

MAKE-UP EXAM

CHEMISTRY 220a

Wednesday, December 12, 2001

NAME (print): _____

TA: _____ Section Day: _____ Section Time: _____

The exam is 55 minutes and it covers the semester's work.

Take a few moments to look over the exam. Answer each question on the exam paper.

Important clues and instructions are in **bold**.

Do all **preliminary** drawing or computations on the work sheets at the end of the exam. The work sheets will not be graded. There is a Periodic Table on the last page of the exam.

STOP writing and hand in your exam when you are asked to do so.

REMEMBER: Neatness is to your advantage.

1. (20 pts) _____

2. (20 pts) _____

3. (20 pts) _____

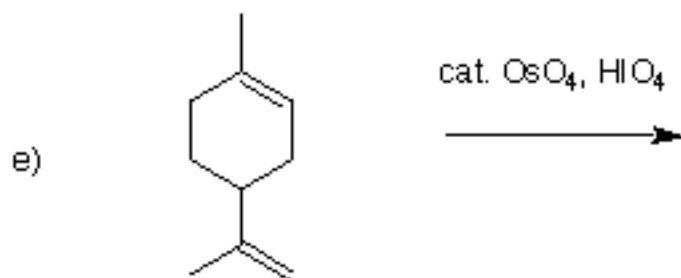
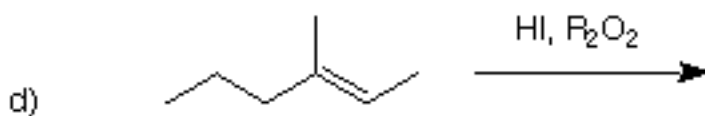
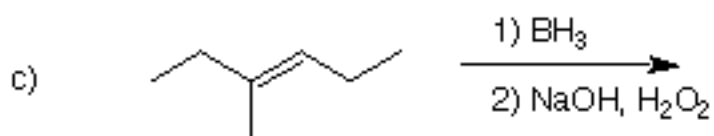
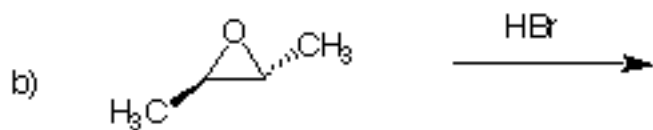
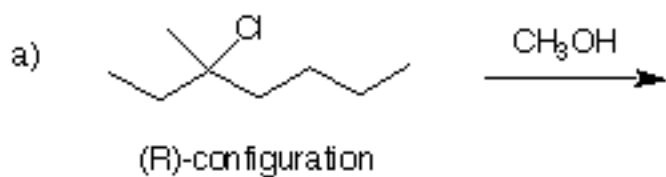
4. (20 pts) _____

