NAME: Key

Email:

The exam must be written in ink. No calculators of any sort allowed.
You have 2 hours to complete the exam.

CHEM 610B
Exam 2
Spring 2002
Instructor: Dr. Brian Pagenkopf

Page	Points
2	8
3	10
4	4
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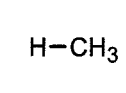
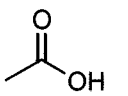
7	9
8	6
9	9
10	9
11	9
12	4
13	10
14	7
	100

Question 1. (8 points) Miscellaneous. this page - all right or ∅ (no partial credit)

a. (2 points). Rank the following molecules in order of increasing acidity (which is the same as decreasing pKa). Write a 5 in the box for the least acidic, a 1 in the box under the most acidic, and so on. all or nothing

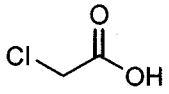


5

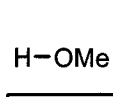


3

1

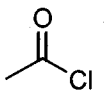


2

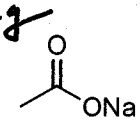


4

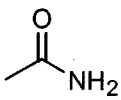
b. (2 points). Rank the following molecules in order if increasing reactivity toward nucleophilic attack. Write a 4 in the box under the least reactive, a 1 for the most reactive, and so on. all or nothing



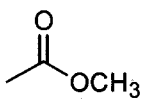
1



4

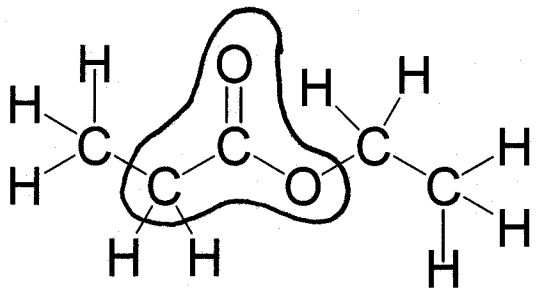


3

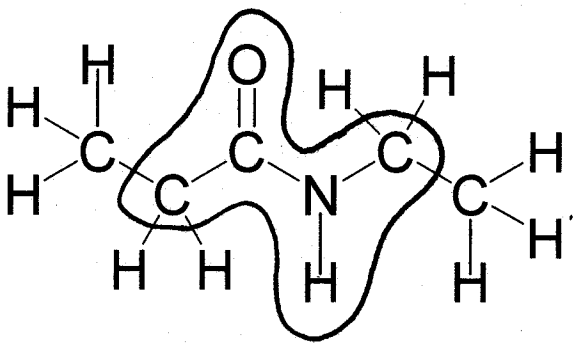


2

c. (2 points) Circle the atoms that are co-planar with the carbonyl carbon.

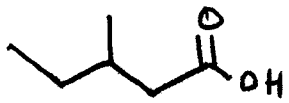


d. (2 points) Circle the atoms that are co-planar with the carbonyl carbon.

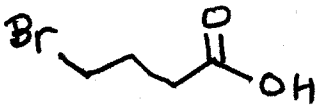


Question 2 (10 points) Nomenclature. Provide a structure for each of the following.

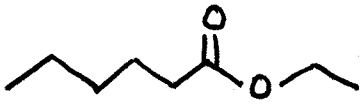
a. 3-methylpentanoic acid



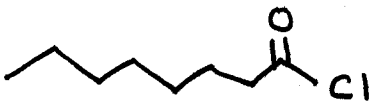
b. 4-bromobutanoic acid



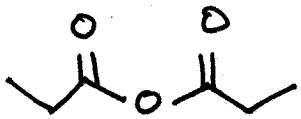
c. ethyl hexanoate



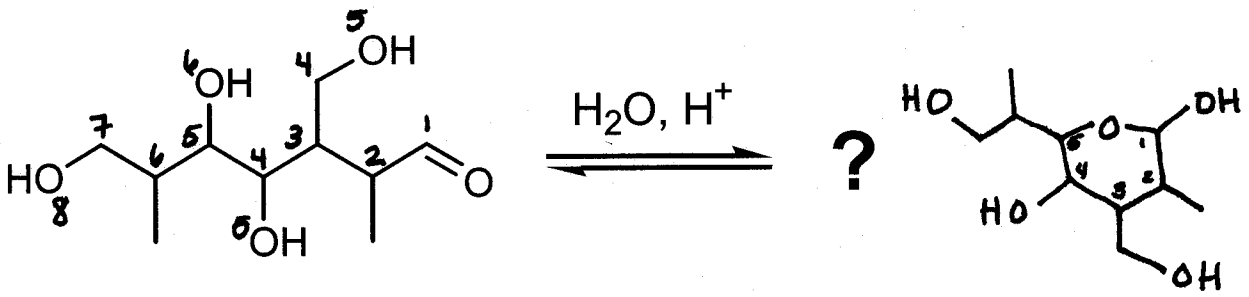
d. octanoyl chloride



e. propanoic anhydride



Question 3. (4 points) Acetals and hemi-acetals. Draw the most stable (thermodynamic) hemi-acetal for the following molecule. You may ignore stereochemistry.

