

CHEM 3311, Fall 2011  
Professor Walba  
Second Hour Exam  
October 20, 2011

scores:

- 1) 20
- 2) 20
- 3) 20
- 4) 20
- 5) 20

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100

CU Honor Code Pledge: On my honor, as a University of Colorado at Boulder Student, I have neither given nor received unauthorized assistance.

Name (printed): Key

Signature: \_\_\_\_\_

Recitation TA Name: \_\_\_\_\_

Recitation day and time: \_\_\_\_\_

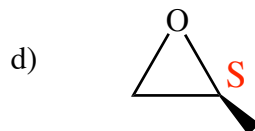
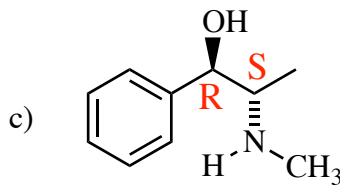
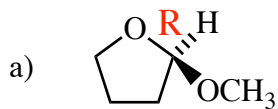
This is a closed-book exam. The use of notes, calculators, scratch paper, or cell phones will not be allowed during the exam. You may use models brought in a clear ziplock bag. Please put all you answers on the test. Use the backs of the pages for scratch.

*PLEASE read the questions very carefully!*

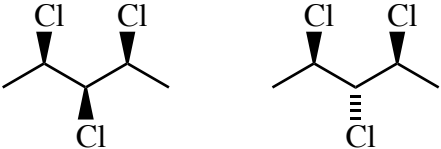
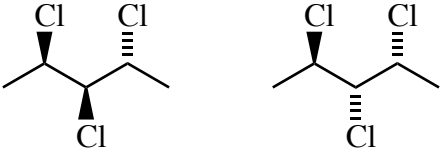
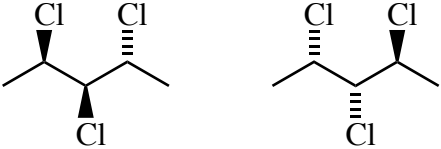
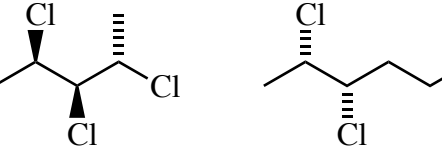
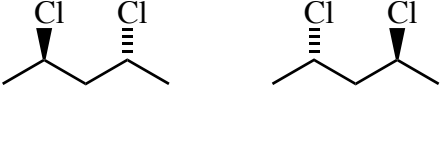
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|----------|----------|----------|----------|---------|---------|----------|----------|---------|--|
| 1A       |          |          |          |         |         |          |          | 8A      |  |
| 1<br>H   |          |          |          |         |         |          |          | 2<br>He |  |
|          | 2A       |          |          |         |         |          |          |         |  |
| 3<br>Li  | 4<br>Be  | 3A       | 4A       | 5A      | 6A      | 7A       | 10<br>Ne |         |  |
|          |          | 5<br>B   | 6<br>C   | 7<br>N  | 8<br>O  | 9<br>F   |          |         |  |
| 11<br>Na | 12<br>Mg | 13<br>Al | 14<br>Si | 15<br>P | 16<br>S | 17<br>Cl | 18<br>Ar |         |  |
|          |          |          |          |         |         |          | 35<br>Br |         |  |
|          |          |          |          |         |         |          | 53<br>I  |         |  |

