Final Exam Organic Chemistry II Lab CHEM 443 Spring 16 4/25Monday 3 pm Dr. Hahn Exam# _____

Sign Name Key Print Name _____

(5 pt each name above print & sign puntative points) (100 pts, 8 pages + IR/NMR chart + periodic table)

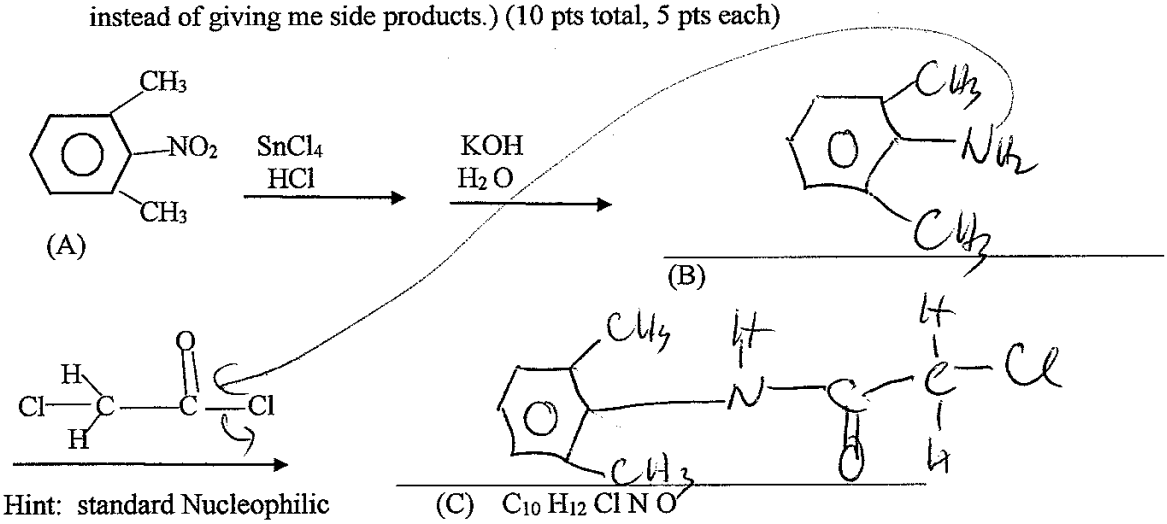
Please show work on all questions for partial credit even on questions which do not specify. Please write legibly. If I cannot read your answer, I cannot grade your answer. (use back of exam for scratch paper – If you want me to grade something not in the space for the answer, clearly specify in writing. Telling me during the exam where to find the answer does not qualify because I will just vaguely remember someone telling me something during the exam not which one of 70 OCI Lab and 90 OCII Lab students told me what to grade on what page of the exam.)

You will do the multiple choice by circling the letter on this exam itself. NO PARTIAL CREDIT ON MULTIPLE CHOICE. NO SCANTRON – not enough multiple choice questions. The multiple choice questions are mixed in between fill in the blank and long answer questions.

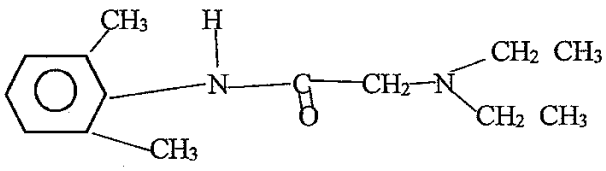
Please READ and FOLLOW directions. (ex: don't give me 5 structures if I only ask for one or you will lose points on this exam by **RUNNING OUT OF TIME**) **TIMED EXAM**

Synthesis of Lidocaine (34 pts)

1. Complete the reaction for the synthesis of Lidocaine. DO **NOT** SHOW ANY SIDE PRODUCTS. (I deliberately left off some of the reaction reagents to make sure that you come up with the products instead of giving me side products.) (10 pts total, 5 pts each)