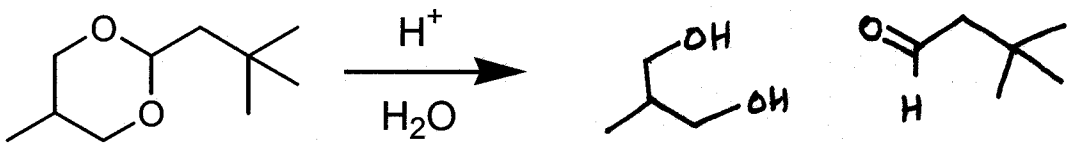


-1 pt for minor mistake in substituents

-2 pts for 5-membered ring

Question 4. (7 points) Acetals and hemi-acetals. Draw all organic product(s) from the following reactions.

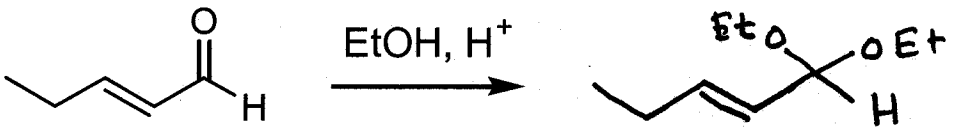
a.



2 pts 2 pts

3pts

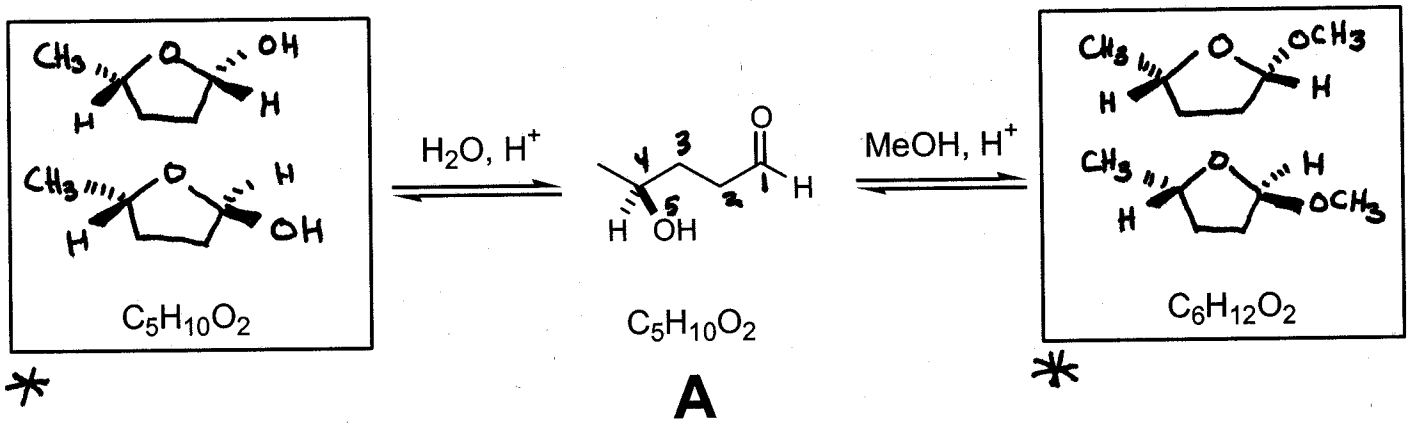
b.



(0 pts)

Question 5. Acetals and hemi-acetals. Compound **A** is optically active and is a single enantiomer.

a. (6 points) In the boxes below draw the structures for the hemi-acetal and the acetal.