Printed Name: \_\_\_\_\_

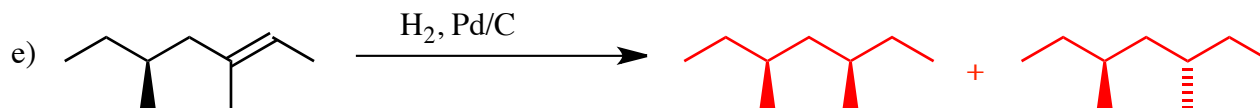
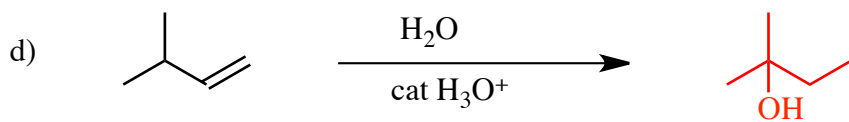
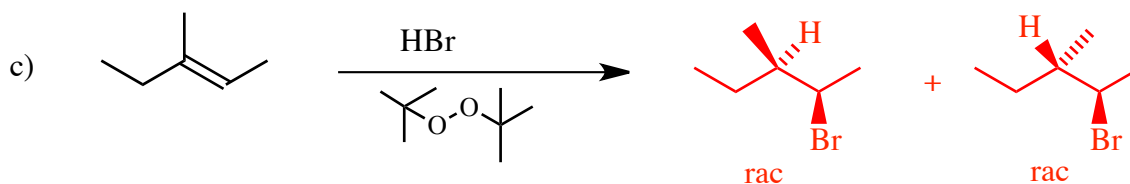
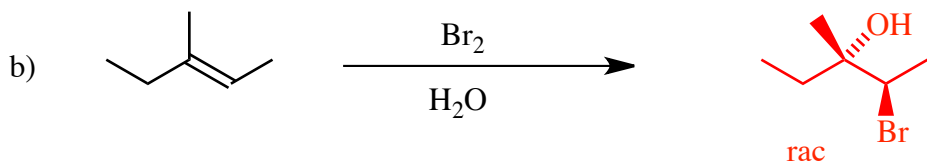
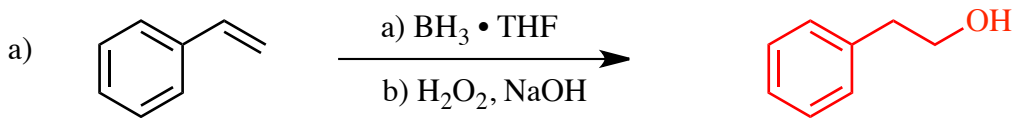
1. (20 pts) A) Carefully label each asymmetric carbon in the following molecules using the R / S stereochemical configuration descriptors.



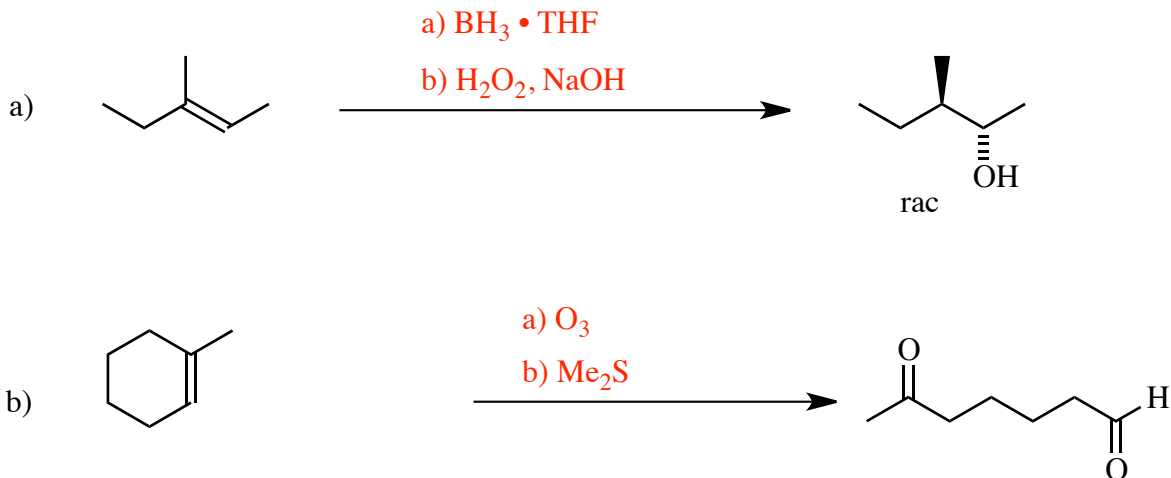
B) Describe the relationship between the following pairs of trichloropentanes (constitutional isomers, enantiomers, diastereomers, or homomers). Please put your answer below each pair of structures.

