

# Chem 331, Spring 2006

William Jenks

Name Key

PLEASE ALSO WRITE YOUR NAME ON THE TOP OF THE BACK OF YOUR EXAM

Please check off which recitation section you are registered for:

\_\_\_\_\_ Monday, 2:10 p.m.

\_\_\_\_\_ Tuesday, 9:00 a.m.

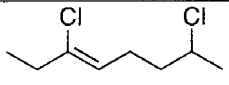

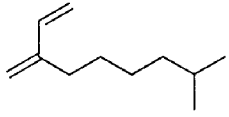
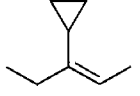
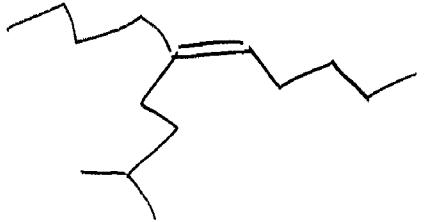

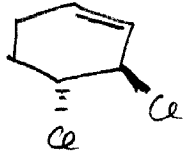
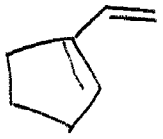
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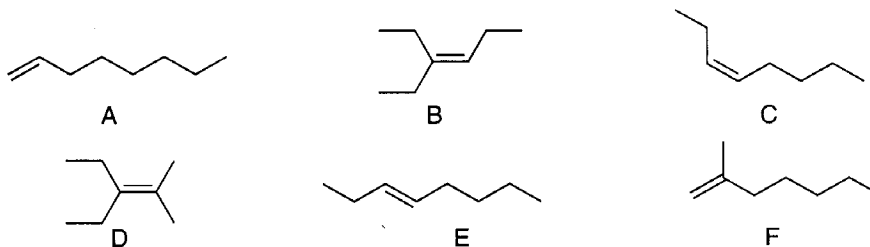
MIDTERM 2  
22 February, 2006

| Problem (max score) | Score |
|---------------------|-------|
| I (20)              |       |
| II (15)             |       |
| III (15)            |       |
| IV (30)             |       |
| V (20)              |       |
| Total (100)         |       |

- I. 20 points. Nomenclature. Provide the name or structure, as appropriate. Remember to indicate stereochemistry (e.g., *cis/trans* or *E/Z* in names and hash/wedge in drawings) as needed. 3 points for names, and two points for structures.

|  |  |
|--|--|
|  <p><i>Z</i>-3,7-dichloro-3-octene</p>          |  <p>3-ethylcyclobutene</p>                  |
|  <p><i>Z</i>-(5-methylhexyl)-1,3-butadiene</p>  |  <p>(<i>Z</i>)-3-cyclopropyl-2-pentene</p> |
| <p>(<i>Z</i>)-5-(3-methylbutyl)-5-decene</p>  | <p>1,2-pentadiene</p>                    |
| <p><i>trans</i>-3,4-dichlorocyclohexene</p>   | <p>1-vinylcyclopentene</p>               |

- II. 15 points total. Consider the following isomeric alkenes when answering the following questions. The same alkene can be an answer to more than one question, and some questions may require more than one answer to be fully correct.



3 each  
1 pt. if a single  
mistake

Which alkene(s) would provide synthetically useful product mixture(s) when treated with HCl?

A F B

Which alkene is the most stable, i.e., has the least negative heat of hydrogenation?

D no partial

Which alkene(s) require the E/Z or cis/trans nomenclature?

C, E

Which alkenes(s) are considered "disubstituted"?

