

# California State Polytechnic University, Pomona

Chem 316  
Final Exam  
Winter, 2007  
Beauchamp

Name: \_\_\_\_\_

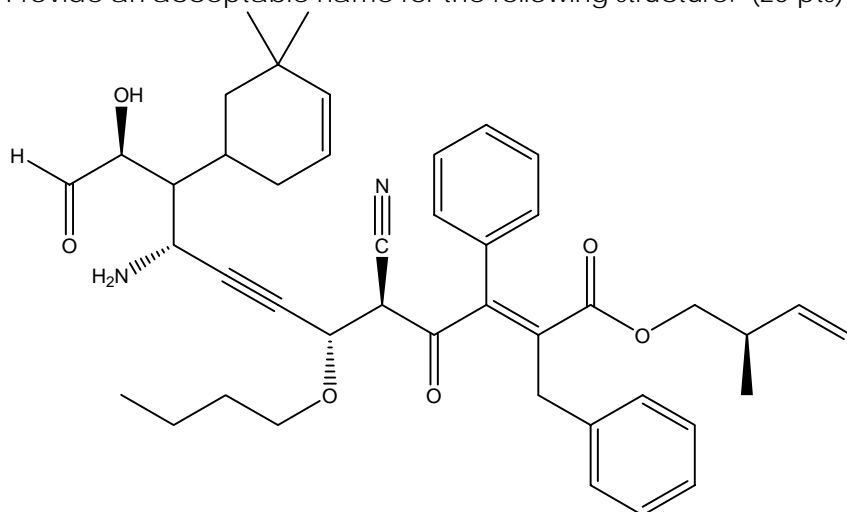
Topic	Total Points Exam Points	Credit
1. Nomenclature (1)	25	
2. Explanation of Relative Reactivities of Aromatic Compounds or Carbonyl Compounds	20	
3. Reactions Page (10 x 3 = 30)	30	
4. Tautomers (acidic conditions and base conditions)	30	
5. Aromatic Mechanism and Explanation of Substituent Effects	30	
6. C-14 Synthesis	30	
7. Bio-organic Game (reaction recognition/simplistic mechanisms)	52	
8. Carbonyl Chemistry – synthesis and mechanisms	28	
<b>Total</b>	245	

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.

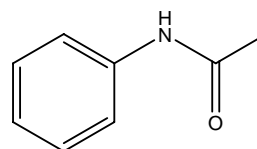
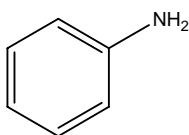
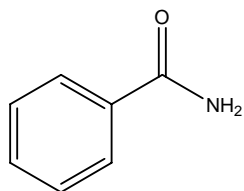
Nothing in life is to be feared. It is only to be understood. Marie Curie

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



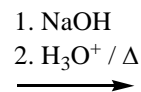
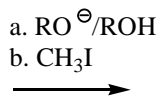
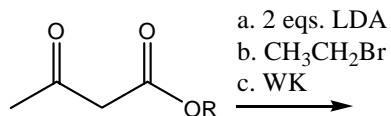
2. State whether each of the following aromatic substituents acts as an activating or deactivating group on the aromatic ring. Order the substituents in decreasing order of activating influence on the aromatic ring (1= most activating). Use structures and a brief explanation to rationalize your order. Write out the reaction conditions for bromination and the expected product in each case. (20 pts)



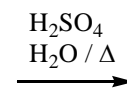
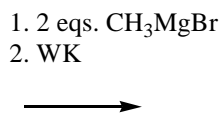
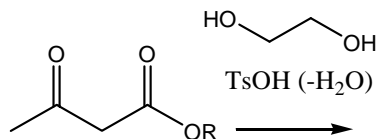
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3. Provide the expected product for each of the following transformations. Show regiochemistry and stereochemistry clearly, if relevant. Do NOT show mechanisms. WK = workup. (30 pts)

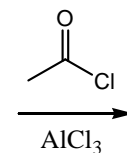
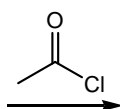
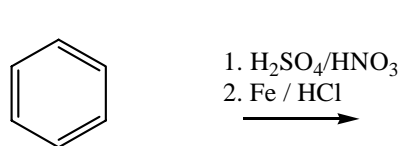
a.



