CHEM 3311-200, Fall 2005

# Exam 2

October 20, 2005
Professor Rebecca Hoenigman

I pledge to uphold the CU Honor Code:

Signature_____

Name (printed)_____

Last four digits of your student ID number_____

Recitation TA_____

Recitation number, day, and time_____

You have 1.5 hours to complete this exam.
No model kits allowed; periodic table and scratch paper are attached.

DO NOT TURN PAGE UNTIL INSTRUCTED TO DO SO.

**Put your name on ALL pages of the exam**

**Recitation Sections:**

| **Number** | **Day** | **Time** | **TA** |
|---|---|---|---|
| 211 | Monday | 8 am | Kate |
| 251 | Monday | 2 pm | Kate |
| 291 | Monday | 5 pm | Xin |
| 252 | Tuesday | 12 pm | Matt |
| 293 | Tuesday | 5 pm | Jon |
| 212 | Wednesday | 8 am | Greg |
| 253 | Wednesday | 1 pm | Greg |
| 292 | Wednesday | 5 pm | Jon |
| 213 | Friday | 8 am | Xin |

Name: _____

1. (10 pts) Answer the following questions about the halogenation of methane via a chain radical reaction with $X_2$.

$$CH_4 + X_2 \rightarrow CH_3X + HX$$

A. What is the chain initiation step?

B. What are the two chain propagating steps?

C. Using the BDEs given below, calculate the enthalpy of each propagation step for $X_2 = I_2$ and $X_2 = F_2$.

BDEs (in kJ/mol)

$CH_3$-H =435 $CH_3$-I=234 $CH_3$-F=451 $I_2$=150 $F_2$=159 HI=297 HF=568

| $I_2$ Step 1 | $F_2$ Step 1 |
|---|---|
| $\Delta H$ = | $\Delta H$ = |

| $I_2$ Step 2 | $F_2$ Step 2 |
|---|---|
| $\Delta H$ = | $\Delta H$ = |

D. Calculate the overall energy for the reactions of methane with iodine and fluorine.

| $I_2$ | $F_2$ |
|---|---|
| $\Delta H_{overall}$ = | $\Delta H_{overall}$ = |

E. Why can't iodomethane be prepared by this mechanism?

Name: _____

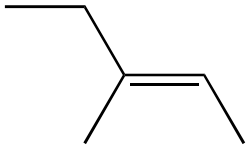
2. (10 pts) On being heated with a solution of sodium ethoxide in ethanol, compound A ($C_7H_{15}Br$) yielded a mixture of two alkenes, B and C, each having the molecular formula $C_7H_{14}$. Catalytic hydrogenation of the major isomer B or the minor isomer C gave only 3-ethylpentane. In the boxes given below, suggest structures for compounds A, B, and C consistent with these observations.

| Compound A | Compound B<br>Major product | Compound C<br>Minor product |
|---|---|---|

Name: _____

3. (5 pts) Give the stereochemical descriptor (E or Z) for the following alkenes. If more than one double bond is present in the compound, label the descriptor with the correct IUPAC number. DO NOT give the IUPAC name.

A.



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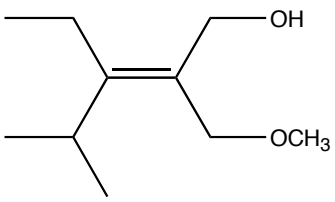


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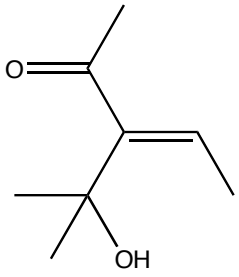


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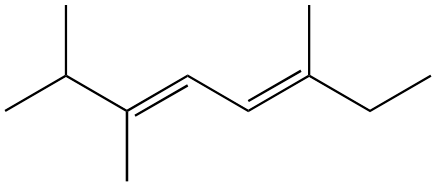

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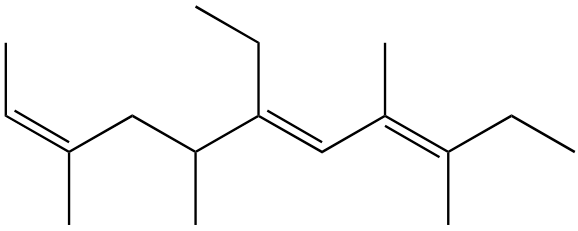
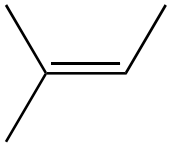


Name: _____

4. (10 pts) Circle the more stable compound in the following pairs.

A. *cis*-4-methyl-2-pentene *or* *trans*-4-methyl-2-pentene

B.