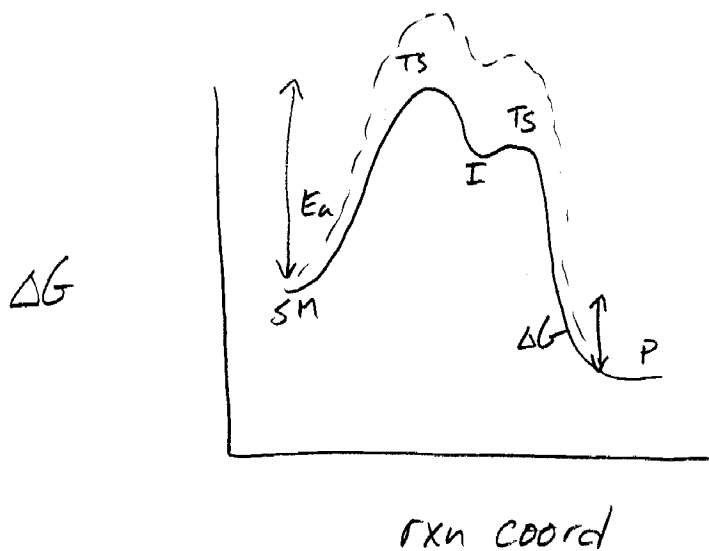
C, E, F

Which alkene(s) could be made in good yield (not as a bad mixture!) by dehydrobromination (i.e., elimination of HBr from an appropriate precursor)?

A, B, D, F

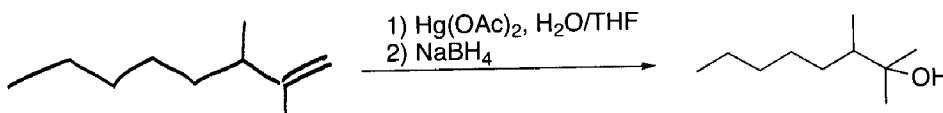
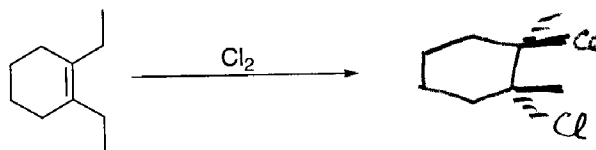
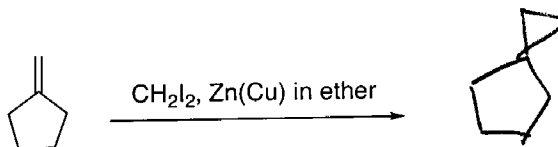
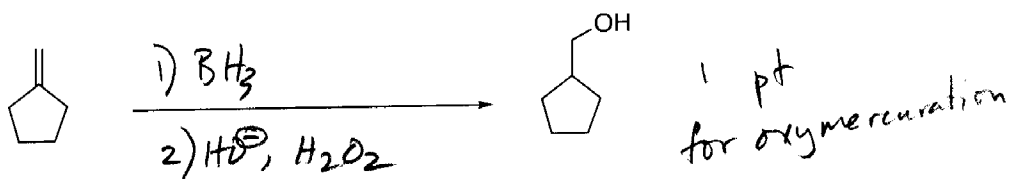
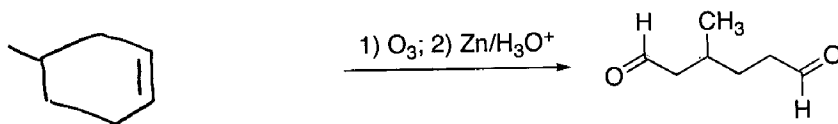
- III. 15 points. Draw a reaction energy diagram for an exothermic reaction that has a single intermediate. Make the first step of the reaction rate-determining. Label the position of the transition state(s) with "TS". Label the position of the intermediate with "I". Label the position of the starting material and products as "SM" and "P" respectively. Label the activation energy as " $E_a$ " and the overall energy change as " $\Delta G$ ".

Finally, with a dotted line, indicate a second reaction path from SM to P by a mechanism that is SLOWER than the original one you labeled.