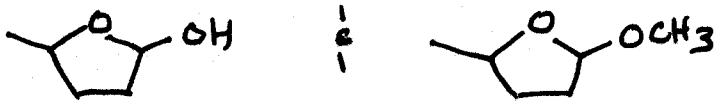


*

A

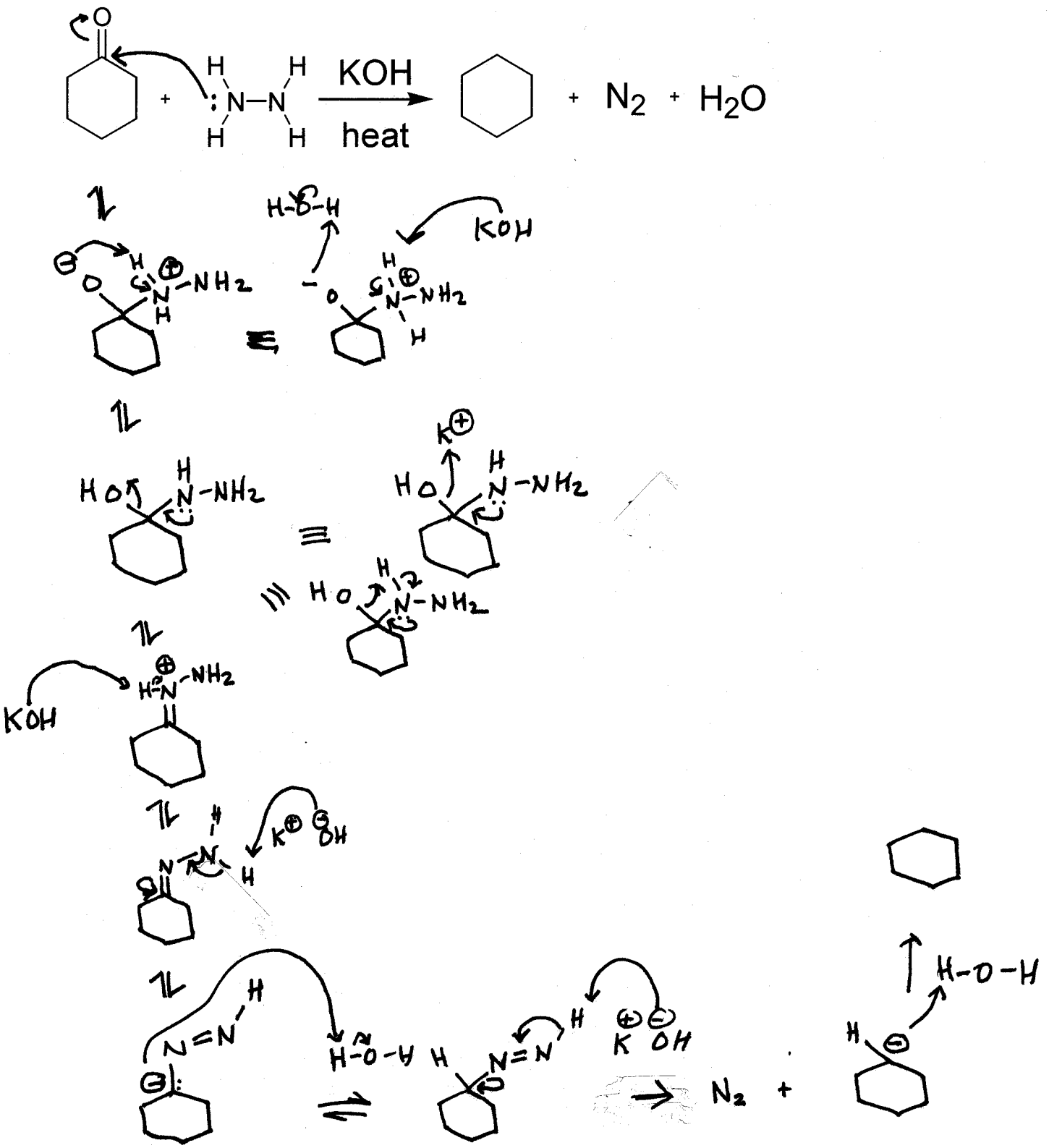
*

b. (2 points) For each product, how many stereoisomers are possible? 2 ← all or nothing

