California State Polytechnic University, Pomona

Chem 315
Final Exam **Name: _____**
Fall, 2010
Beauchamp

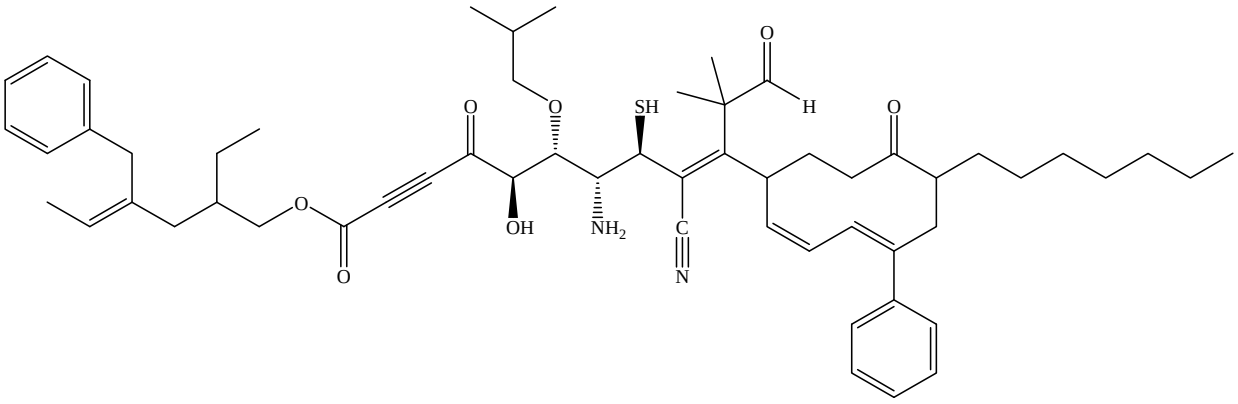
Topic	Total Points Exam Points	Credit
1. Nomenclature (1)	30	
2. Short Syntheses (5, can be done in about 3 steps)	30	
3. Reactions Page, using reactions learned thus far (30)	30	
4. Mechanism in acid and mechanism in base	30	
5. Tautomers (in acid and in base)	30	
6. Synthesis Problems (4)	48	
7. S_N1/E1 and S_N2/E2 reactions. Stereochemistry, Arrow Pushing, Carbocations, Rearrangements	32	
8. Relative Reactivity of C=O Groups	20	
9. Alkene Reactions (Regioselect., Stereoselect.)	30	
Total	280	

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 on the front of each page. Do your best to show me what you know in the time available.

To one who has faith, no explanation is necessary. To one without faith, no explanation is possible.
St. Thomas Aquinas

California State Polytechnic University, Pomona

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 about 4 steps (1 step = single pot sequence). Do not show mechanisms. (30 pts)

a.

b.

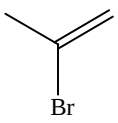
c.

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. excess $NaNR_2$
2. $H_2C{=}O$
3. WK

→

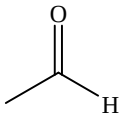
1. excess $NaNR_2$
2. WK

→

1. R_2B-H
2. H_2O_2,$HO^{\ominus}$

→

b.



pH = 5

(-H_2O)

→

1. NaH_3BCN
2. WK

→

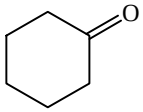
1. 

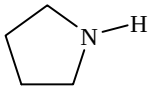
(-H_2O)

pH = 5

2. NaH_3BCN

c.





pH = 5 (-H_2O)

→

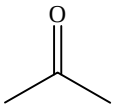
1. CH_3Br
2. WK

→

1. $LiAlH_4$
2. WK

→

d.



1. Ph-Li
2. WK

→

H_2SO_4

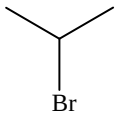
(-H_2O)

→

1. BH_3
2. H_2O_2,$HO^{\ominus}$

→

e.



1. Li
2. 
3. WK

→

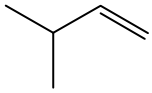
1. TsCl/py
2. NaBr

→

1. Mg
2. CO_2
3. WK

→

f.

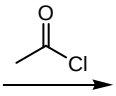


HBr

→

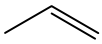
H_2O

→



→

g.