5. (20 pts) _____

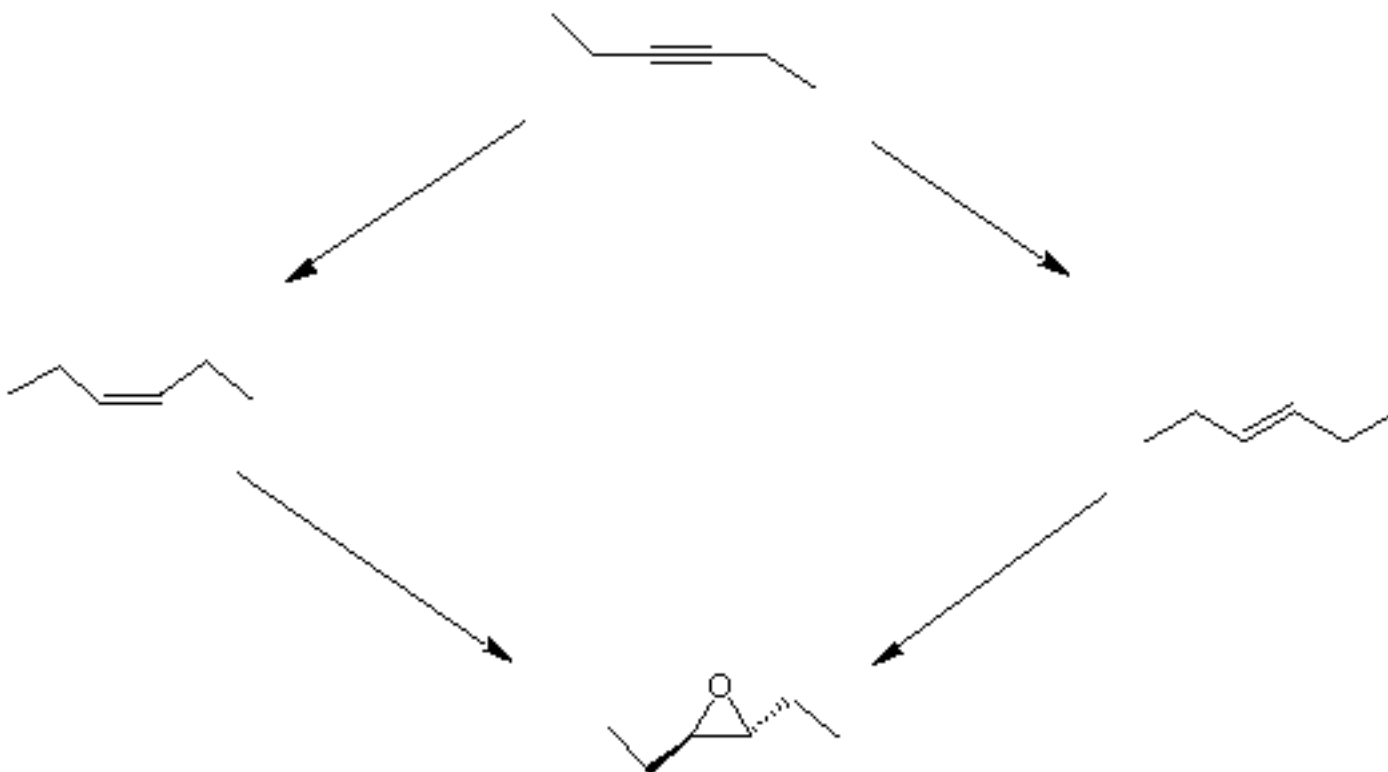
Total (100 pts)

1. (5 x 4 pts. = 20 pts.) Provide the expected product(s) of each of the following reactions.

Pay attention to stereochemistry.



2. (20 pts.) Provide the reaction conditions necessary to convert 3-hexyne into the trans-epoxide shown below. Place the reagents next to the the four arrows. Some transformations may require more than one step.



3. (4 x 5 pts. = 20 pts.) Complete each of the following questions.

a) A solution of a 60/40 mixture of the two enantiomers of a compound is prepared. The observed optical rotation is $+80^\circ$. What is the optical rotation of the levorotatory enantiomer? Show work.

b) An overall chemical reaction having an intermediate is exothermic by 20 kcal/mol and the first step is endothermic by 3 kcal/mol. The second step has an activation energy (E_a) of 1 kcal/mol. What is the rate limiting step in the reaction? What is ΔH° for the second step? Illustrate with an energy diagram.

c) What is the major free radical monochlorination product of n-butane? Show calculations.

d) List the following compounds from left to right in increasing order of pKa: H_3O^+ ,

$\text{CH}_3\text{CO}_2\text{H}$, H_2O , $(\text{CH}_3)_3\text{COH}$, HCCH , NH_3 , CH_4 .

4. (20 pts.) Design a synthesis of 3-ethyl-2-pentene (C_7H_{14}) from ethylene as your source of carbon atoms. All reagents are available to you. [Note: Ethylene has an even number of carbons; C_7H_{14} has an odd number.]

5. (20 pts.) Compound **A**, C_8H_{12} , reacts with hydrogen in the presence of the catalyst Pt to afford **B**, C_8H_{14} . Compound **B** forms only 2 monobromination derivatives, **C** and **D**, upon free radical bromination. Compound **C** forms **A** and alcohol **E** ($C_8H_{14}O$) upon reaction with KOH. Compound **D** cannot undergo an S_N2 reaction (why?) with KOH nor can it undergo elimination. What are the structures of **A-E**? Show your reasoning. [Hint: This problem should be familiar to you.]