California State Polytechnic University, Pomona

Chem 315
Final Exam **Name: _____**
Fall, 2013
Beauchamp

Topic	Total Points Exam Points	Credit
1. Nomenclature (1)	30	
2. Short Syntheses (5, can be done in about 3 steps)	30	
3. Reactions Page, using reactions learned thus far (30)	30	
4. Course Related Mechanisms (from lunch time journal articles), one easy, two medium, one challenging	32	
5. Tautomers (in acid and in base, both can be done in two transformations)	30	
6. Synthesis (2)	30	
7. S_N1/E1 and S_N2/E2 reactions. Stereochemistry, Arrow Pushing, Carbocations, Rearrangements	30	
8. Alkene Reactions (Regioselectivity, Stereoselectivity.)	36	
Total	248	

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 in mechanism and explanation problems. If resonance is part of an answer, draw the best resonance structure, plus at least one additional resonance structure to show that resonance is present. Only write answers in the space available. Do your best to show me what you know in the time available.

"Darkness cannot drive out darkness: only light can do that. Hate cannot drive out hate: only love can do that."
Martin Luther King Jr.

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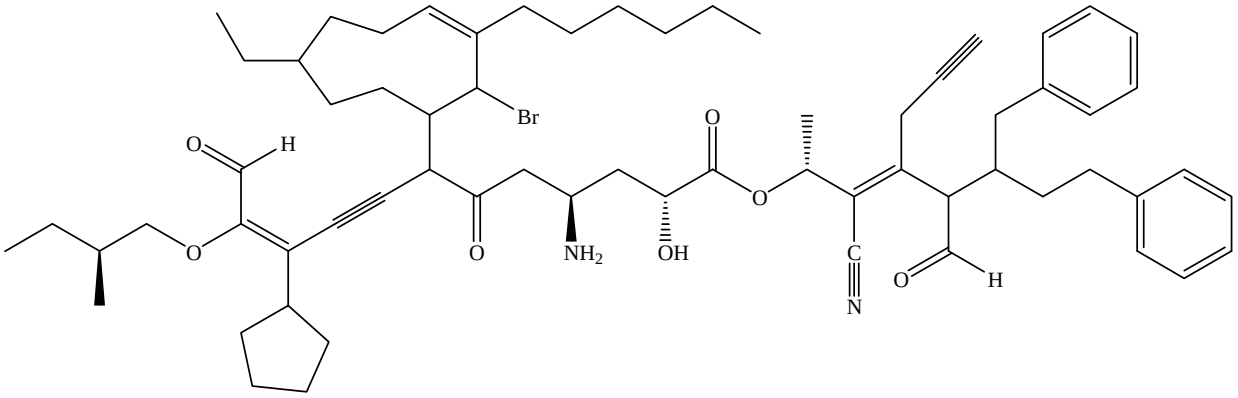
1. Provide an acceptable name for the following structure. (30 pts)



2. Propose a series of synthetic steps that will transform the indicated starting material into the target molecule. **You can use any other reagents and molecules you need (you don't need to make them).** Each part can be done in as few as 3 steps (1 step = single pot sequence). Do not show mechanisms. (30 pts)

a.

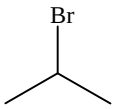
b.

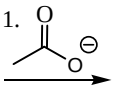
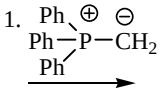
c.

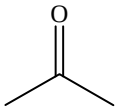
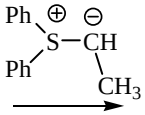
d.

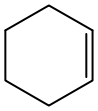
e.

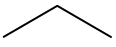
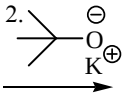
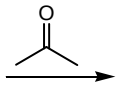
3. Provide the expected product for each of the following reactions. Show regiochemistry and stereochemistry clearly, if relevant. Do NOT show mechanisms. WK = workup (30 pts)

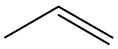
a. 

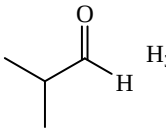
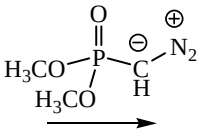
1. 
2. NaOH
CrO_3/H_2O
1. 
2. OsO_4

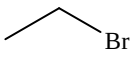
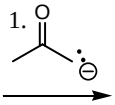
b. 

$CH_3OH_2^{\oplus}$
CH_3OH
CrO_3
pyridine

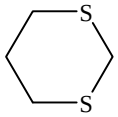
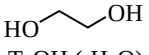
c. 
HBr
1. Mg
2. CO_2
3. WK
1. $SOCl_2$
2. $(CH_3)_2NH$

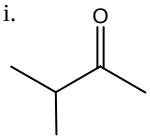
d. 
1. $Br_2/h\nu$
2. 
1. mCPBA
2. H_3O^+/H_2O

TsOH ($-H_2O$)

e. 
Br_2
1. excess $NaNR_2$
2. CH_3Br
Na / NH_3

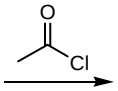
f. 