Hint: standard Nucleophilic Substitution reaction for carboxylic acid derivative



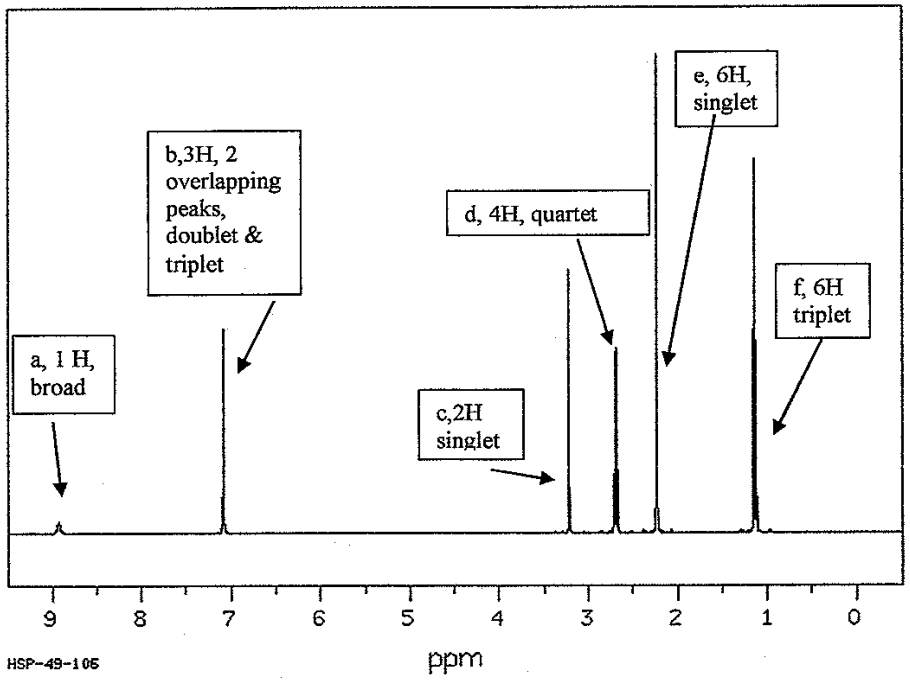
(use 2 equivalents)

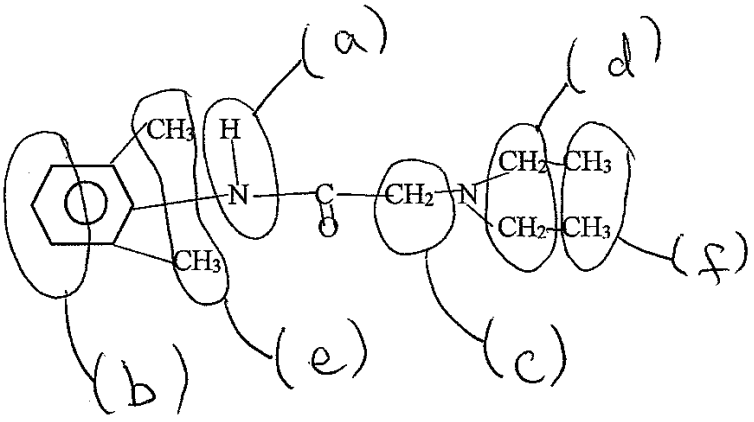
(D) Lidocaine

[~ 2 equivalents to 1 equivalent of (C)] 1 equivalent is to neutralize the acid in the reaction.]

2. Given the following NMR, match the NMR to the molecule for product (D) in your scheme in #1 above by filling in the parenthesis with the letter from the NMR spectrum.

   The letter that I want you to assign your molecule and the integration numbers are shown near the NMR peaks. Peak b is a multiplet of 2 overlapping peaks





Lidocaine ---- fill in the parenthesis with the letters from the NMR Spectra above (12 pts total, 2 pts each parenthesis)

3. Multiple choice question based on the reaction scheme in # 1 above (12 pts)

The book says that you should use 2.2 grams of molecule C (0.0111 mole of molecule C) to react with 2.4 grams of the diethylamine (0.0328 moles of diethylamine). (Assume that you are supposed to use at least 2 equivalents of the diethylamine to one equivalent of molecule (C).) If I only have 0.4 mol of reagent (C) which I made from the prior step:

[formula weight of molecule C (of formula $C_{10}H_{12}$ Cl N O) = 197.72 g molecule C /mole C]

[formula mass of diethyl amine is 73.15 grams diethyl amine /mole diethyl amine]

Part 1: Circle one of the letters (6 pts)

(a) I should use 1.18 moles of the diethylamine ✓

(b) I will make 1.18 moles of lidocaine assuming complete reaction X

(c) I should use 0.135 moles of the diethylamine X

(d) I will make 0.135 mole of lidocaine assuming complete reaction X

(e) (a) and (b) are true.

(f) (c) and (d) are true.

(g) All statements above are false.