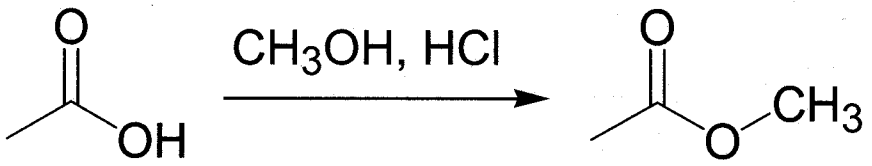
* full credit for  &

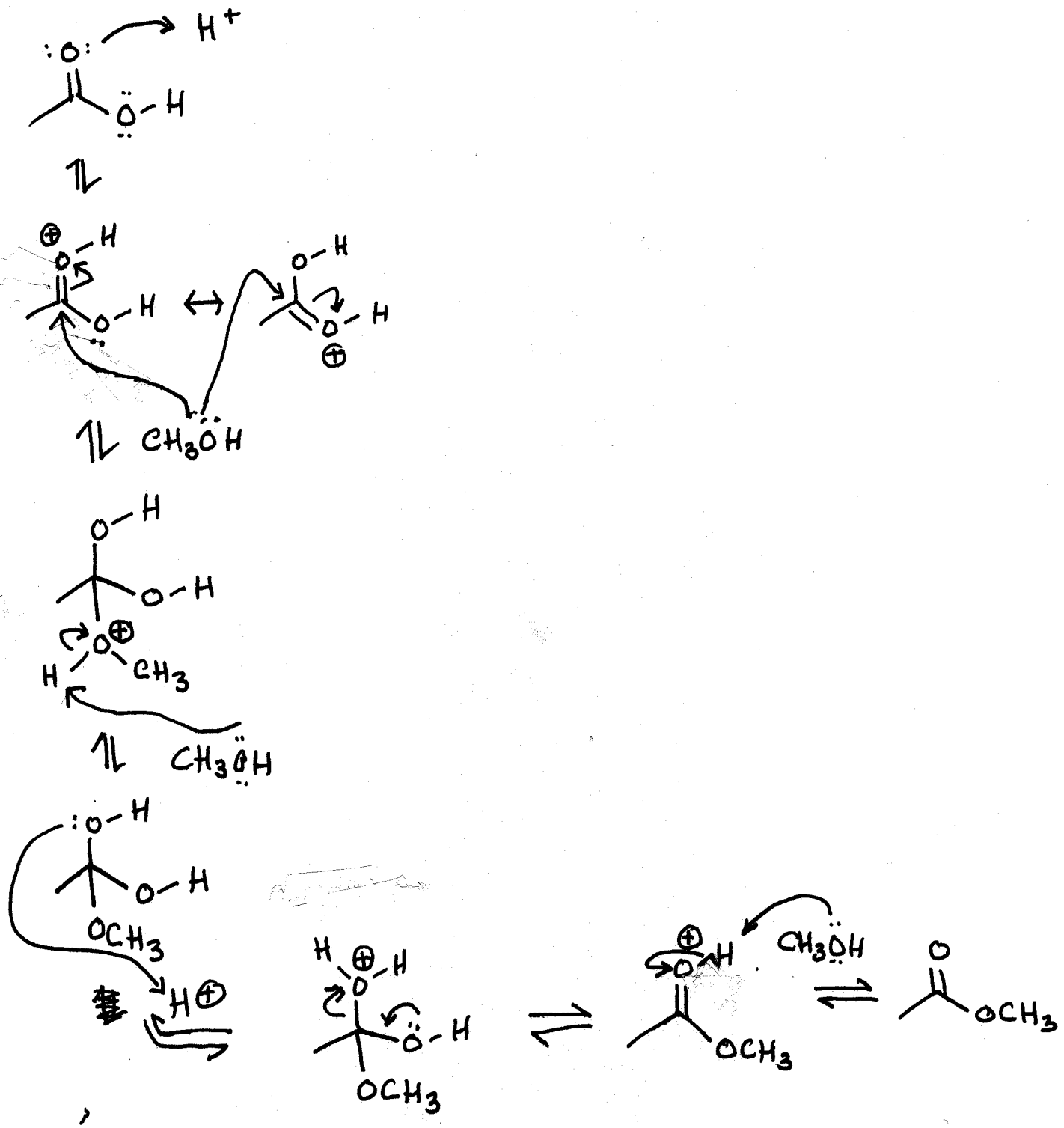
(not necessary to show stereochemistry)

Question 6. (9 points) Provide the mechanism for the Wolff-Kishner Reduction shown below.



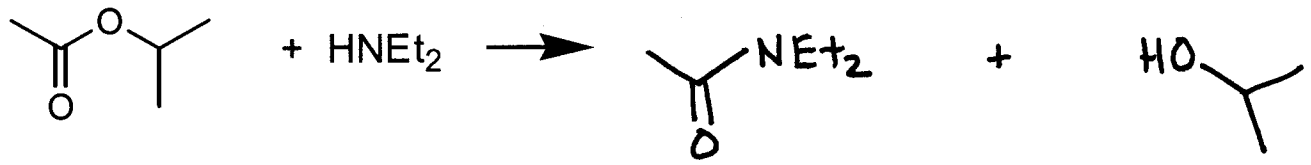
Question 7. (6 points) Provide the mechanism for the Fisher Esterification shown below.



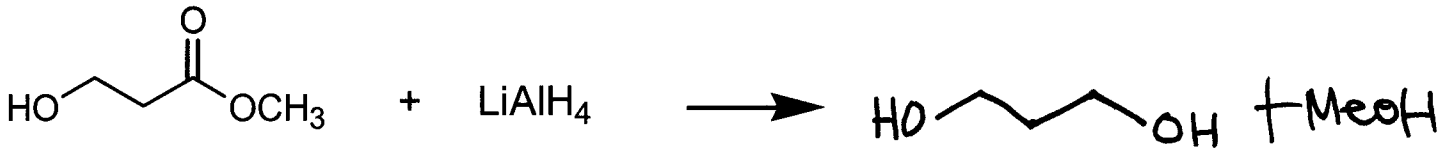


Question 8. (27 points) Show the expected products from the following reactions. You may assume the reaction is finished with a standard workup if needed.