|  |   |
|--|---|
| <br><p style="text-align: center;">diastereomers</p> | <br><p style="text-align: center;">homomers</p>                |
| <br><p style="text-align: center;">enantiomers</p>  | <br><p style="text-align: center;">constitutional isomers</p> |
| <br><p style="text-align: center;">enantiomers</p>  | <p style="text-align: center;">Left blank intentionally</p>   |

2) (20 pts) Give the single major product (or two major products if two are formed) for each of the following reactions, carefully showing stereochemistry using wedges and dashes. If a racemate is formed, show only one enantiomer and label it "rac." Assume chiral starting materials are single pure enantiomers unless they are labeled "rac."

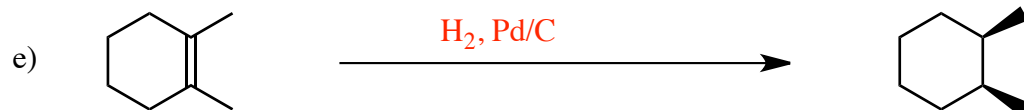
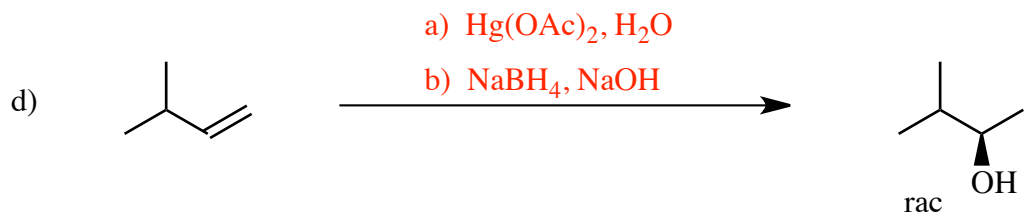
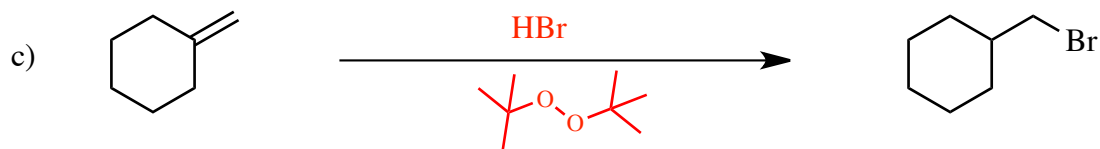


3) 20 pts) Propose reagents for accomplishing each of the following reactions. Make your reaction efficient (i.e. the target product should be the major product). Assume chiral starting materials and products are single pure enantiomers unless they are labeled "rac." For question 3b, please give the required starting material.



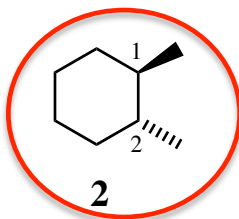
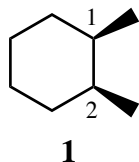
Give the starting material

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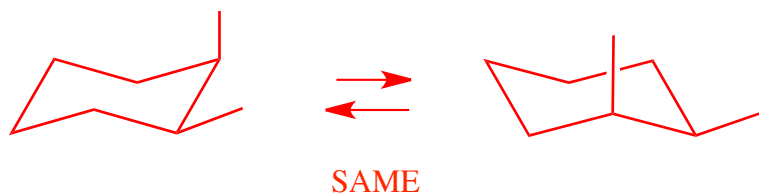


4) (20 pts) a) For each of the two compounds cis-1,2-dimethylcyclohexane (**1**), and (1R, 2R) trans-1,2-dimethylcyclohexane (**2**), draw the two flip-chair conformations and circle the more stable conformation. If the two flip chairs have the same strain energy, then label them "same." Draw ALL of the chair conformations with carbon 1 being the rightmost (farthest right) carbon. Please do not include hydrogen atoms – show only the carbons.