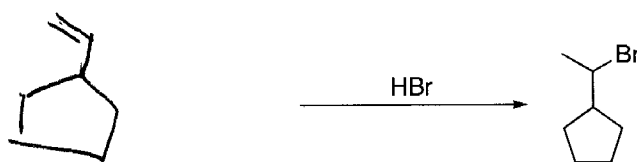
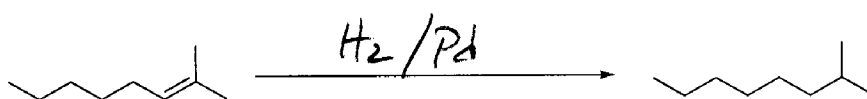
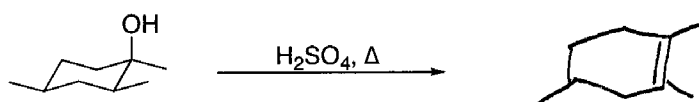
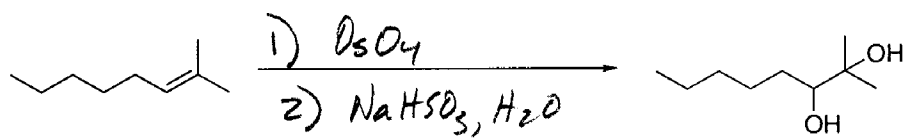
ca. 2 pts for  
each correct element

IV. 30 points, 3 points each. Provide structures corresponding to the Starting Materials, reagents, or major organic products, as appropriate. You do not need to indicate small-molecule byproducts like NaCl or H<sub>2</sub>O. If you provide starting materials, be sure to choose something that will lead to the given product as a single major product, not a bad mixture.

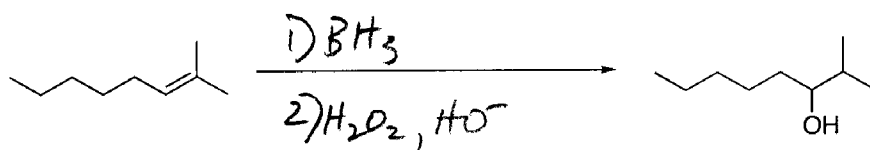


*1 pt for wrong isomer*

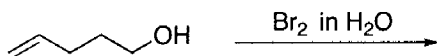
IV, cont.



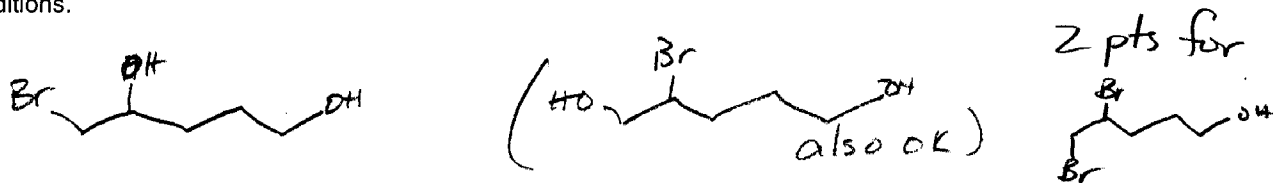
2 pts for for wrong alkene



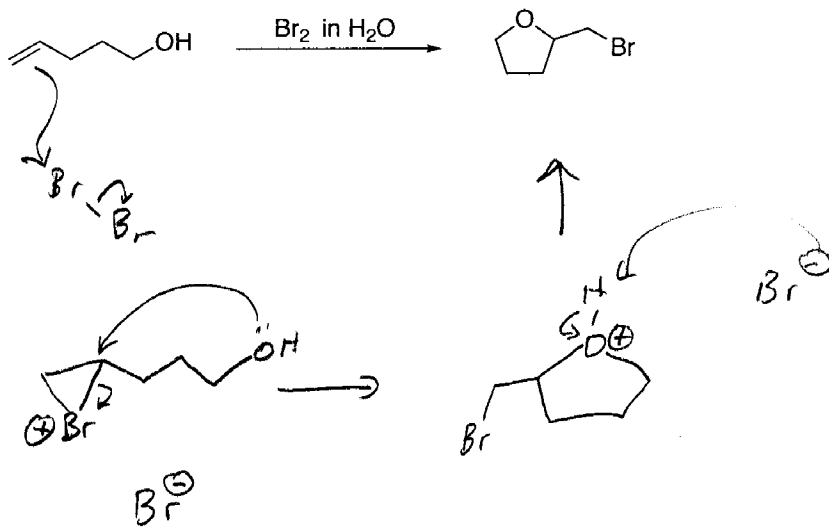
V. 20 points. Consider the molecule 4-penten-1-ol, illustrated below, and its reaction with  $\text{Br}_2$  in water:



a) 4 points. Draw the product that is expected from a simple reaction of the alkene with the reagents under these conditions.



b) 16 points. Instead of the "expected" product, the actual product observed is 2-(bromomethyl)tetrahydrofuran. Write a curly arrow mechanism that accounts for this transformation.



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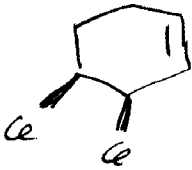

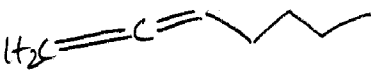
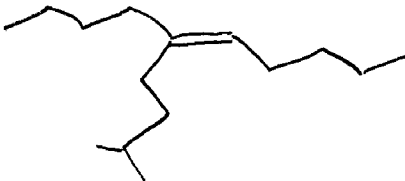
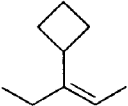
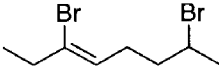

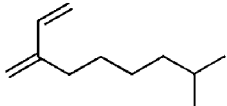
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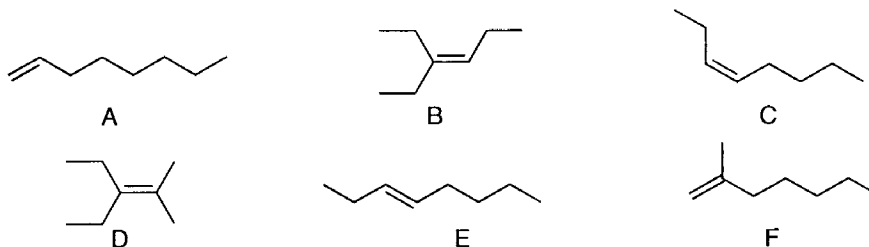
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| Total (100)         |       |

1. 20 points. Nomenclature. Provide the name or structure, as appropriate. Remember to indicate stereochemistry (e.g., *cis/trans* or *E/Z* in names and hash/wedge in drawings) as needed. 3 points for names, and two points for structures.

|   |   |
|---|---|
| <p><i>cis</i>-3,4-dichlorocyclohexene</p>  | <p>1-vinylcyclohexene</p>                     |
| <p>1,2-heptadiene</p>                      | <p>(<i>E</i>)-5-(3-methylbutyl)-5-decene</p>  |
|  <p>(<i>Z</i>)-3-cyclobutyl-2-pentene</p> |  <p>(<i>Z</i>)-3,7-dibromo-3-octene</p>      |
|  <p>3-ethylcyclobutene</p>               |  <p>2-(5-methylhexyl)-1,3-butadiene</p>     |

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Which alkene(s) require the E/Z or cis/trans nomenclature?

AF

Which alkenes(s) are considered "disubstituted"?

D

Which alkene(s) would provide synthetically useful product mixture(s) when treated with HCl?

BCE

Which alkene is the most stable, i.e., has the least negative heat of hydrogenation?

CEF

Which alkene(s) could be made in good yield (not as a bad mixture!) by dehydrobromination (i.e., elimination of HBr from an appropriate precursor)?