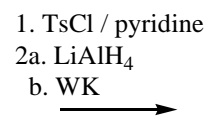
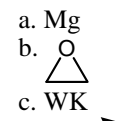
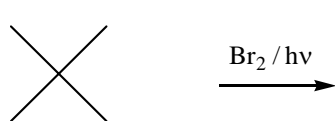
b.



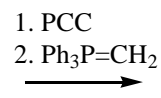
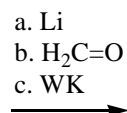
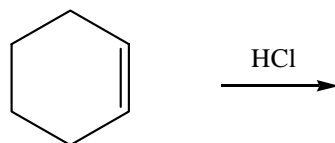
c.



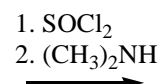
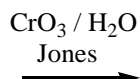
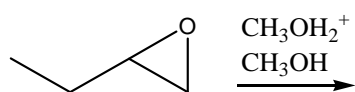
d.



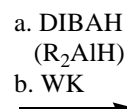
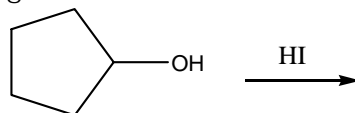
e.



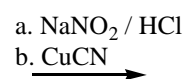
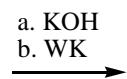
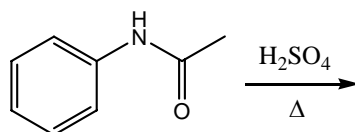
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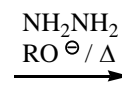
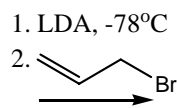
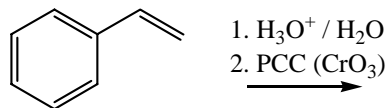
g.



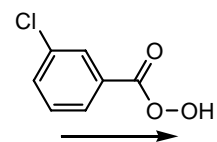
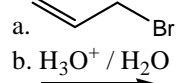
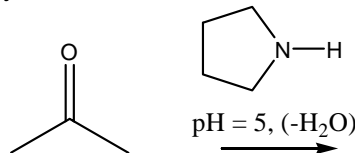
h.



i.



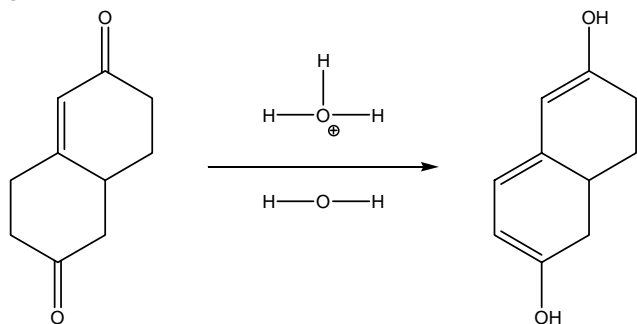
j.



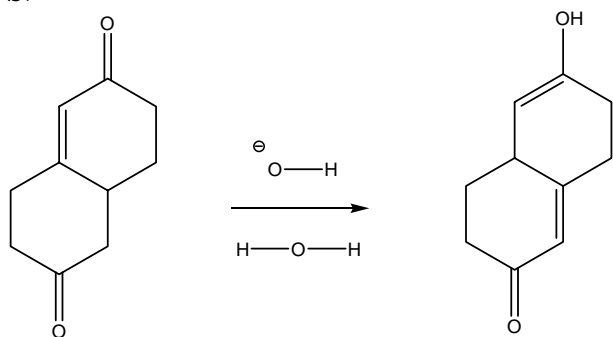
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4. Provide a complete arrow-pushing mechanism for each reaction below. Include curved arrows, lone pairs and formal charge. If resonance is present, draw at least one additional resonance structure to show you recognize this feature, and one of them should be the "best" resonance structure. (30 pts)

a.



b.