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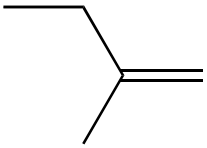

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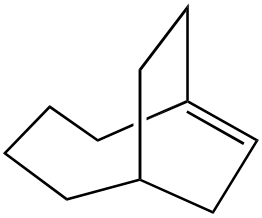

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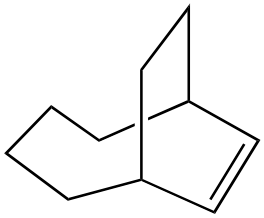

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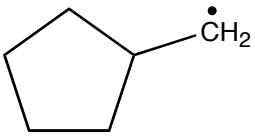


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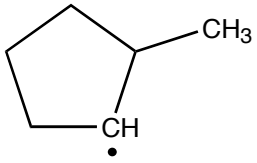


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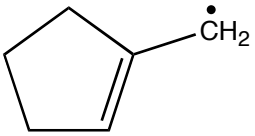


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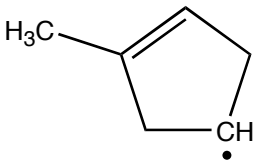

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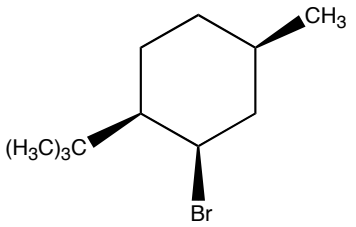
5. (3 pts) Circle the compound that will have the faster rate of reaction when undergoing an E2 reaction.

A.

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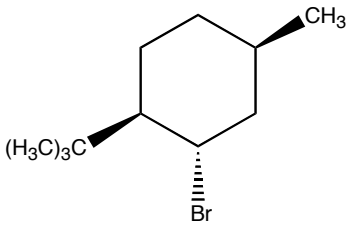
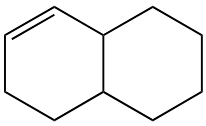



B. 2-bromo-3-methylhexane or 3-bromo-3-methylhexane

C. neopentyl bromide or 2-bromo-3-methylbutane

6. (2 pts) State whether the following pairs of compounds are constitutional isomers, stereoisomers, conformers, resonance structures, the same structure, or have no relation. Place your answer in the box.

A.



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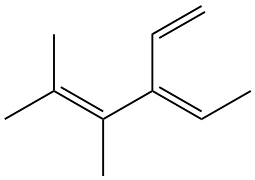

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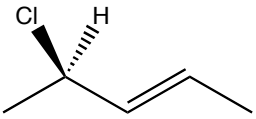


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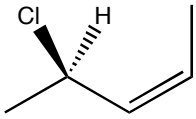

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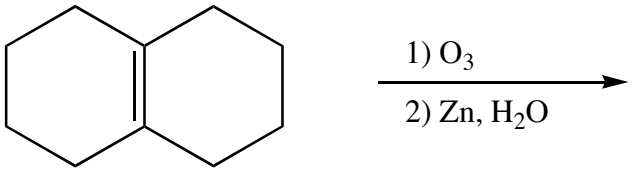
7. (15 pts) Give the organic products for the following reactions. Where possible, clearly label the major and minor products.

A.

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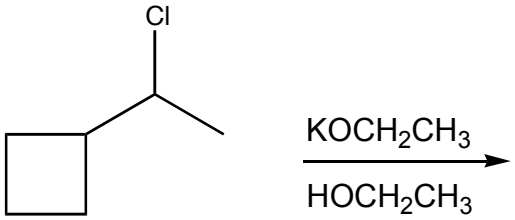


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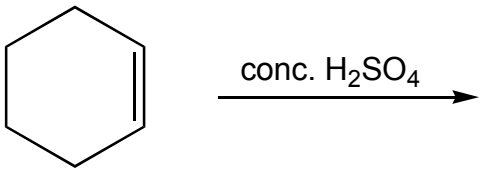


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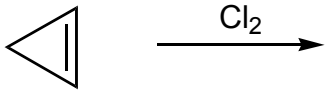


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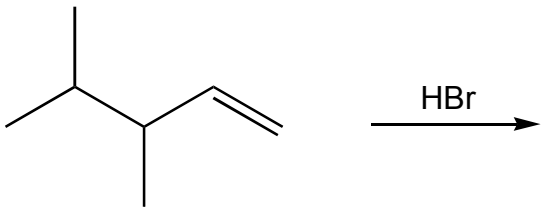

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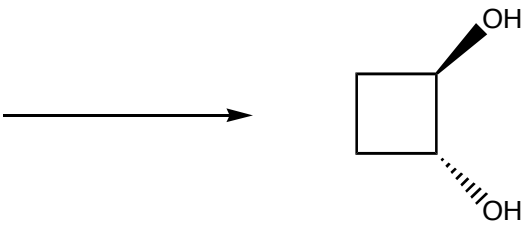
8. (20 pts) Fill in the missing reactants and reagents for the following reactions.

A.