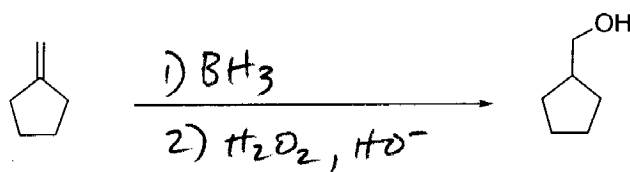
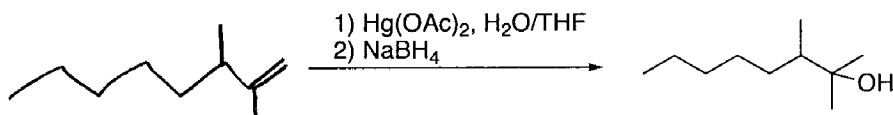
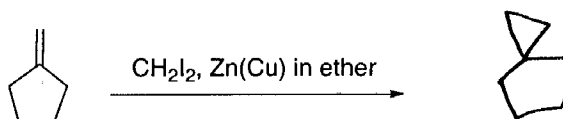
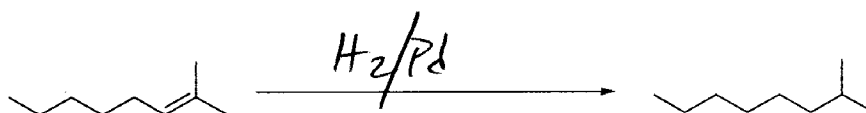
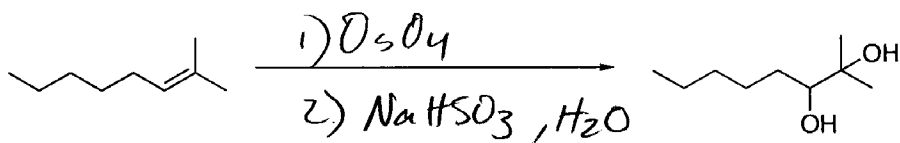
ABDF

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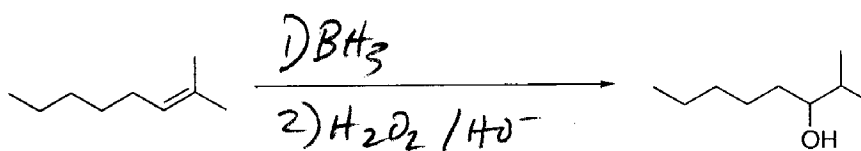
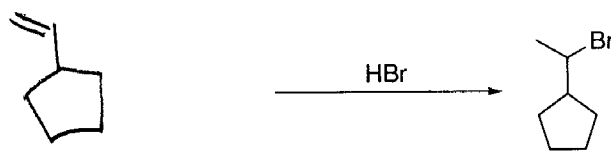
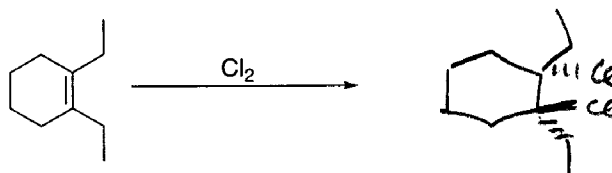
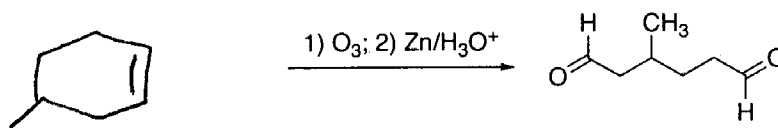
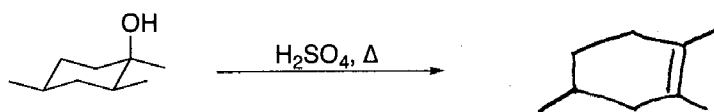
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see p. 3

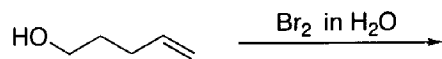
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*see p. 6*

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