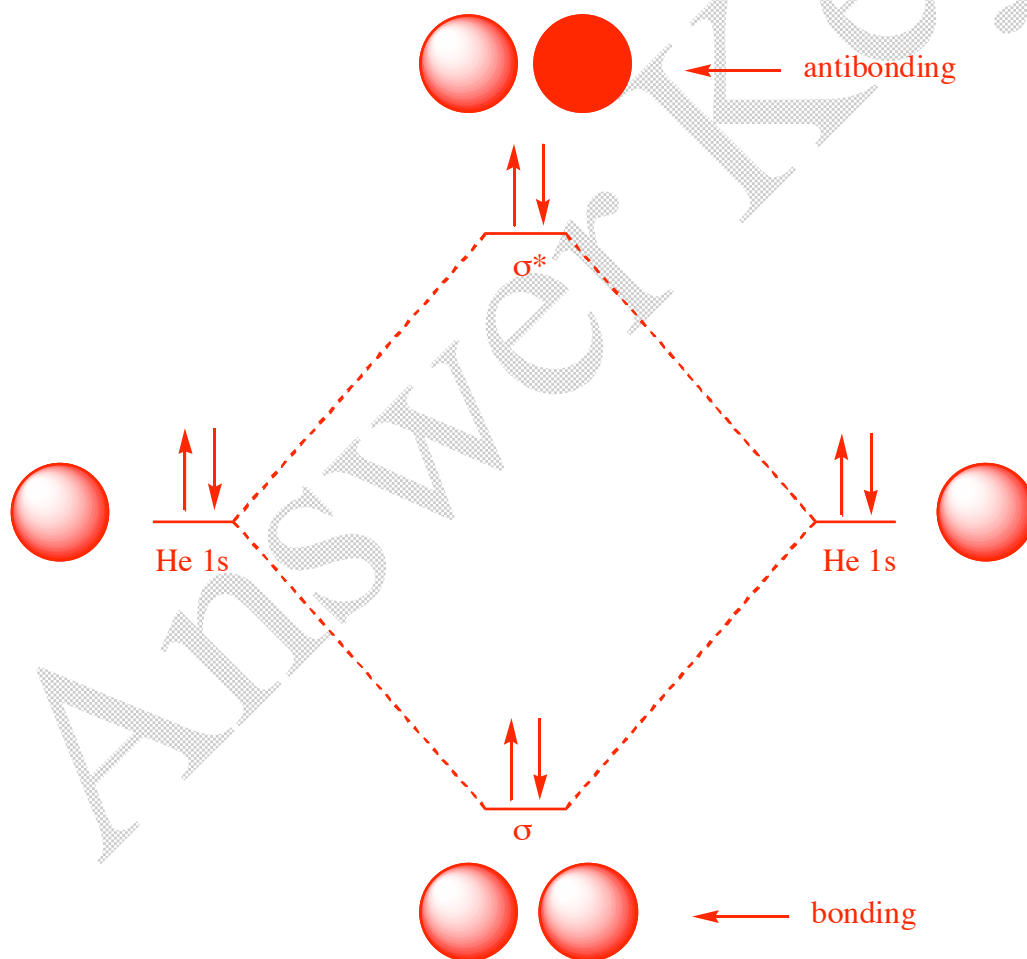
The *cis* compound has higher torsional strain due to the eclipsing interactions of the methyl groups.

6. (2 pts) The following is a similar question to one found on a practice dental assessment exam. Draw the conjugate base of the following compound.



7. (10 pts) Use a molecular orbital diagram to explain why He₂ does not exist. Be sure to label the bonding and antibonding orbitals.

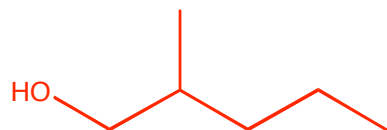
(7 points diagram, 3 points explanation)



He₂ does not exist because to do so, 2 electrons would have to go into a destabilizing antibonding orbital.

10. (24 pts) Draw bond-line formulas for all the constitutional isomers that have the formula $C_6H_{14}O$ and that would be named in the IUPAC system as pentanols. Label each alcohol as primary, secondary, or tertiary. Do not repeat structures.

(2 points each structure, 1 point each label, -1 point each structure that isn't a bond line formula, -2 points for incorrect or duplicate structures)



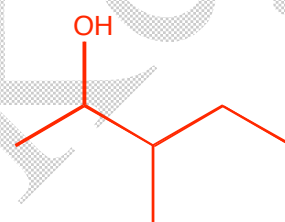
primary alcohol



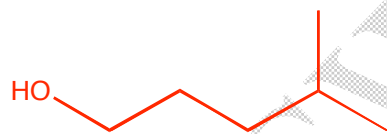
tertiary alcohol



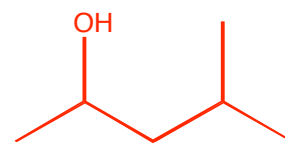
primary alcohol



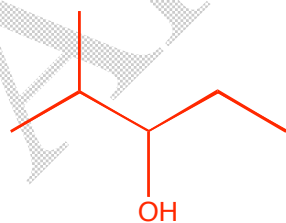
secondary alcohol



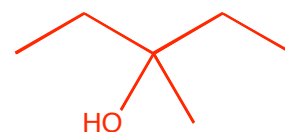
primary alcohol



secondary alcohol



secondary alcohol



tertiary alcohol

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Answer Key

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Total _____

Answer Key