Chemistry 117 Sec. 1 (7:45-8:45)
Exam No. 2
"Nucleophilic Acyl Substitution, Carbohydrates, Amino Acids, α-Carbonyl Chemistry"
March 27, 2006

Instructions: You will have 60 min. to complete the exam. At the 60 min. mark, all remaining test takers must cease writing, turn their exams over, and pass them to the rightmost seat in their row. If you finish within 55 min. you may turn in the exam at the front of the room prior to leaving. If you finish in the final 5 min. of class, please turn your exam over and remain seated until I call for the remaining exams to be turned in. *In fairness to all, any exams not collected by Dr. Mills before he leaves class will receive a grade of zero!*

Be sure to read the instructions for each question. It may be helpful to skim the entire exam and solve the easier questions first.

Exam Agreement: I, _____, have read and agree
(Please print)
to abide by the instructions above. On my honor, I have neither given nor accepted any help during this exam.

Signature: _____

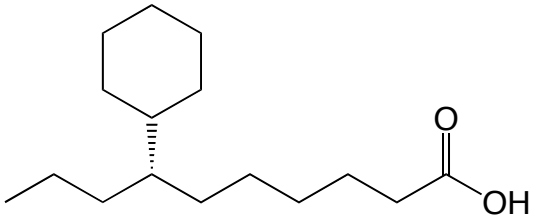
College: _____

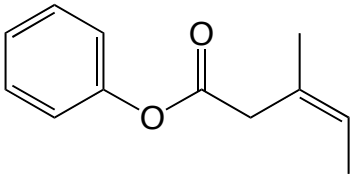
NO CALCULATORS ALLOWED

CAREFULLY DETACH THE LAST PAGE AND USE IT AS A REFERENCE

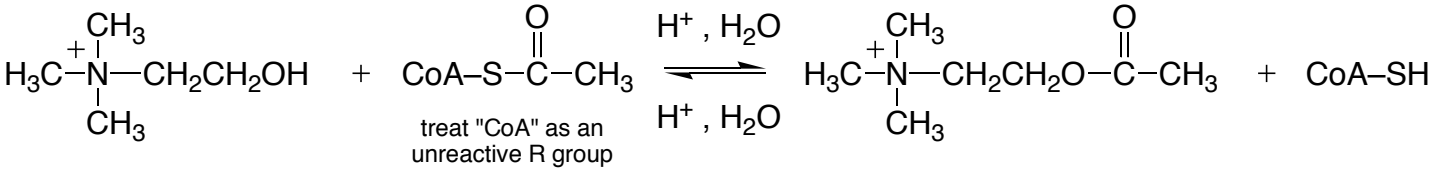
DO NOT OPEN THIS EXAM UNTIL INSTRUCTED TO DO SO

1. Provide an unambiguous name (IUPAC or common) for each of the following molecules. (8 points)



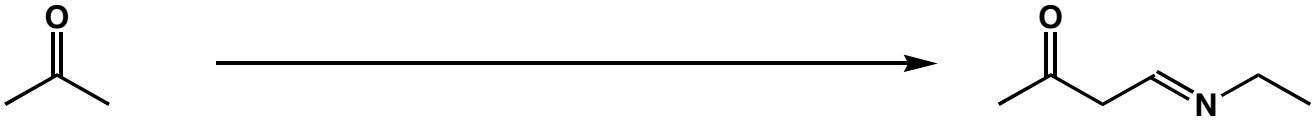


2. The reaction shown below is important in the transmission of nerve impulses. In biological systems, enzymes catalyze this reaction in both directions. Suppose the reaction were to take place outside of the body (in H^+, H_2O). Which side of the equilibrium would be favored (circle the compounds that indicate your choice)? Provide a mechanism for the reaction that proceeds in the selected direction. (10 points)

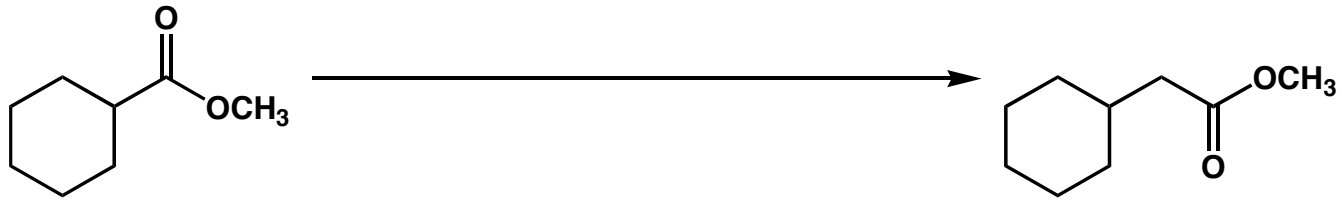


Why is the direction of equilibrium that you chose favored over the other (explain in the space provided)?