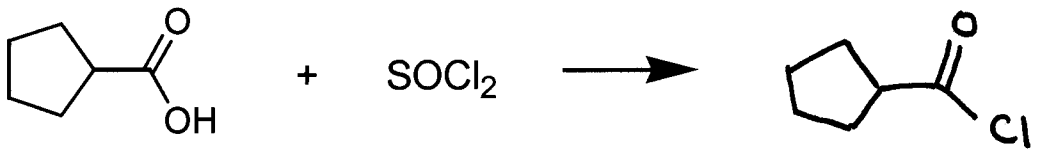
a.



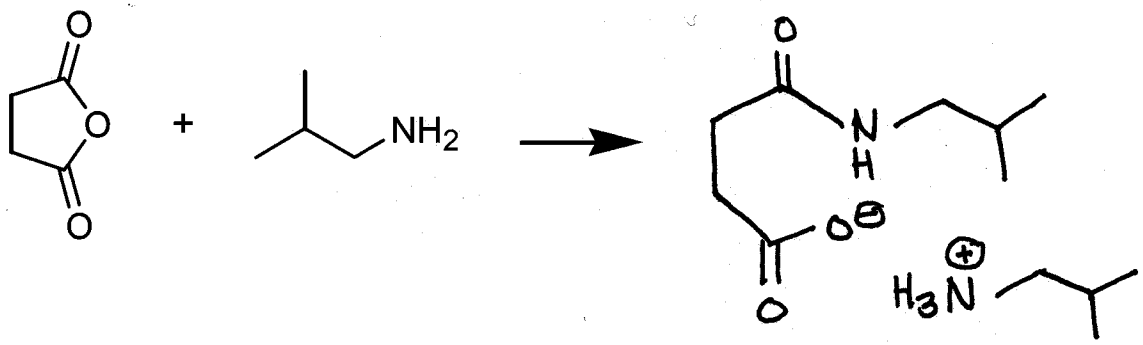
b.



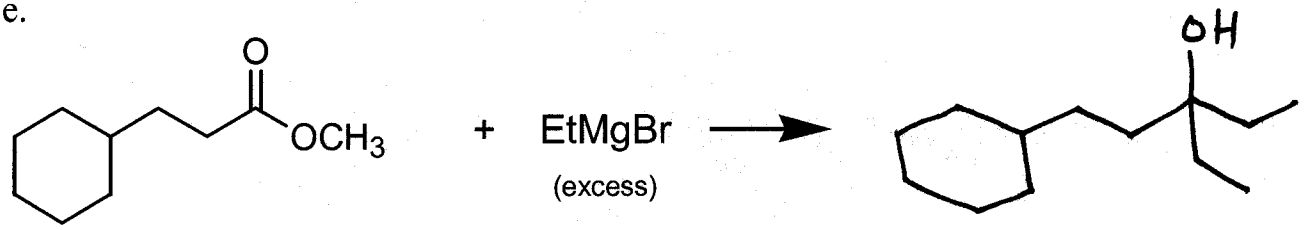
c.



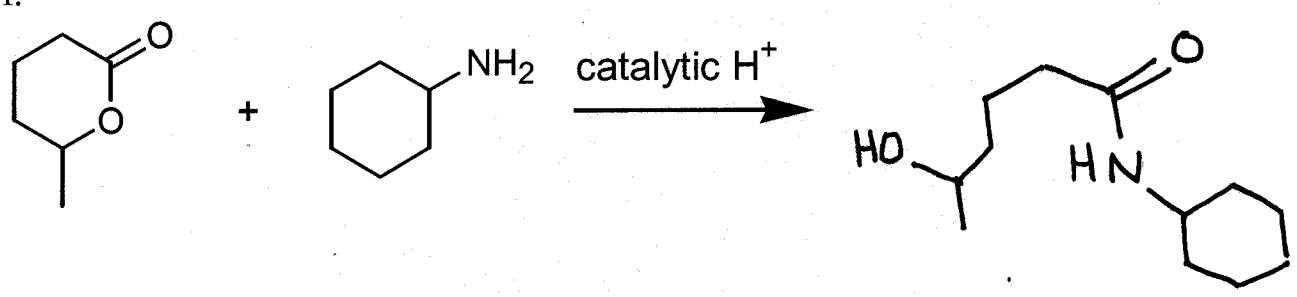
d.


O
O
O
+
NH2
O
N
H
O
O
H3N

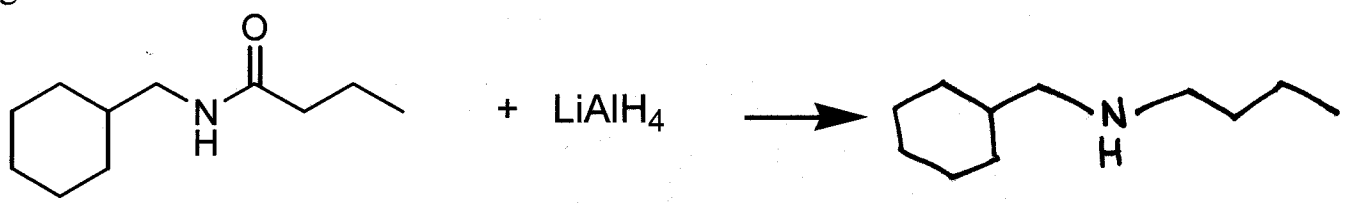
e.