1. Br_2/H_2O
2. NaOH

→

1. NaCN

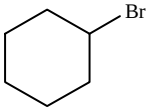
2. WK

→

1. CH_3-Li
2. H_3O^{+}/H_2O

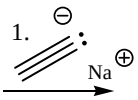
→

h.



1. $(CH_3)_3C$-$O^{\ominus}$
2. mCPBA

→

1. 

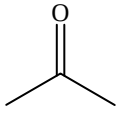
2. WK

CrO_3

pyridine

→

i.



1. $Ph_3P{=}CH_2$
2. WK

→

OsO_4

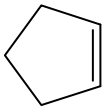
→

TsOH

(-H_2O)

→

j.



1. BH_3
2. Br_2,$CH_3O^{\ominus}$

→

1.NaCN

2. H_2SO_4,Δ

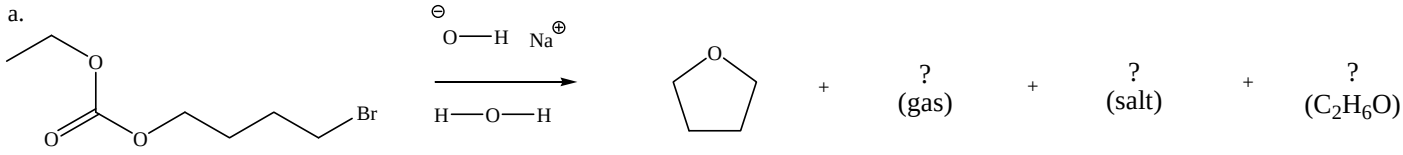
→

1. $SOCl_2$
2. CH_3OH

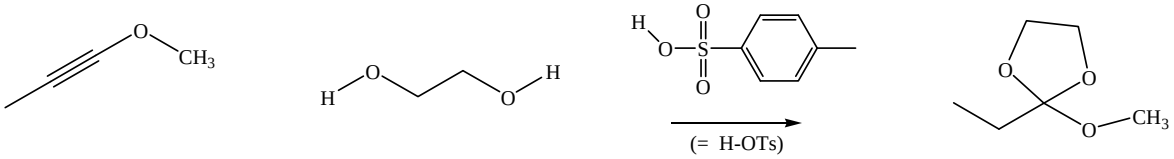
→

4. Provide a complete arrow-pushing mechanism (curved arrows, lone pairs and formal charge) to explain the following transformations. Resonance structures are present in both reactions, so show the "best" one, and at least one other resonance structure to demonstrate that you are aware of its presence. Make sure to take account of the acid or base conditions. It may help to match atoms in your starting structures and products. I can show both mechanisms in 5 steps. (30 pts)

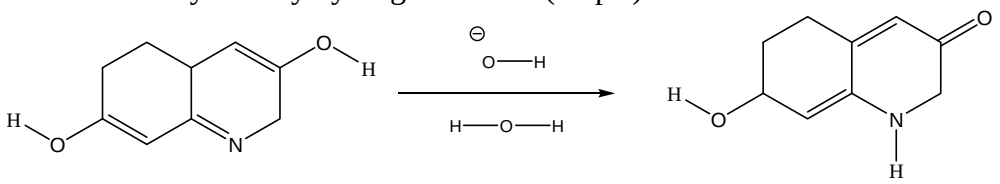
a.

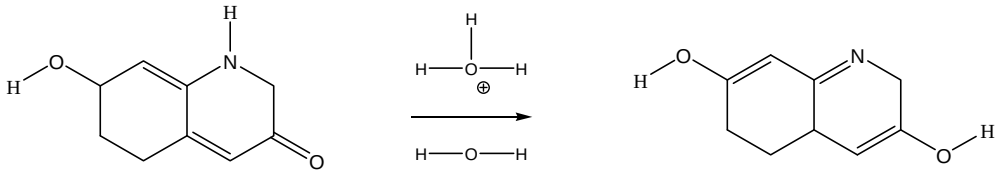


b.