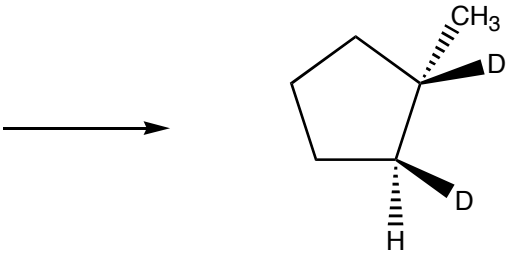



B.



2-bromo-2,3-dimethylbutane

C.

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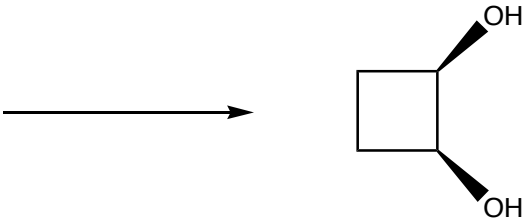
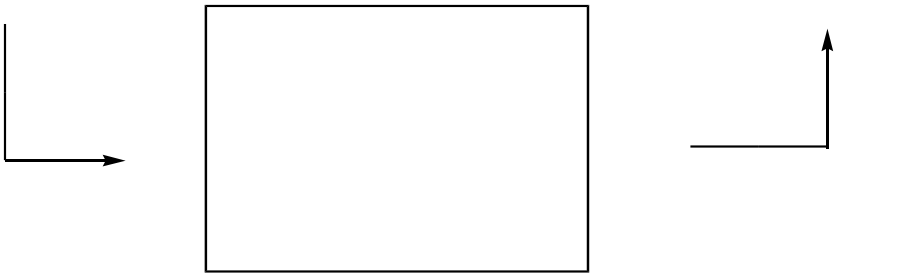


Name: _____

9. (15 pts) Each of the following transformations can be carried out in two or three steps. For each transformation show above and/or below the arrows the necessary reagents and between the arrows show the organic intermediate that is formed in the first reaction and serves as the starting material for the second reaction.

A.

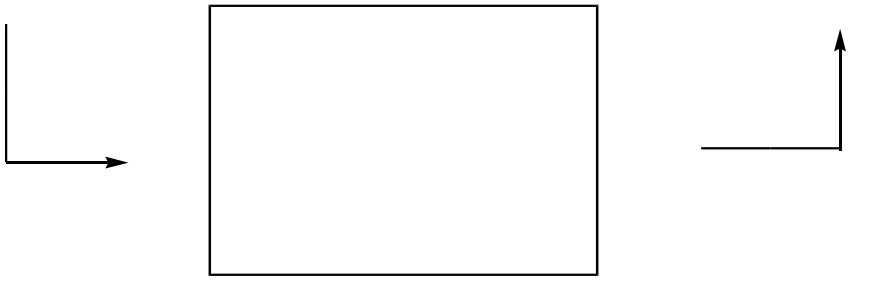
1-bromopropane



1-bromo-2-propanol

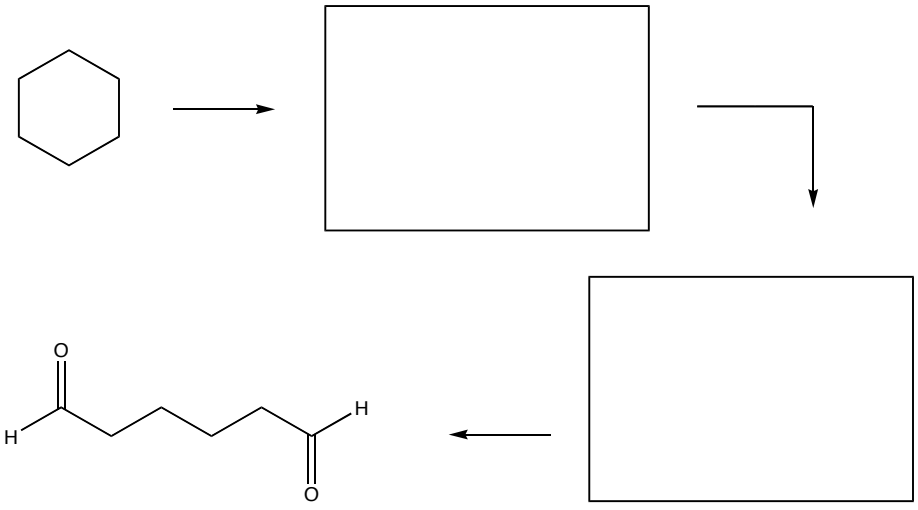
B.

$CH_3CHBrCH_3$



$CH_3CH_2CH_2Br$

C.



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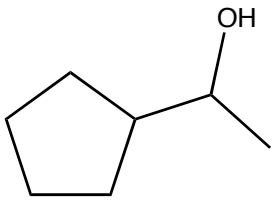
10. (10 pts) Draw an arrow-pushing mechanism for the E1 dehydration of the alcohol shown below. Be sure to account for the formation of all major and minor products.



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