Part 2: Explain your multiple choice question answer by showing your calculation. (6 pts)

used 2 g. -2

$0.4\ \text{mol C} \times \frac{0.0328\ \text{mol N Et}_2}{0.0111\ \text{mol C}} = \frac{1.18\ \text{mol N Et}_2}{\text{mol}}$

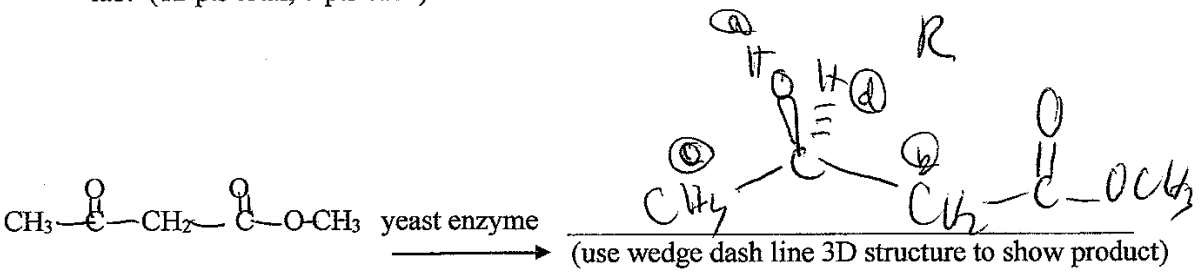
mole lidocaine ≈ 0.4 mol

mole -1

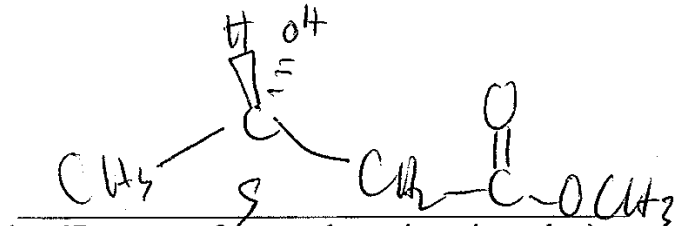
RA -4

Enzymatic Reduction (32 pts)

1. Complete the following reaction which you experimentally carried out in the enzymatic Reduction lab. (12 pts total, 6 pts each)



(use wedge dash line 3D structure to show product)



(use 3D structure for second enantiomeric product)

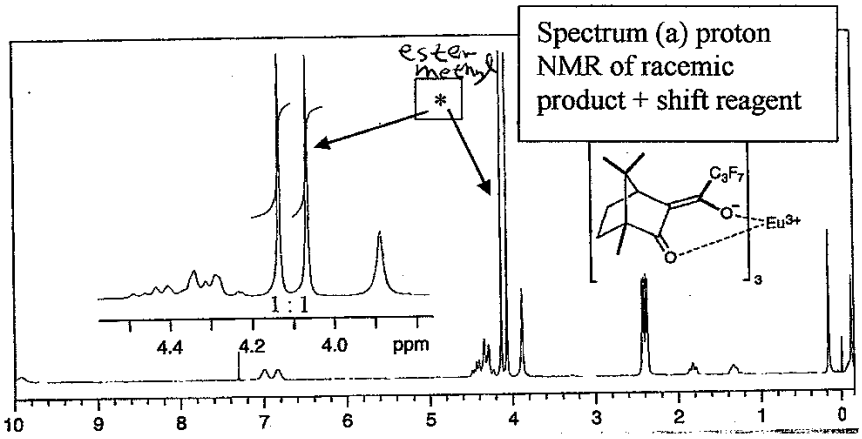
major

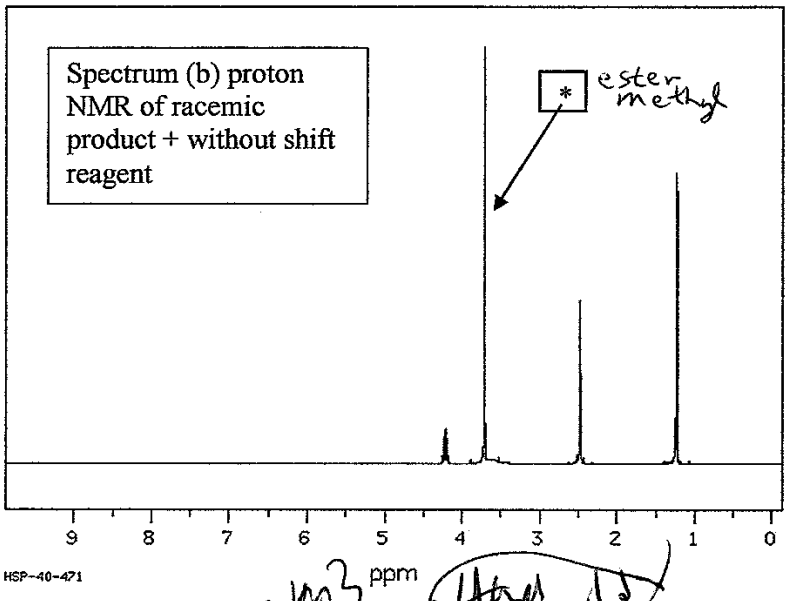
2. Multiple choice circle one. (6 pts)