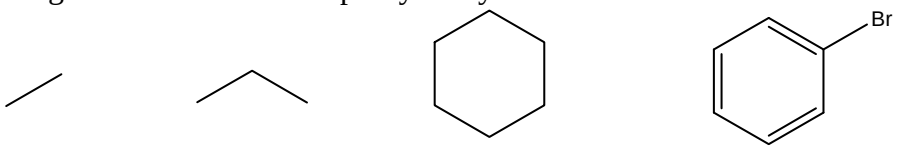


5. Provide a complete arrow-pushing mechanism for the following transformations (curved arrows, lone pairs, formal charge and at least 2 resonance structures, including a "best" one). **Restrict your tautomeric changes to keto or enol portions of the molecules**, not isolated carbon-carbon double bonds. 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)





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. (48 pts)

CH_4  available structures

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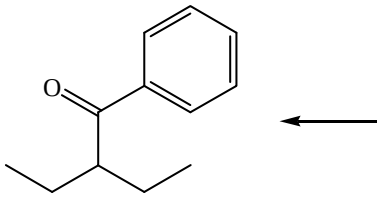
a. Use a nitrile



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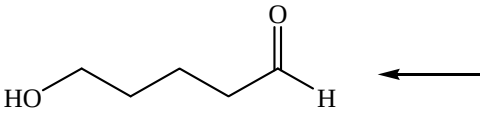
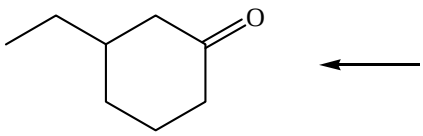
b. Use the Wittig reaction

c. Use an alkyne

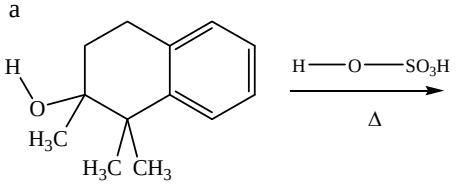


d. Use a cuprate



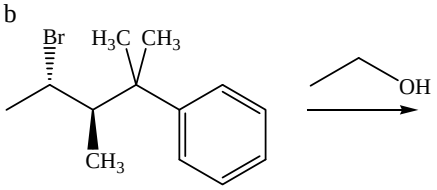
7. Write the structure(s) of the expected **major** product(s). Include a simple mechanism that clearly shows how the reaction likely proceeds. State what mechanism each reaction follows. If chiral centers are present, indicate absolute configuration(s) in starting materials and products. Show 3D representations when necessary to explain the result. If rearrangements are reasonable, assume they will form the most stable carbocation. (32 pts)

a



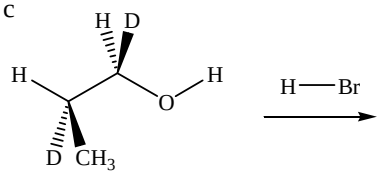
Mechanism = _____ (10 pts)

b



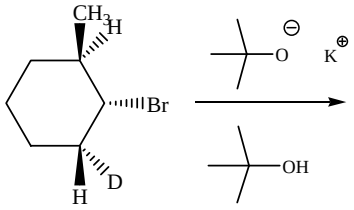
Mechanism = _____ (10 pts)

c



Mechanism = _____ (6 pts)

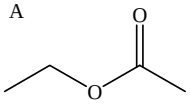
d. Draw the necessary 3D structure to show the reaction.



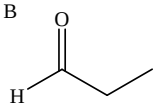
Mechanism = _____ (6 pts)

8. List the following carbonyl groups in order of decreasing reactivity (1 = most reactive). Explain your reasoning. Write out the expected product from a. CH_3-Li b. WK with each structure (no mechanisms required). (20 pts)

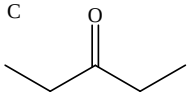
A



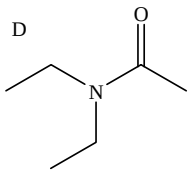
B



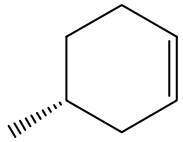
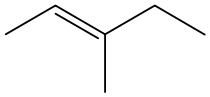
C



D



9. Using the given alkenes, show the expected 3D stereochemical and regiochemical result for each set of conditions. 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 chiral centers as R or S in **<u>one</u>** of your structures in each part. (30 pts)

Alkenes	A 	B 
Reagent 1 1. Br_2 / H_2O 2. NaOH 3. $CH_3OH_2^+$ CH_3OH		
Reagent 2 1. BD_3 $\ominus$ 2. Br_2 / CH_3O		

Common sense is the collection of prejudices acquired by age 18. Albert Einstein