California State Polytechnic University, Pomona

Chem 315
Final Exam
Summer, 2004
Beauchamp

Name: _____

Topic	Total Points Exam Points	Credit
1. Nomenclature (1)	25	
2. Relative Order of Reactivity	20	
3. Reactions Page, using reactions learned thus far (30)	30	
4. Mechanism in acid and in base	24	
5. Tautomers (in acid and in base), Drawing Additional Tautomer Structures.	26	
6. ^{14}C Synthesis	25	
7. S_N1/E1 and S_N2/E2 reactions. Stereochemistry, Arrow Pushing, Carbocations, Rearrangements	28	
8. Alkene Reactions (Regioselect., Stereoselect.)	28	
Total	206	

This is a long exam. It has been designed so that no one question will make or break you. The best strategy is to work steadily, starting with those problems you understand best. Make sure you show all of your work. Draw in any lone pairs of electrons, formal charge and curved arrows to show electron movement. Only write answers on the front of each page. Do your best to show me what you know in the time available.

Discovering consists of seeing what everybody has seen and thinking what nobody has thought.

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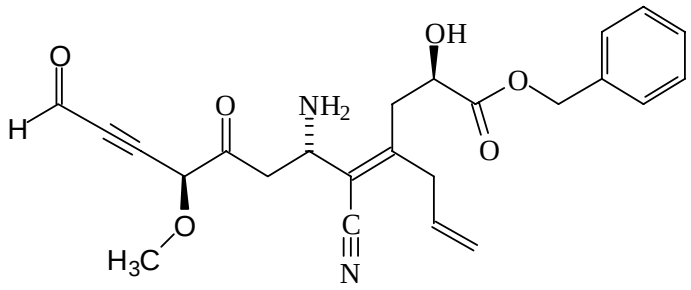
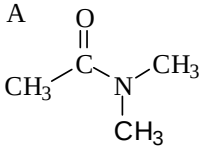
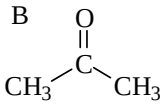
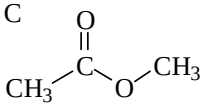
1. Provide an acceptable name for the following structure. (25 pts)

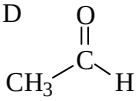


2. Predict the relative order of reactivity of strong nucleophiles with the indicated carbonyl compounds (1 = most reactive). Provide an explanation for that order of reactivity. Use all three routine arguments of organic chemistry. Show structures, lone pairs and arrow-pushing conventions in your answer. Write out the expected products for the addition of lithium aluminium hydride (LAH) to each carbonyl center after acidic workup? You do not need to show mechanisms. (20 pts)

A 

B 

C 

D 

Expected LAH products, after workup.

A B C D

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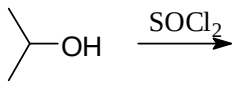
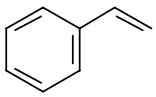
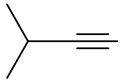
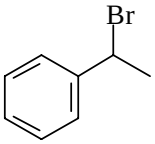
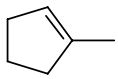
3. Provide the expected product for each of the following reactions. Show regiochemistry and stereochemistry clearly, if relevant. Do NOT show mechanisms. WK = workup (30 pts)

a. 

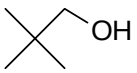
b. 

c. 

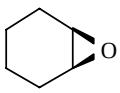
d. 

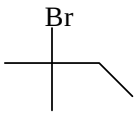
e. 

f. 

g. 

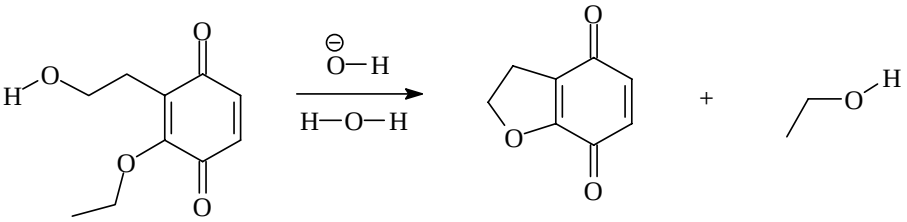
h. 

i. 

j. 

4. Provide a complete arrow-pushing mechanism (curved arrows, lone pairs and formal charge) to explain the following transformations. If resonance structures are present, show at least one other resonance structure to demonstrate that you are aware of their presence. In neither example does the reaction begin with the ethoxy group. Make sure to take account of the acid or base conditions. The base reaction is the simpler of the two mechanisms and begins with a proton transfer. What do you expect with a carbonyl group and acid? (24 pts)

a.