O
OCH3
+
EtMgBr
(excess)
OH

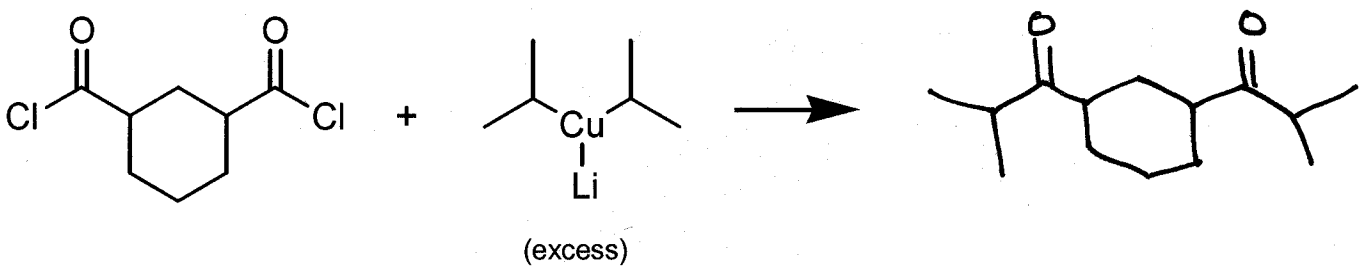
f.


O
O
+
NH2
catalytic H+
O
HO
HN

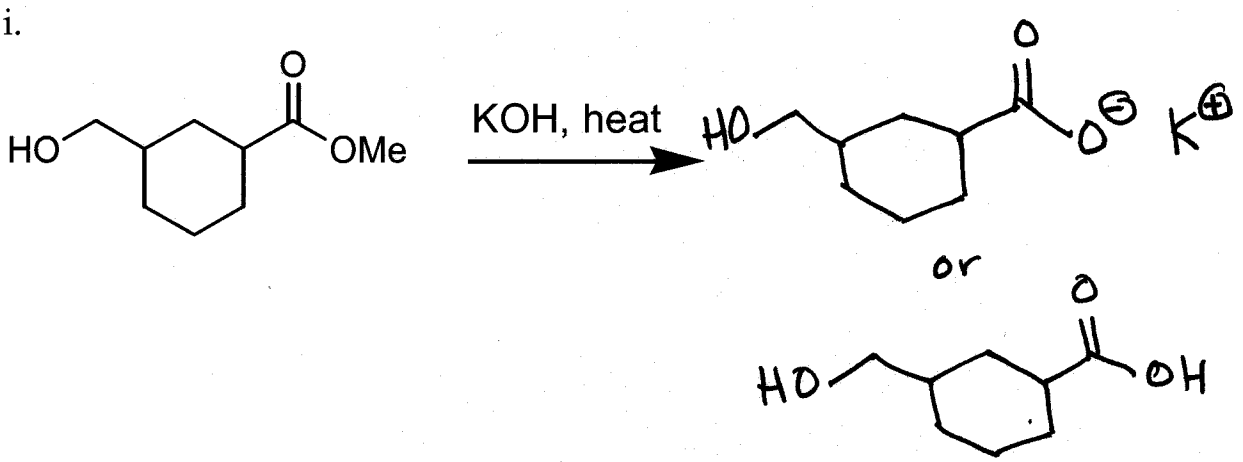
g.



h.

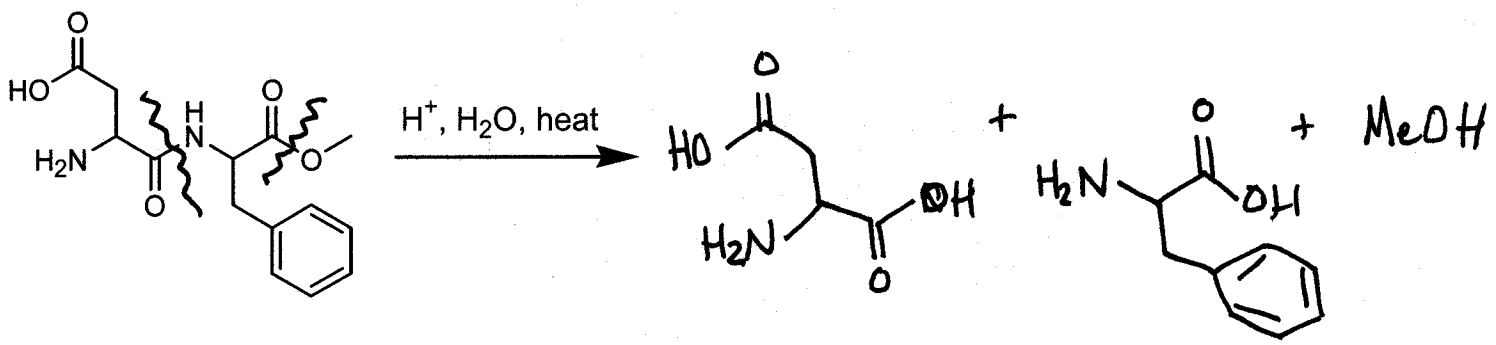


i.



not necessary to show MeOH

Question 9. (4 points). The following is the structure of NutraSweet. Show all of the hydrolysis products.