Pd/H_2
quinoline
H_3O^+
H_2O

g. 
1. Li
2. $CH_2=O$
3. workup
$SOBr_2$
1. 
2. workup

h. 
1. n-butyl lithium
2. 
$HgBr_2$
H_2O

TsOH ($-H_2O$)

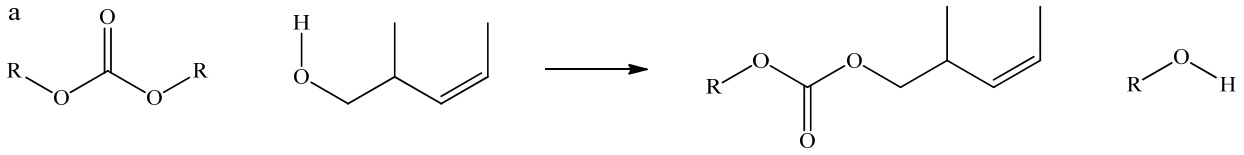
i. 
1. $NaBD_4$
2. workup
1. TsCl
pyridine
2. NaBr
1. Li
2. 
3. WK

j. 

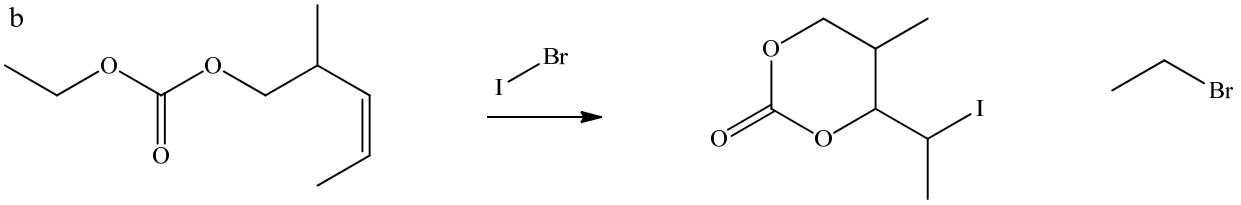
NaCN
1. $LiAlH_4$
2. workup


4. The following reactions were taken from literature synthesis papers (using simplified structures) I read while eating lunch. Provide a complete arrow-pushing mechanism (curved arrows, lone pairs, formal charge at least 2 resonance structures, when present) to explain each one. (32 pts, points = 6, 8, 8, 10)

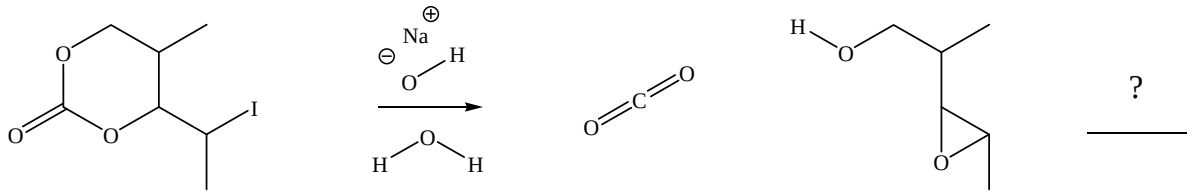
a



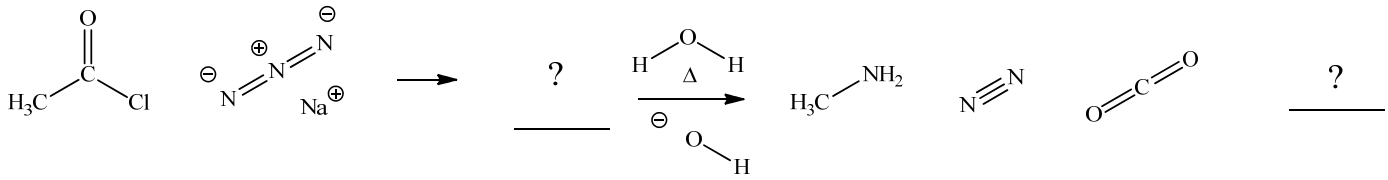
b



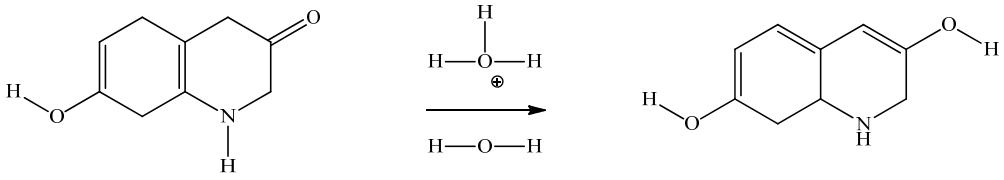
c



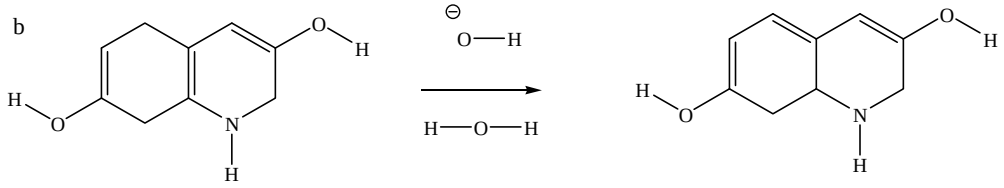
d. Hints: A different resonance structure might be more helpful, look at what atoms are bonded together and there is a rearrangement.