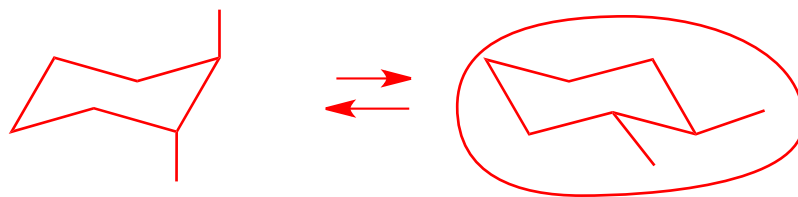
b) Circle the more stable isomer, **1** or **2**.



The more stable isomer should be circled



Two flip chair structures for compound **1**, with more stable conformation circled, or conformations labeled "same." For both chairs, carbon 1 should be the rightmost carbon.

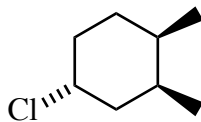
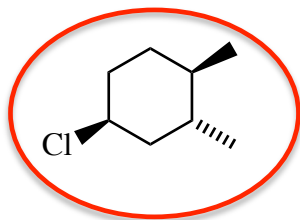


Two flip chair structures for compound **2**, with more stable conformation circled, or conformations labeled "same." For both chairs, carbon 1 should be the rightmost carbon.

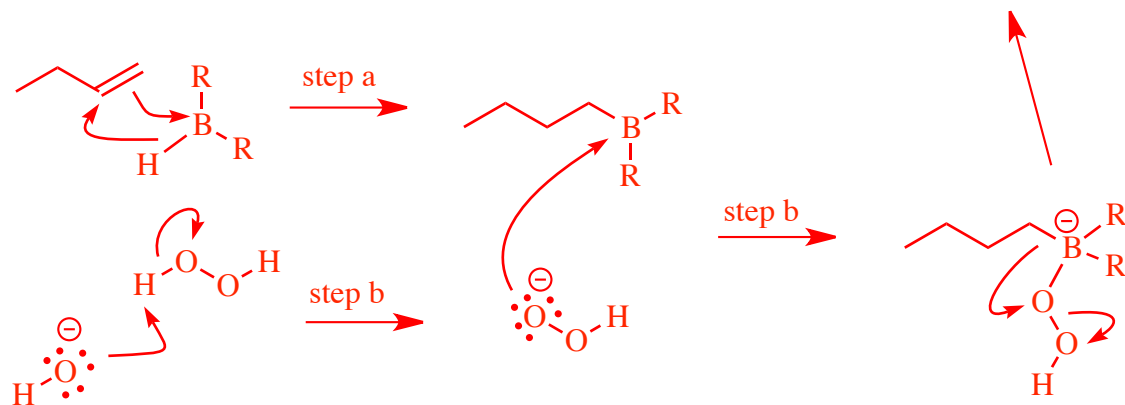
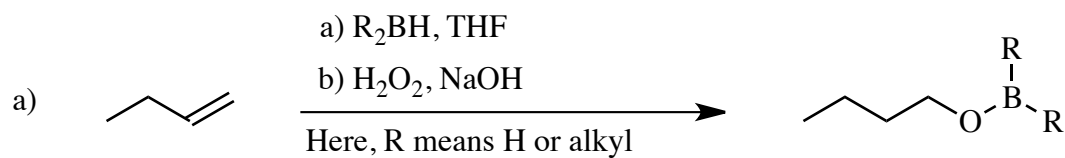
c) Estimate the energy difference between the more stable and less stable isomer in units of "gauche butane interactions" (GBIs). **2 GBIs**

4) –continued–

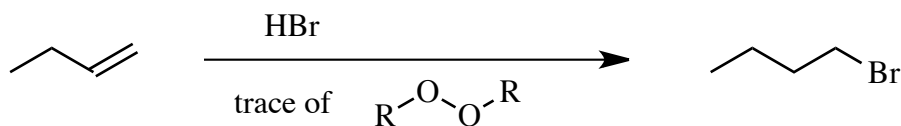
c) The energy difference between axial and equatorial chlorocyclohexane is considerably less than the energy difference between axial and equatorial methylcyclohexane (the Cl atom is smaller than a  $\text{CH}_3$  group). For the chloro-dimethylcyclohexane isomers given below, circle the more stable isomer.