6 C 12.011 — Atomic number, Symbol, Atomic mass

PERIODIC TABLE OF THE ELEMENTS

Atomic masses are based on ^{12}C. Atomic masses in parentheses are for the most stable isotope.

Periods	Groups 1A	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
	1 H 1.00079																	2 He 4.00260
	3 Li 6.941	4 Be 9.01218											5 B 10.81	6 C 12..011	7 N 14.0067	8 O 15.9994	9 F 18.998403	10 Ne 20.179
	11 Na 22.98977	12 Mg 24.305											13 Al 26.98154	14 Si 28.0855	15 P 30.97376	16 S 32.06	17 Cl 35.453	18 Ar 39.948
	19 K 39.0963	20 Ca 40.08	21 Sc 44.9559	22 Ti 47.90	23 V 50.9415	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.70	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
	37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.22	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.4	47 Ag 107.868	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.9045	54 Xe 131.30
	55 Cs 132.9054	56 Ba 137.33	57 La* 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.9665	80 Hg 200.59	81 Tl 204.37	82 Pb 207.2	83 Bi 208.9804	84 Po (209)	85 At (210)	86 Rn (222)
	87 Fr (223)	88 Ra 226.0254	89 Ac† 227.0278	104 Unq (261)	105 Unp (262)	106 Unh (263)												

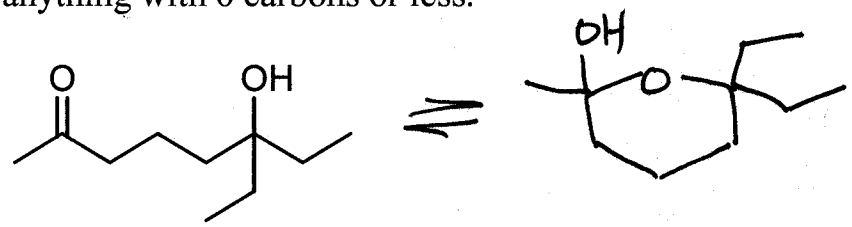
*Lanthanide series

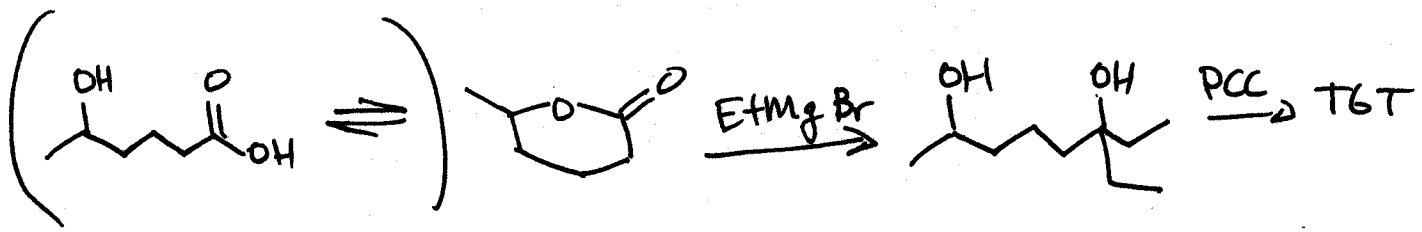
58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.9254	66 Dy 162.50	67 Ho 164.9304	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.967