If you do the reaction under air without the $Ba(OH)_2$ solution, speculate on the ratio of the two enantiomers ?

(a) You will generate only the S enantiomer
(b) You will generate only the R enantiomer
(c) You will generate more S than without air.
(d) You will generate more R than without air.
(e) The $Ba(OH)_2$ solution has no effect on the ratio of R/S enantiomer product.

3. Below is the NMR of the racemic product with a chiral shift reagent and the racemic product without a chiral shift reagent. (14 pts total)





(1) Why does the chemical shift in (a) not match the NMR chemical shift in (b) and are you able to see the difference in the chemical shift between the two enantiomers ? [7 pts about (a) & (b) above]

(b) without shift reagent both enantiomers have exactly same NMR @ & does not match between @ & (b) because of shift which is concentration dependent.

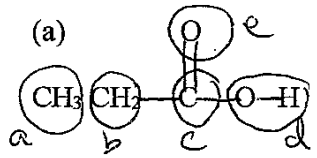
(2) How can you tell that this is the racemic mixture by the shown integration in spectrum (a) ? (I have labeled the peak for the ester methyl in both NMR spectra.) (7 pts)

It is racemic because the integrity of 2 peaks is (1:1) between the two enantiomers.

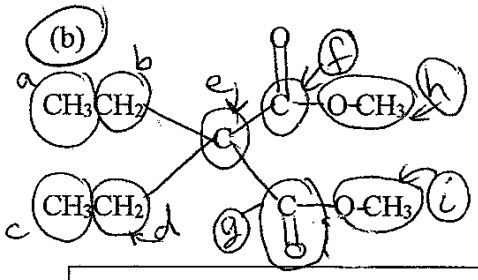
Unknown An unknown has the following IR, proton NMR, and carbon NMR. Select from the 2 potential molecule which you believe is the actual molecule. Explain under each spectrum in support of your choice of molecules. I labeled the molecule but all labels do not necessarily match parts of the spectrum. (34 pts total)

Part (1) Circle one of the letter by one of the two molecules below (4 pts)

(a)

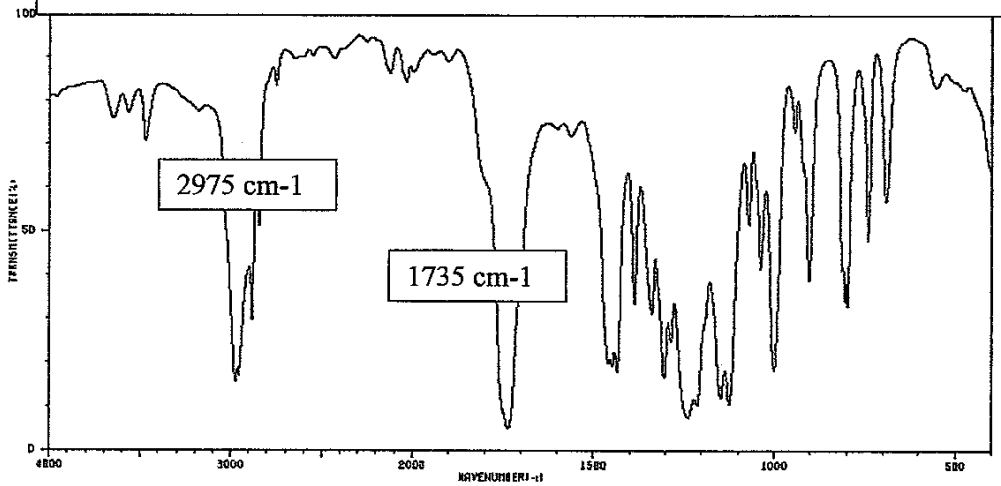


(b)



4 pts

Part (2) IR Spectrum of Unknown: Fill in the blanks below to match your choice of either (a) or (b) molecule in Part (1) above. (8 pts, 2 pts each blank below.