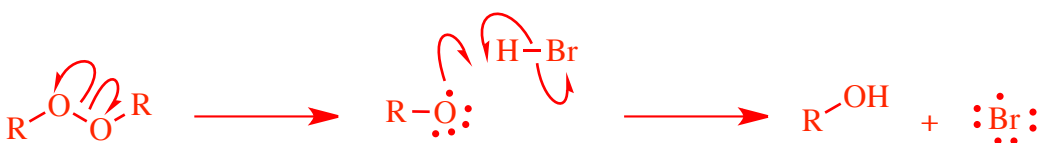
5) (20 pts) Propose an arrow-pushing mechanism, showing all reactive intermediates (no transition states), for each of the following reactions. Indicate the stereochemistry of your intermediates using wedges and dashes if appropriate.



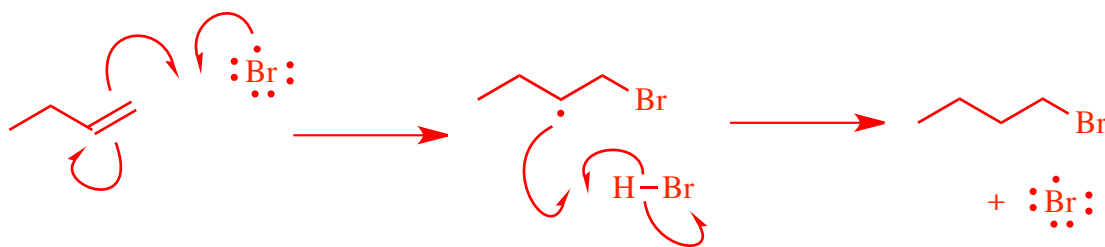
b) For this reaction, give the mechanism of initiation and propagation.



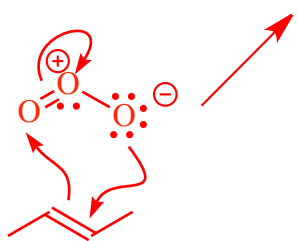
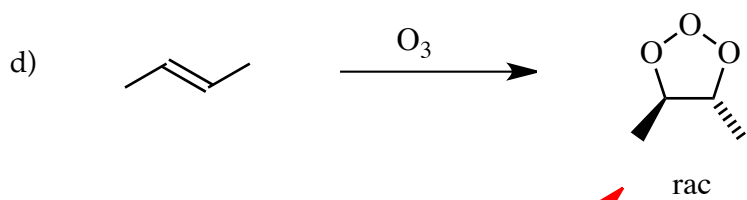
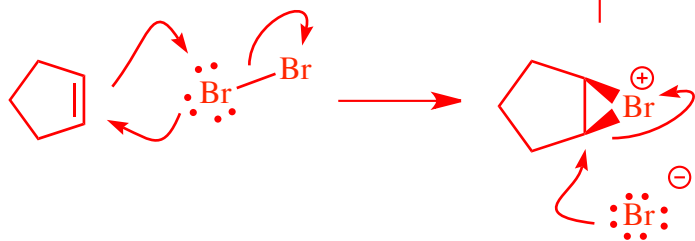
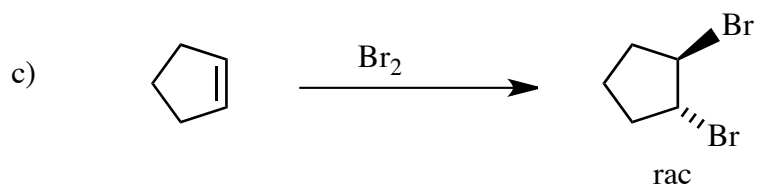
Initiation:



Propagation



5) – Continued



Show only the mechanism for formation of the molozonide as indicated.

e) The molozonide from part d above is a reactive intermediate. Give the structure of the product obtained from the reaction of trans-2-butene with ozone (**before** addition of dimethylsulfide or hydrogen peroxide/water).

