

## *First Hour Exam*

My name is (print your name here): \_\_\_\_\_

My recitation instructor's name is (print your instructor's name here): \_\_\_\_\_

My recitation is held on (print the day and time here): \_\_\_\_\_

PROBLEM	Possible points	Score
1	<u>20</u>	_____
2	<u>30</u>	_____
3	<u>26</u>	_____
4	<u>12</u>	_____
5	<u>12</u>	_____
TOTAL	<u>100</u>	_____

You have 2 hours to complete the exam.

The man who finds his conscience aches

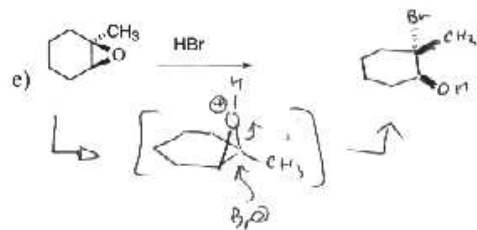
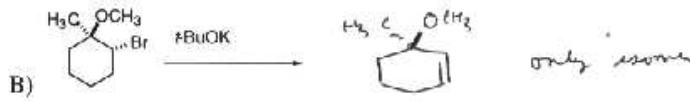
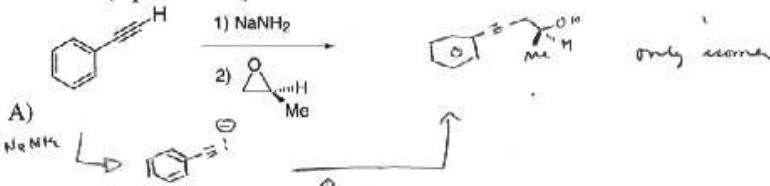
No peace at all enjoys.

And as I lay in bed awake,

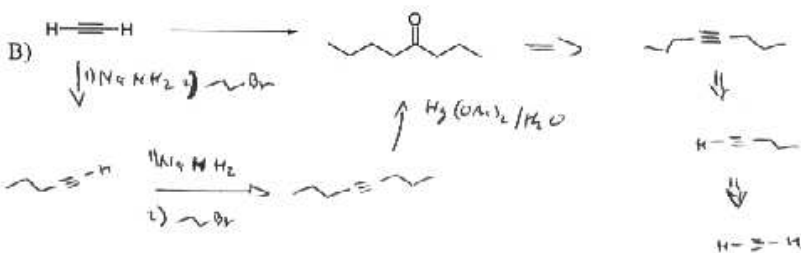
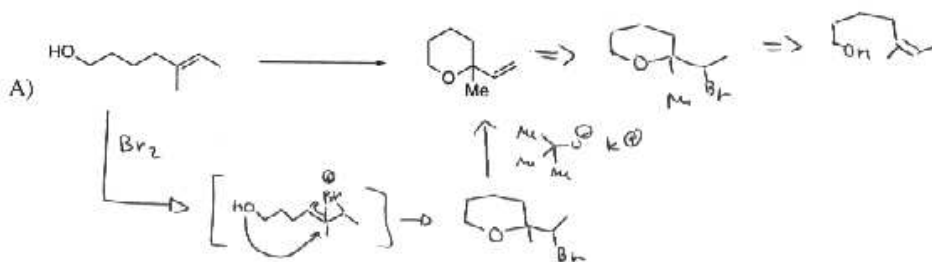
I thought I heard a noise.

***Don't cheat!***

1) Provide the products of the following reactions. Be sure to indicate the stereochemistry of the products where appropriate. If more than one stereoisomer will be formed, draw both isomers and indicate if they will be formed in equal or unequal amounts. (4 points each)



2) Complete the syntheses shown below using organic reagents of 5 carbons or less and any inorganic reagents you wish. If you want partial credit, then write the product of each reaction (12 points each).

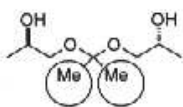


3) The 100 MHz  $^1\text{H}$  NMR spectrum of a compound shows two signals at  $\delta=7$  and at  $\delta=1$ . Each signal is a doublet with a 10 Hz coupling constant.

a) On a 500 MHz machine, will the chemical shift be (3 points, circle one):  
5 times larger, 2 times larger, the same, 2 times smaller, 5 times smaller

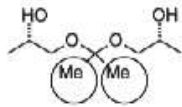
b) On a 500 MHz machine, will the coupling constant be (3 points, circle one):  
5 times larger, 2 times larger, the same, 2 times smaller, 5 times smaller

4) Label the circled protons as homotopic (H), enantiotopic (E), diastereotopic (D), or does not apply (DNA) and indicate which of the circled sets of protons **must** appear at the same chemical shift in the  $^1\text{H}$  NMR spectrum. (circle the correct answers for each molecule, 3 points / molecule)



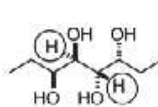
H E D DNA

$\delta =$  ~~same~~ / not same



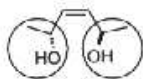
H E D DNA

$\delta =$  same / ~~not same~~



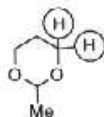
H E D DNA

$\delta =$  ~~same~~ / not same



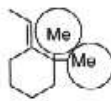
H E D DNA

$\delta =$  ~~same~~ / not same



H E D DNA

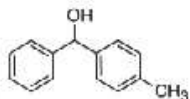
$\delta =$  same / ~~not same~~



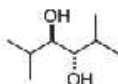
H E D DNA

$\delta =$  ~~same~~ / not same

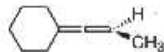
5) Are the following molecules chiral, achiral or meso (circle one for each molecule, 2 points each)?



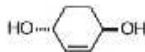
~~chiral~~ achiral meso



chiral ~~achiral~~ meso



chiral ~~achiral~~ meso



~~chiral~~ achiral meso

6) What are the structures of the compounds which provide the  $^1\text{H}$  and  $^{13}\text{C}$  NMR spectra shown on the next two pages? For partial credit, draw any partial structures you can identify (i.e., a *tert*-butyl group, a *para*-disubstituted benzene ring, etc) (12 points each)

