

NAME: _____

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

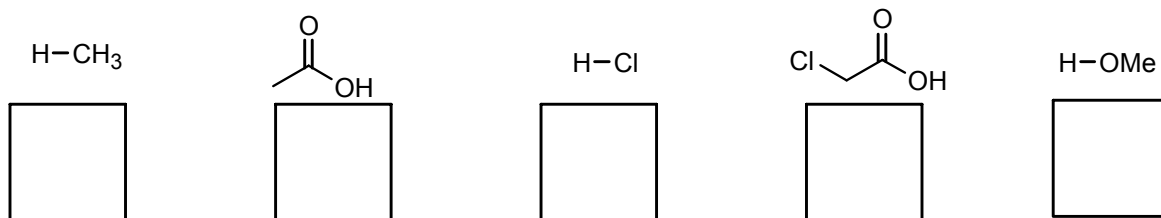
Spring 2002

Instructor: Dr. Brian Pagenkopf

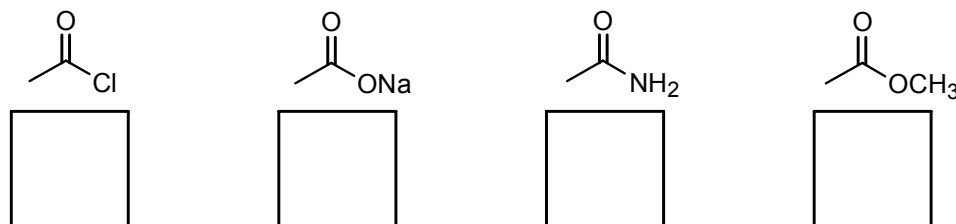
Page	Points
2	8
3	10
4	4
5	7
6	8
7	9
8	6
9	9
10	9
11	9
12	4
13	10
14	7
	100

Question 1. (8 points) Miscellaneous.

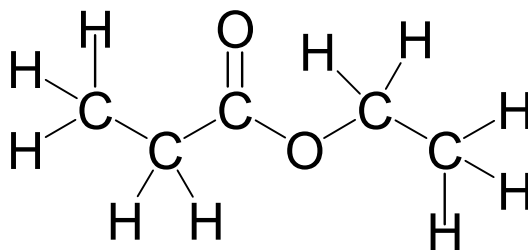
a. (2 points). Rank the following molecules in order of increasing acidity (which is the same as decreasing pKa). Write a 5 in the box for the least acidic, a 1 in the box under the most acidic, and so on.



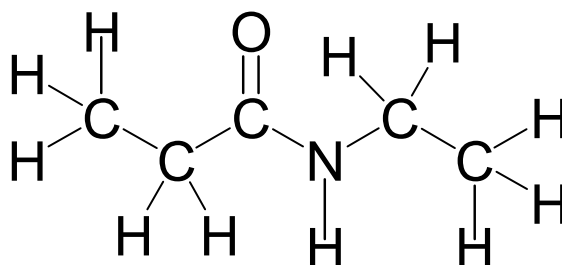
b. (2 points). Rank the following molecules in order of increasing reactivity toward nucleophilic attack. Write a 4 in the box under the least reactive, a 1 for the most reactive, and so on.



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.