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5. Starting from benzene, propose a synthesis for each of the following molecules. Provide mechanisms that show how any necessary electrophiles are generated. Provide a mechanism for the second reaction step that explains the observed regioselectivity (ortho, para or meta) in each of your proposed syntheses. (25 pts)

a. Synthetic targets – Propose a synthetic sequence that leads to each molecule. No mechanisms are required here. (4 pts)



b. Provide mechanisms for generating any electrophiles used in the above synthetic sequences. (6 pts)

i.

ii.

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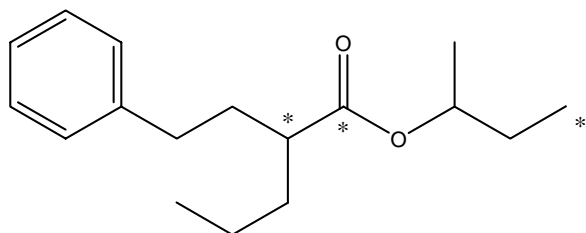
c. Provide a mechanistic explanation that explains the observed regioselectivity in each reaction in part a. (20 pts)

i.

ii.

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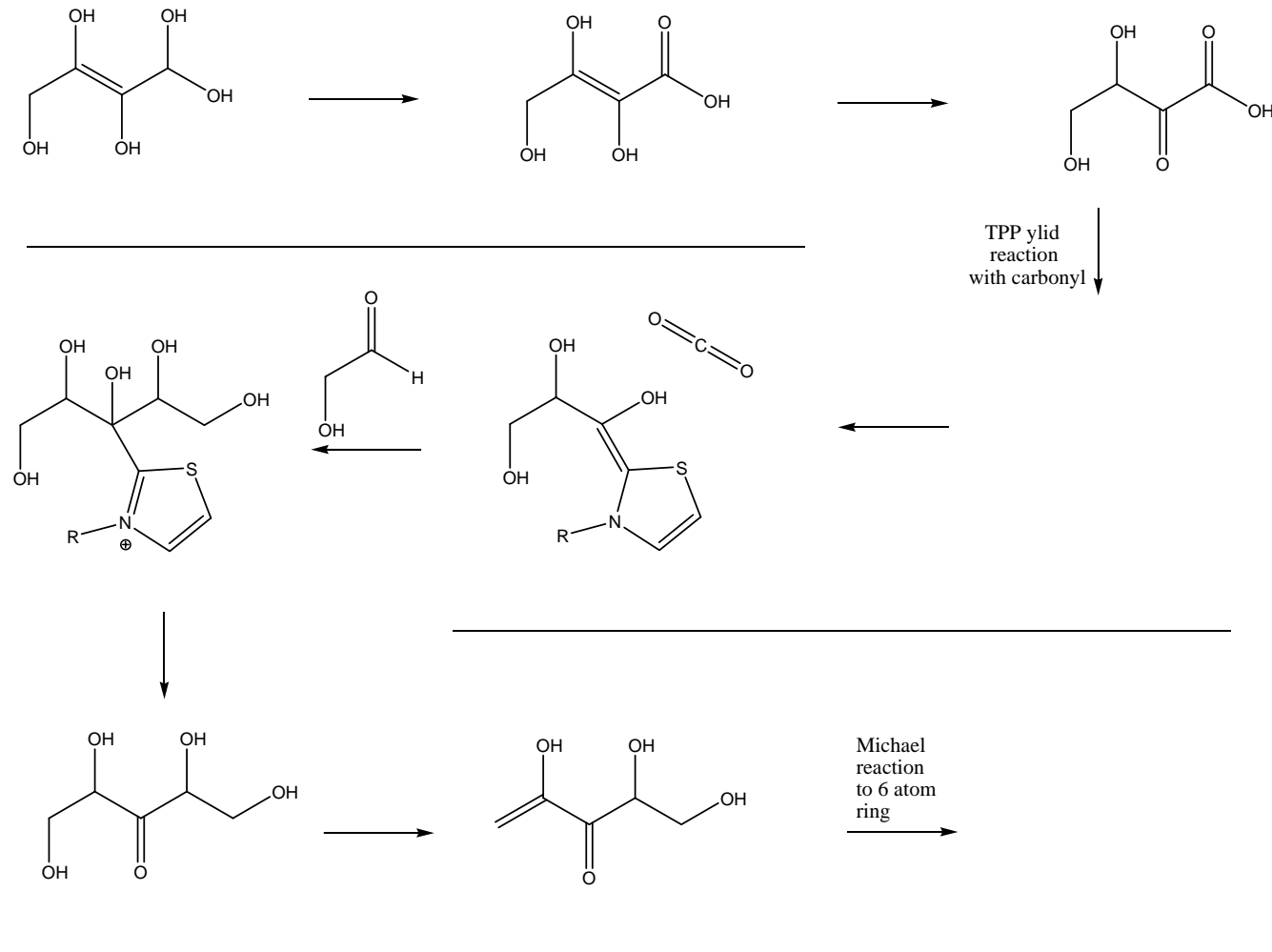
6. Propose a synthesis for the following compound using methane, ethane, propane, cyclohexane, benzene, sodium cyanide and/or carbon dioxide. Your only sources of radioactive  $^{14}\text{C}$  carbon are methyl bromide,  $^*\text{CH}_3\text{Br}$ , carbon dioxide,  $^*\text{CO}_2$  and sodium cyanide,  $\text{Na}^*\text{CN}$ . You may also use any typical organic reagents. Often the best strategy is to work backwards from the target molecule. The last step of the synthesis should be your first step. Show the reagents and reactant for each backwards step until you reach allowable starting molecules. Do not show mechanisms. (30 pts)