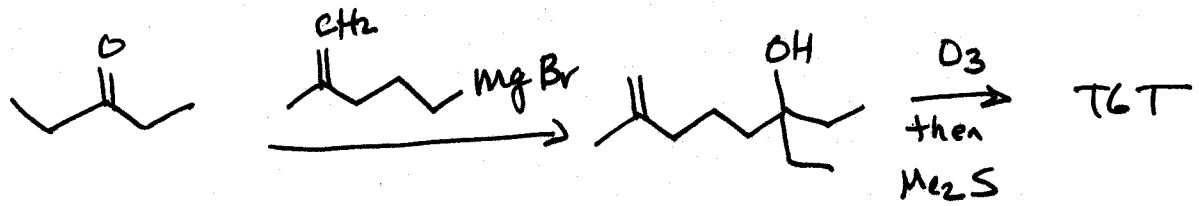
†Actinide series

90 Th 232.0381	91 Pa 231.0359	92 U 238.029	93 Np 237.0482	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

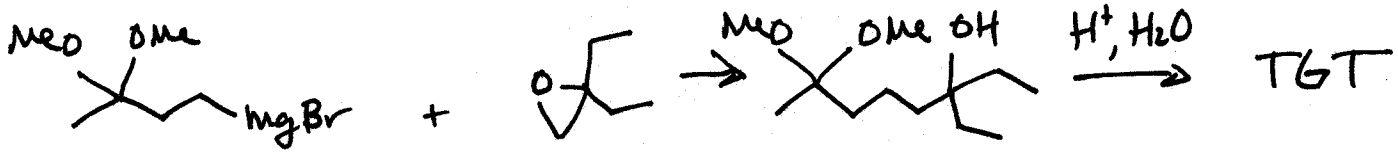
Question 10. (10 points) Propose a synthesis of the following molecule starting from anything with 6 carbons or less.



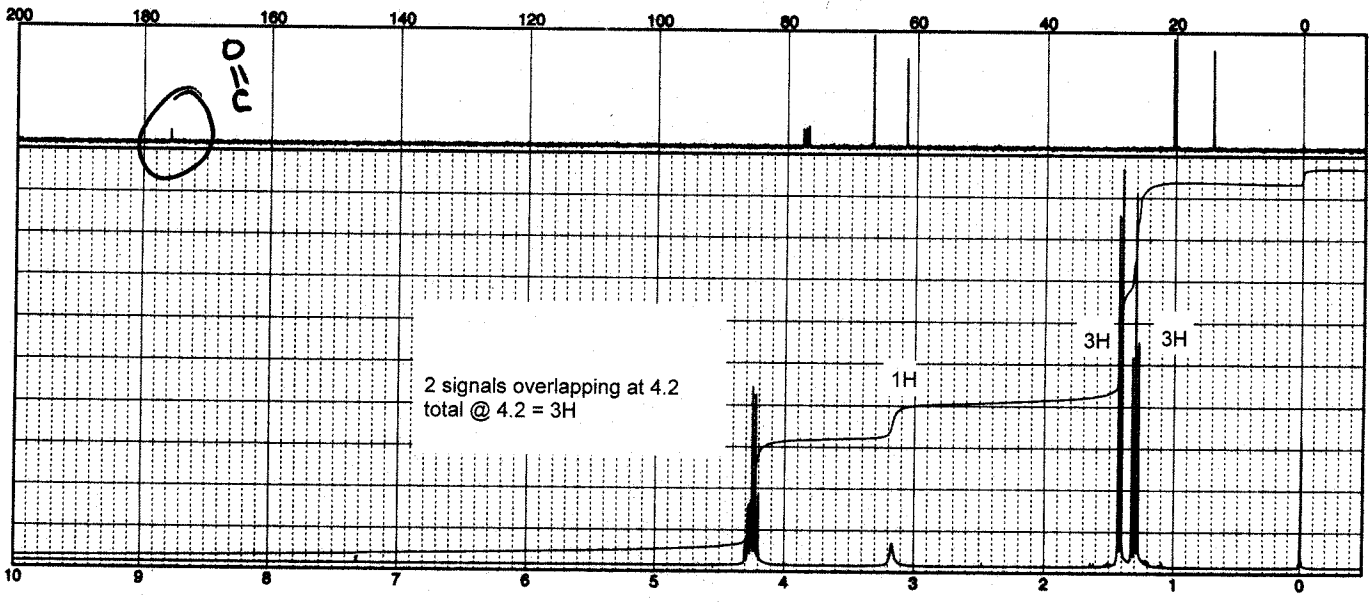
1. 

2. 

3. 

4. 

Question 11. (7 points) NMR. The following is a ^{1}H and ^{13}C NMR of compound **X**, formula $C_5H_{10}O_3$. When treated with hot KOH and then dilute aqueous HCl, a product of formula $C_3H_6O_3$ is obtained. What is compound X? Lactic acid. This can make our muscles sore after exercise.

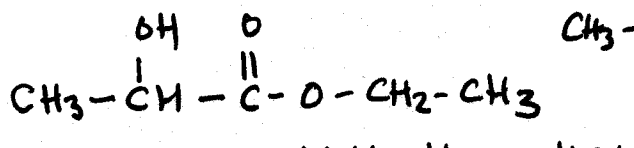


$C_5H_{10}O_3$ = 1 ring or 1 double bond

4.2 ppm	3 H	?	
3.2	1 H	broad	OH
1.4	3H	d	Me, CH_3-CH
1.3	3H	t	Me, CH_3-CH_2-

= these pieces = 10 H
therefore 4.2 must be:
$CH_3-\underset{=}{CH}-O$; $Me-\underset{=}{CH_2}-O$

put together:



↓ KOH, then HCl