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

a. 3-methylpentanoic acid

b. 4-bromobutanoic acid

c. ethyl hexanoate

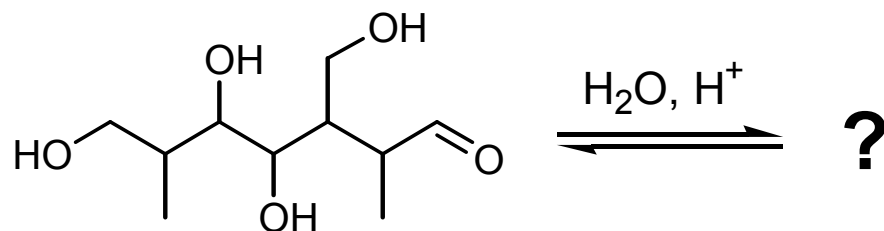
d. octanoyl chloride

e. propanoic anhydride

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

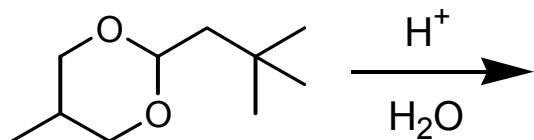


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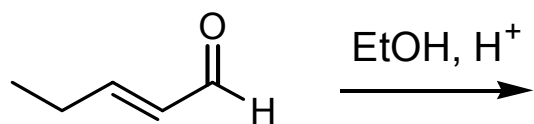
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Question 4. (7 points) Acetals and hemi-acetals. Draw all organic product(s) from the following reactions.

a.



b.

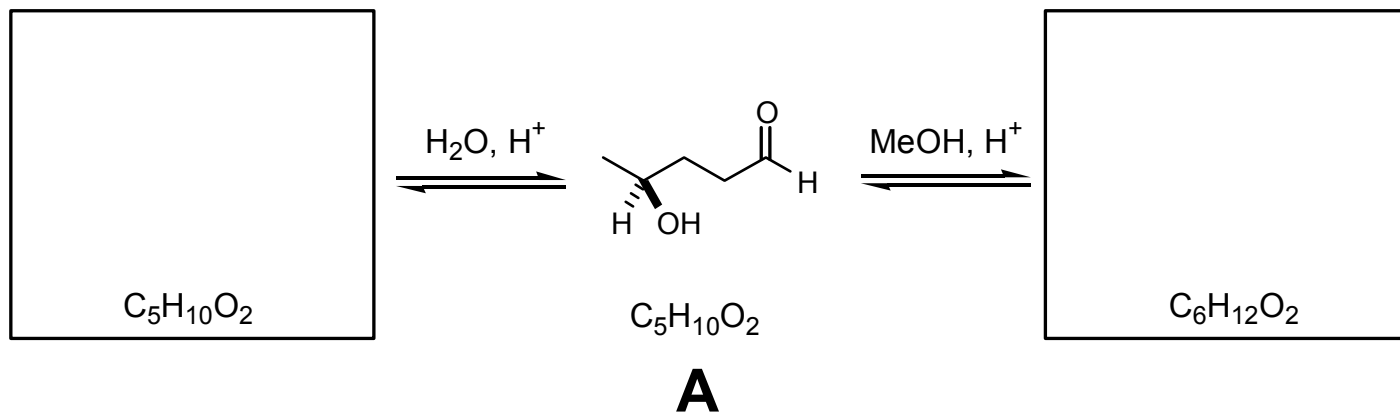


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Question 5. Acetals and hemi-acetals. Compound **A** is optically active and is a single enantiomer.

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

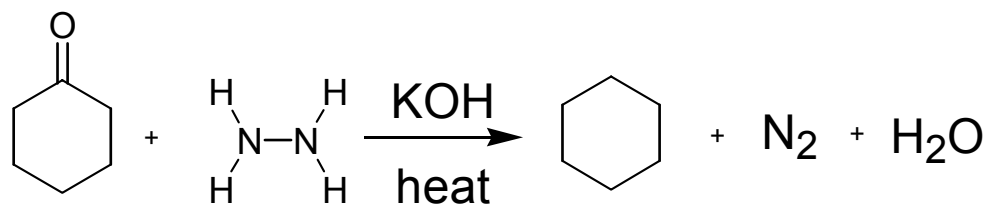


b. (2 points) For each product, how many stereoisomers are possible?

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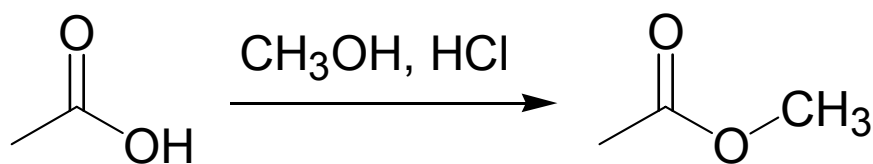
Question 6. (9 points) Provide the mechanism for the Wolff-Kishner Reduction shown below.