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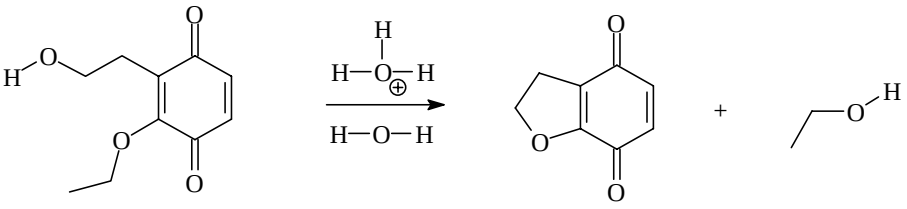
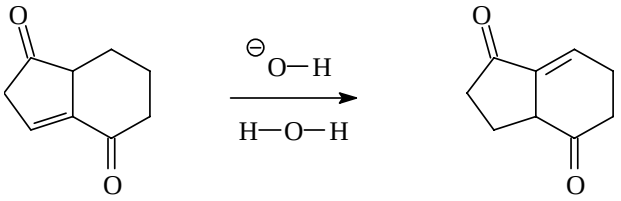
b.

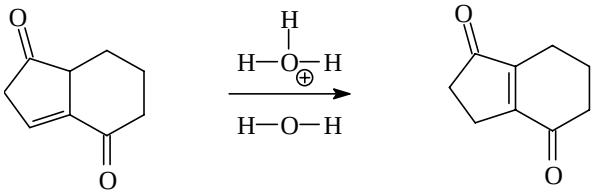


5. Provide a complete arrow-pushing mechanism (curved arrows, lone pairs, formal charge, important resonance structures for the following transformations. Restrict your tautomeric changes to keto or enol portions of the molecules, not isolated carbon-carbon double bonds. If oxygen is part of an anionic or cationic resonance system, show that structure. Help yourself and circle the hydrogens that move. (total = 26 pts)

a.

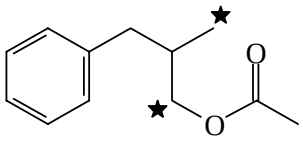


b.



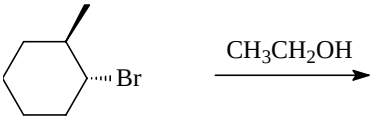
c. Write out 3 additional tautomeric structures different than those drawn above (there are several more possible). Remember the number of π bonds and the formal charge does not change among tautomers. (6 pts)

6. Propose a reasonable synthesis for the following molecule. Your only source of ^{14}C is labeled methanol, $*CH_3OH$, and carbon dioxide, $*CO_2$. You may also use non-^{14}C methanol, bromobenzene, ethene and propene, as well as any other routine reagents discussed in our course. Begin with the given structure and work backwards to allowable starting materials. You must show the reagents and starting structure for each step of your synthesis, but do not show mechanisms. (25 pts)

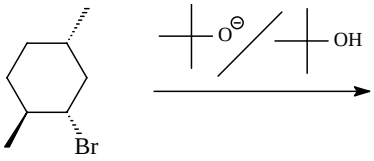


7. Write the structure(s) of the expected **major** product(s). Include a simple mechanism that clearly shows how the reaction likely proceeds. State what mechanism each reaction follows. If chiral centers are present, indicate absolute configuration(s). Show 3D representations when necessary to explain the result. If rearrangements are reasonable, assume they will happen. (28 pts)

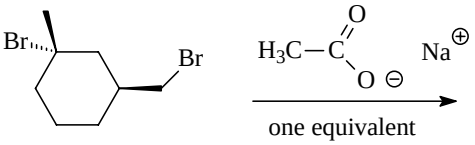
a. Mechanism = _____



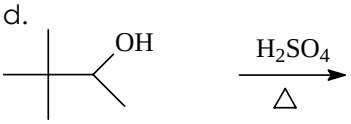
b. Mechanism = _____



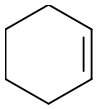
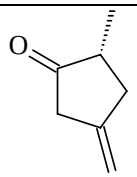
c. Mechanism = _____



d. Mechanism = _____



8. Using the given alkenes, show the expected stereochemical and regiochemical result for each set of conditions. State whether the products will reveal if the reaction is stereoselective and/or regioselective. Also circle the appropriate letter indicating if the product(s) is(are) chiral (c), enantiomers (e), diastereomers (d), meso (m) or no chiral centers (n). If more than one product is formed, predict which is the major product or if they are formed in equal amounts. In column A classify all chiral centers as R or S. (28 pts)

Alkenes		
Reagent 1 1. mCPBA 2. H_2O/H_3O^+	(c) (e) (d) (m) (n) R/S	(c) (e) (d) (m) (n)
Reagent 2 OsO_4	(c) (e) (d) (m) (n) R/S	(c) (e) (d) (m) (n)

You cannot do a kindness too soon for you never know how soon it will be too late. Ralph Waldo Emerson