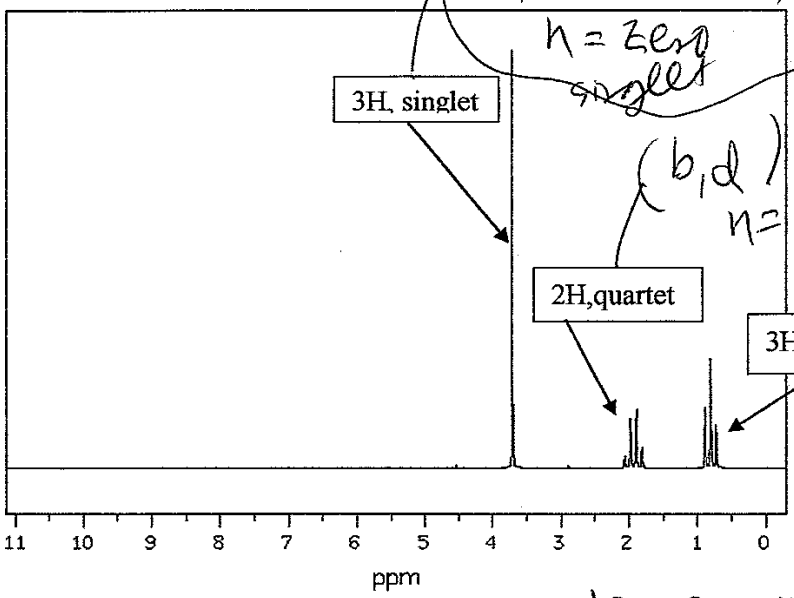
2pt 2pt

Functional group is C=O ester IR number is 1735 cm^{-1}

Functional group is C-H alkane IR number is 2975 cm^{-1}

2pt 2pt

Part (3) proton NMR label the peaks below to ~~match your choice of~~ molecule (a) or molecule (b) with the NMR spectra. Label your spectra parenthesis with the letter from the molecule above. (12 pts, 4 pts each peak)

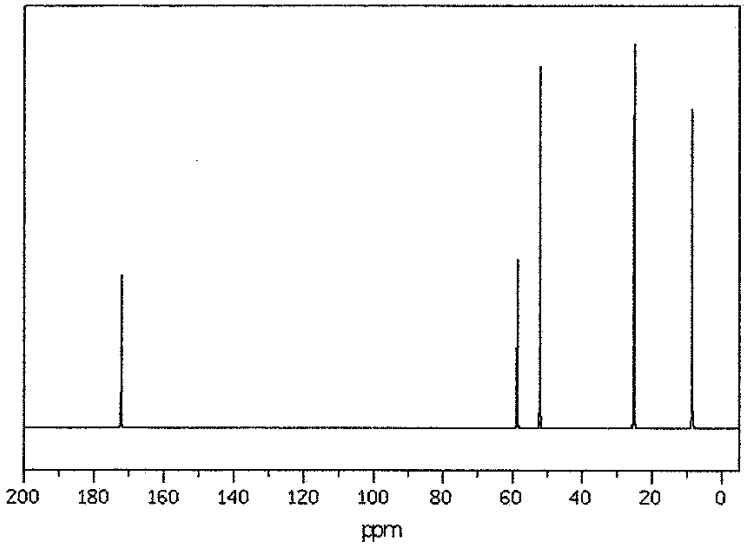


(h, i) 6/2 = 3 integration
n = zero
singlet
d is ester H
(b, d) 4H/2 = 2H
n = 3 → quartet
(g, c) — 4 pts
2 letters
6H/2 = 3H
n = 2 → triplet

-12 on wrong molecule

Part (4): Carbon NMR spectrum – How many carbon peaks should your choice of molecule have in the NMR below. Number of carbon peaks are from the labels for the parts of the molecule. You do not need to match the molecule to specific parts of the spectrum but you do need to show which are the 5 carbon peak parts of the molecule. (10 pts each, 2 pts each peak)

-10 on wrong molecule



Peak 1 g, c
Peak 2 b, d
Peak 3 e
Peak 4 f, g
Peak 5 h, i

(h, i) OK