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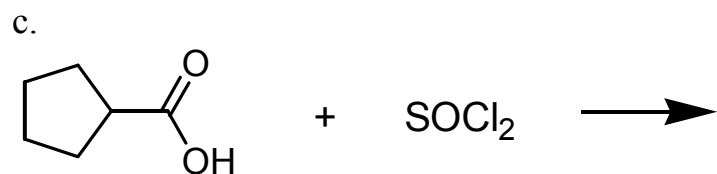
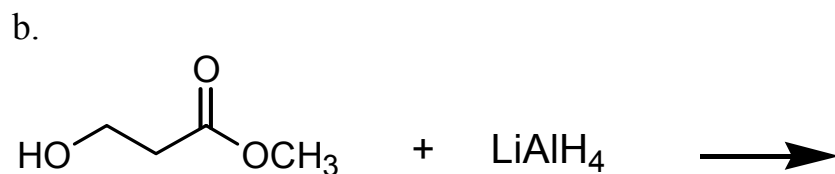
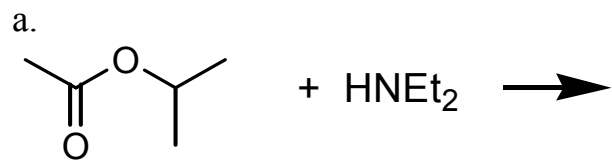
Question 7. (6 points) Provide the mechanism for the Fisher Esterification shown below.



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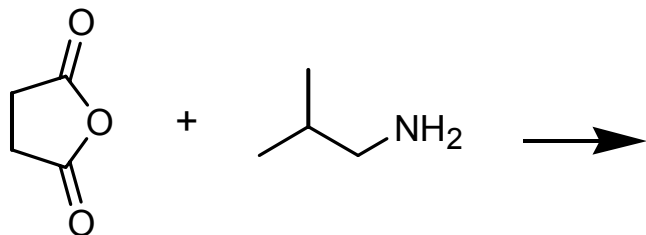
Question 8. (27 points) Show the expected products from the following reactions. You may assume the reaction is finished with a standard workup if needed.



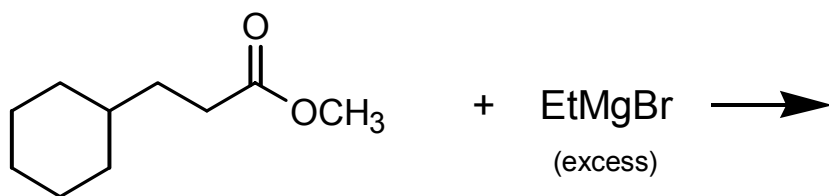
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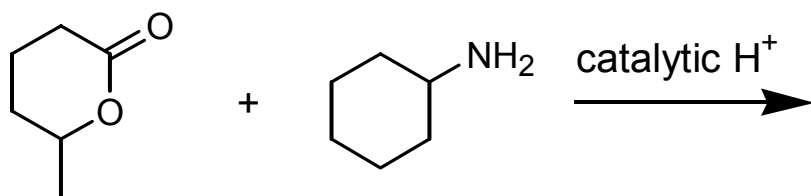
d.



e.



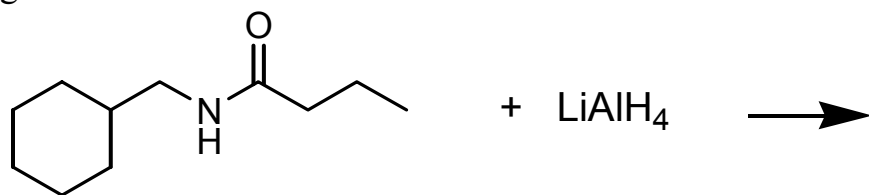
f.