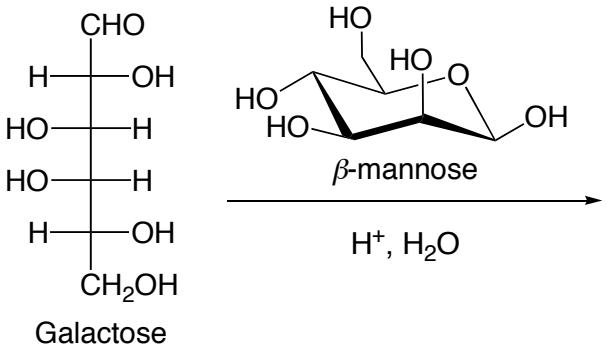
3. Provide a synthesis for the following transformation (include the products of each major step). (8 pts)



4. Provide a synthesis for the following transformation (include the products of each major step). (10 pts)

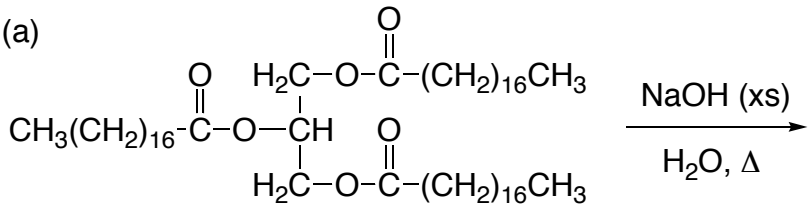


5. Draw the structure of the α-1,2-disaccharide of galactose and β-mannose. Provide a mechanism that shows how this dissacharide could be formed from the starting materials provided. Show the products of each step for full credit. (10 points)

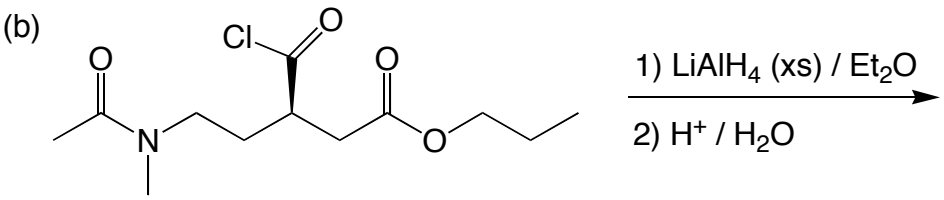


6. Draw the **major product(s)** of each of the following reactions. (20 pts)

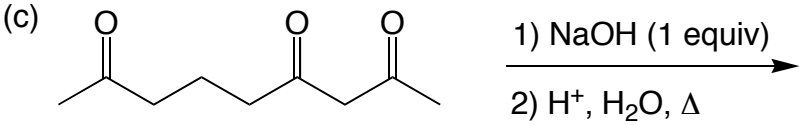
(a)



(b)

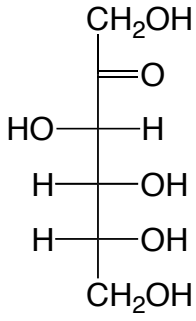


(c)



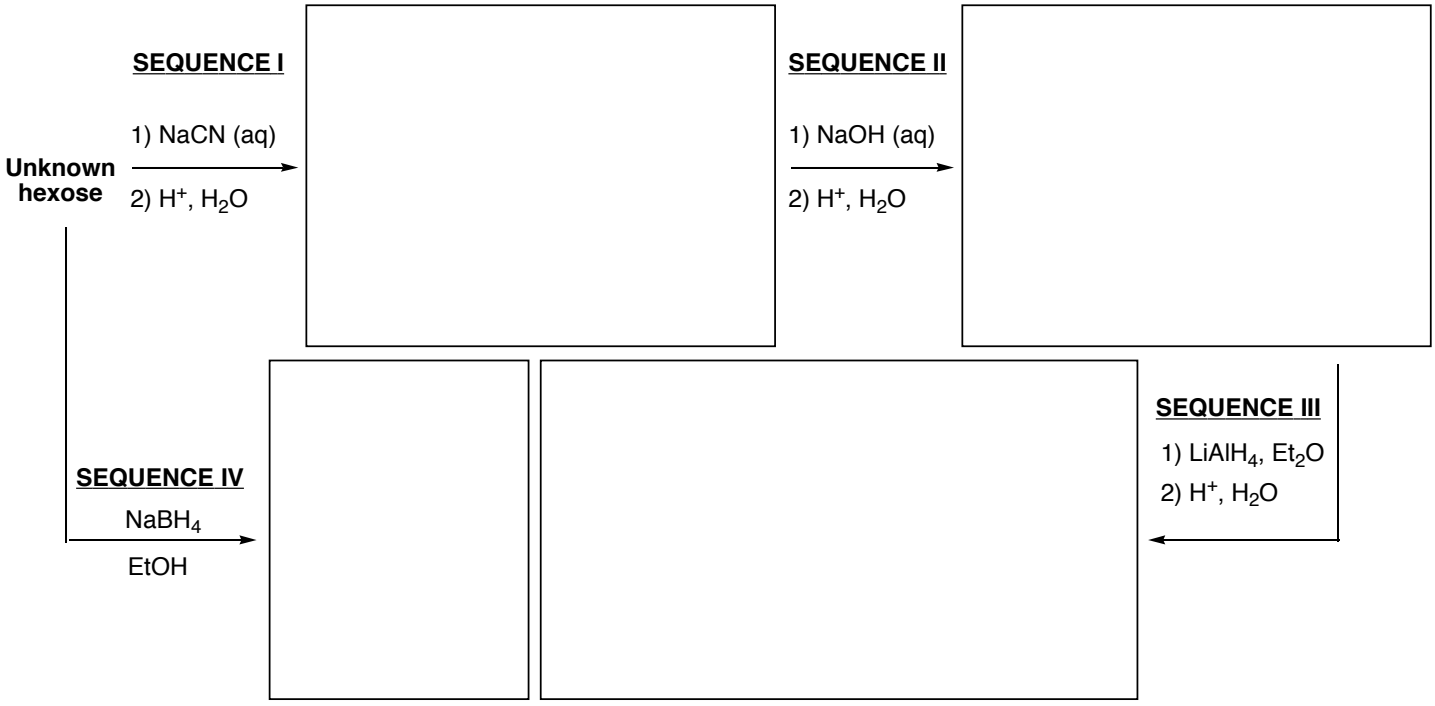
(d)