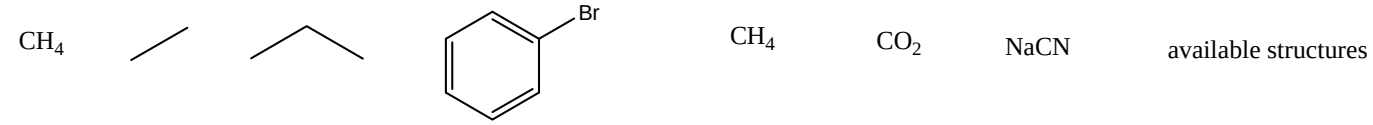
5. Provide a complete arrow-pushing mechanism for the following transformations (curved arrows, lone pairs, formal charge and at least 2 resonance structures, including a "best" one). **Restrict your tautomeric changes to keto or enol portions of the molecules**, not isolated carbon-carbon double bonds. Both of these tautomer mechanisms can be shown with two tautomeric changes (that's 4 reaction steps). You might want to identify the key hydrogen atoms. (30 pts)



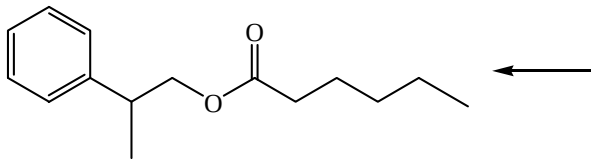
b



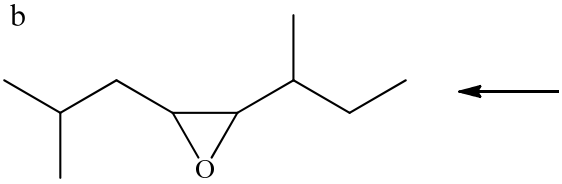
6. Propose a reasonable synthesis for the following molecules. Allowed starting carbon structures are shown below. You may also use any other routine reagents discussed in our course. Begin at the end, with the given structure, and work backwards to allowable starting materials. You must show the reagents and starting structure for each step of your synthesis. Do NOT show mechanisms. (30 pts)



a

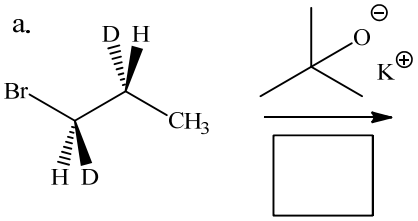


b

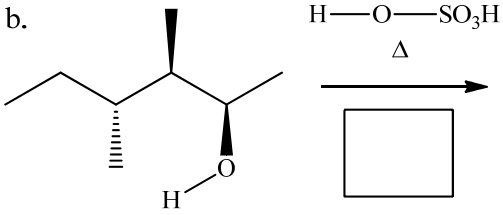


7. Write the structure(s) of the expected **major** product(s). Include one simple mechanism that clearly shows how the reaction likely proceeds (curved arrows, lone pairs and formal charge). Write in the box what mechanism each reaction follows. Show 3D representations when necessary to explain the result. If rearrangements are reasonable, assume they will form the most stable carbocation. (30 pts)

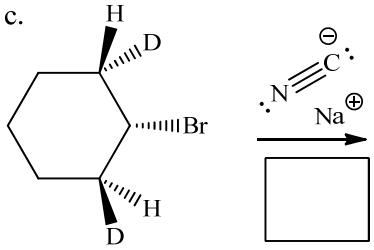
a.



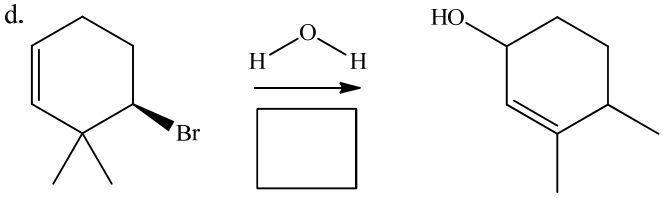
b.



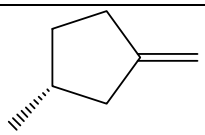
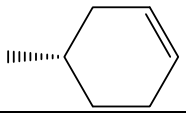
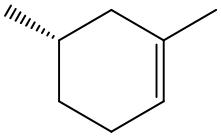
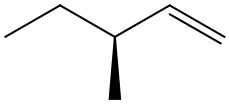
c.



d.



8. Using the given alkenes, show the expected stereochemical and regiochemical result for each set of conditions in 3D. State whether the products will reveal if the reaction is stereoselective and/or regioselective. Also indicate whether the product(s) is(are) chiral, enantiomers, diastereomers, meso or no chiral centers. 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. (36 pts)

Alkenes	top: use  bottom: use 		
Reagent 1 			
Reagent 2 1. Br_2 / H_2O 2. NaOH 3. H_3O^+ / H_2O			

"For every minute you are angry you lose sixty seconds of happiness." Ralph Waldo Emerson