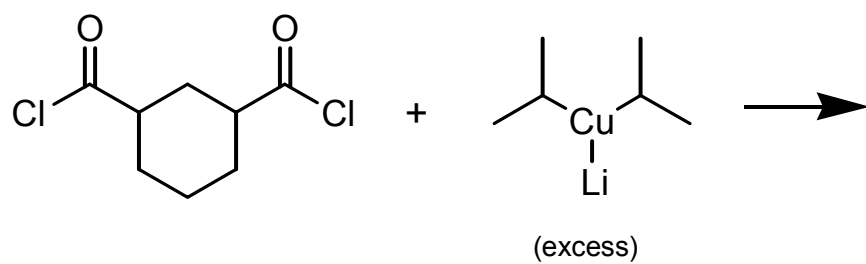
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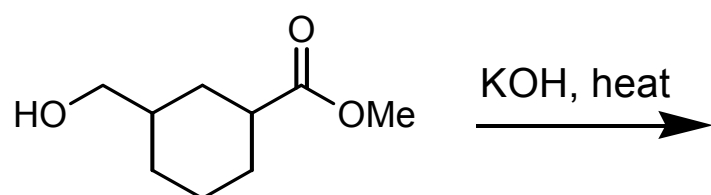
g.



h.

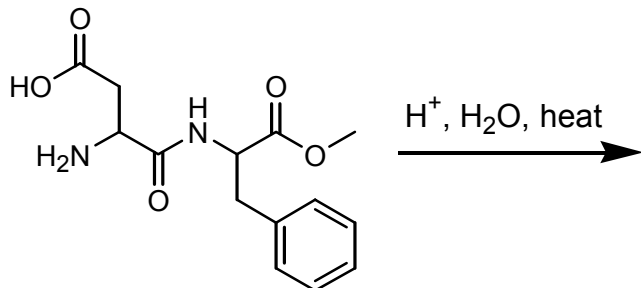


i.



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



6 — Atomic number
C — Symbol
 12.011 — Atomic mass

PERIODIC TABLE OF THE ELEMENTS

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

Groups																VIII A	
1A															2		
1															2		
H															He		
1.00079															4.00260		
IIA												IIIA	IVA	VA	VIA	VIIA	
3	4											5	6	7	8	9	10
Li	Be											B	C	N	O	F	Ne
6.941	9.01218											10.81	12.011	14.0067	15.9994	18.998403	20.179
11	12	IIIB		IVB	VB	VIB	VII B	VIII B		IB	IIB	13	14	15	16	17	18
Na	Mg											Al	Si	P	S	Cl	Ar
22.98977	24.305											26.98154	28.0855	30.97376	32.06	35.453	39.948
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
39.0963	40.08	44.9559	47.90	50.9415	51.996	54.9380	55.847	58.9332	58.70	63.546	65.38	69.72	72.59	74.9216	78.96	79.904	83.80
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
85.4678	87.62	88.9059	91.22	92.9064	95.94	(98)	101.07	102.9055	106.4	107.868	112.41	114.82	118.69	121.75	127.60	126.9045	131.30
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
132.9054	137.33	138.9055	178.49	180.9479	183.85	186.207	190.2	192.22	195.09	196.9665	200.59	204.37	207.2	208.9804	(209)	(210)	(222)
87	88	89	104	105	106												
Fr	Ra	Ac	Unq	Unp	Unh												
(223)	226.0254	227.0278	(261)	(262)	(263)												

*Lanthanide series

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

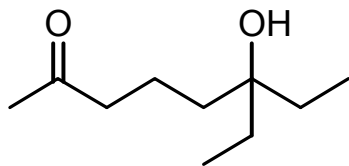
†Actinide series

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

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



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Question 11. (7 points) NMR. The following is a ^1H and ^{13}C NMR of compound **X**, formula $\text{C}_5\text{H}_{10}\text{O}_3$. When treated with hot KOH and then dilute aqueous HCl, a product of formula $\text{C}_3\text{H}_6\text{O}_3$ is obtained. What is compound **X**?