7. Provide a mechanism that explains why D-fructose gives a positive Tollens test (i.e. acts as a reducing sugar) even though it doesn't contain an aldehyde group. Recall that the Tollens test is done under aqueous, basic conditions (NaOH, H_2O). Note: you are *not* being asked to provide the mechanism of the Tollens rxn. (10 pts)



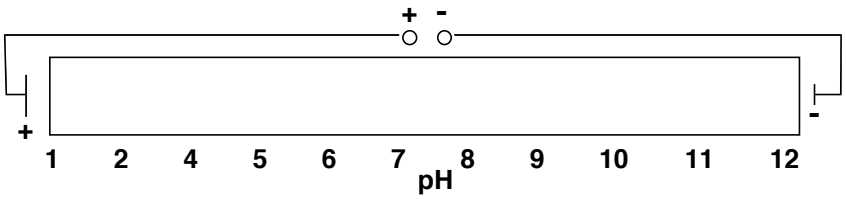
D-Fructose

8. One of the 8 naturally occurring hexoses (shown below) is subjected to the reactions shown. The product of SEQUENCE IV is chiral. as are the two products that result after SEQUENCE III. The β-pyranose of the unknown contains only 1 axial hydroxyl group. Determine the identity of the unknown hexose (provide its name) and provide products for each sequence of reactions (use Fisher projections). (12 pts)



Name of unknown hexose: _____

9. Draw (showing the correct stereochemistry for each stereocenter) the predominant form of Gly-His-Lys at pH 8.5. Then indicate where it would show up on the p*H* gradient electrophoresis gel below. (12 points)

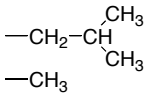
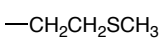
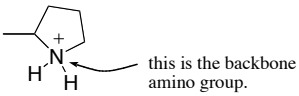
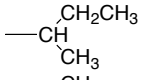
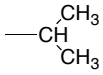
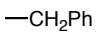
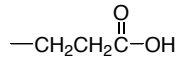
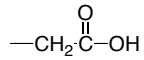
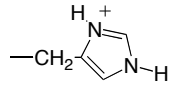
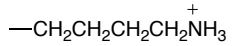
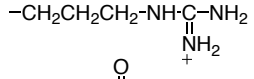
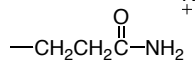
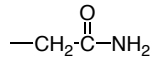
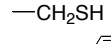
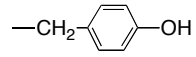
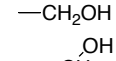
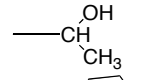
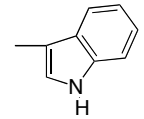


Structure of Gly-His-Lys:

Grading Summary

Page	Point Value	Points Earned
1	26	
2	20	
3	30	
4	24	
	Total Score =	

The side chains of the 20 common amino acids and their acidities.

Name	3-letter Abbr.	1-letter Abbr.	Side Chain (protonated form)	pK_a α-COOH	pK_a α-NH_3^+	pK_a side chain
leucine	Leu	L		2.4	9.6	---
alanine	Ala	A		2.3	9.9	---
methionine	Met	M		2.3	9.2	---
proline	Pro	P		2.0	10.6	---
glycine	Gly	G		2.4	9.8	---
isoleucine	Ile	I		2.4	9.7	---
valine	Val	V		2.3	9.6	---
phenylalanine	Phe	F		1.8	9.1	---
glutamic acid	Glu	E		2.2	9.7	4.3
aspartic acid	Asp	D		2.0	10.0	3.9
histidine	His	H		1.8	9.2	6.0
lysine	Lys	K		2.2	9.2	10.8
arginine	Arg	R		1.8	9.0	12.5
glutamine	Gln	Q		2.2	9.1	---
asparagine	Asn	N		2.0	8.8	---
cysteine	Cys	C		1.8	10.8	8.3
tyrosine	Tyr	Y		2.2	9.1	10.9
serine	Ser	S		2.1	9.2	---
threonine	Thr	T		2.6	10.4	---
tryptophan	Trp	W		2.4	9.4	---

The naturally occurring hexoses