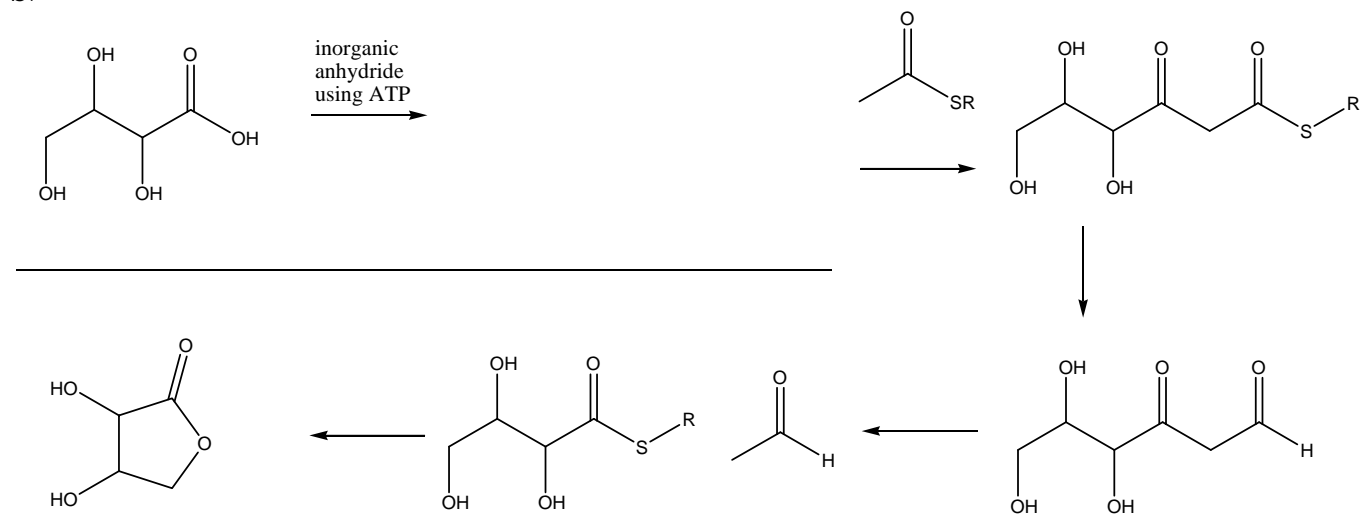
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7. From the given bio-organic structure, use our simplistic mechanisms to show how each transformation could occur. If any structures are missing, use the descriptive term to fill in the necessary structures and details. Draw in any additional atoms or structures needed to demonstrate the transformations (e.g. a hydrogen atom or a water molecule, any co-factors, etc.). Use **B:** if you need a base and **B-H<sup>⊕</sup>** if you need an acid. Acceptable representations of possible co-factors are provided at the bottom of the last page. (52 pts)

a.



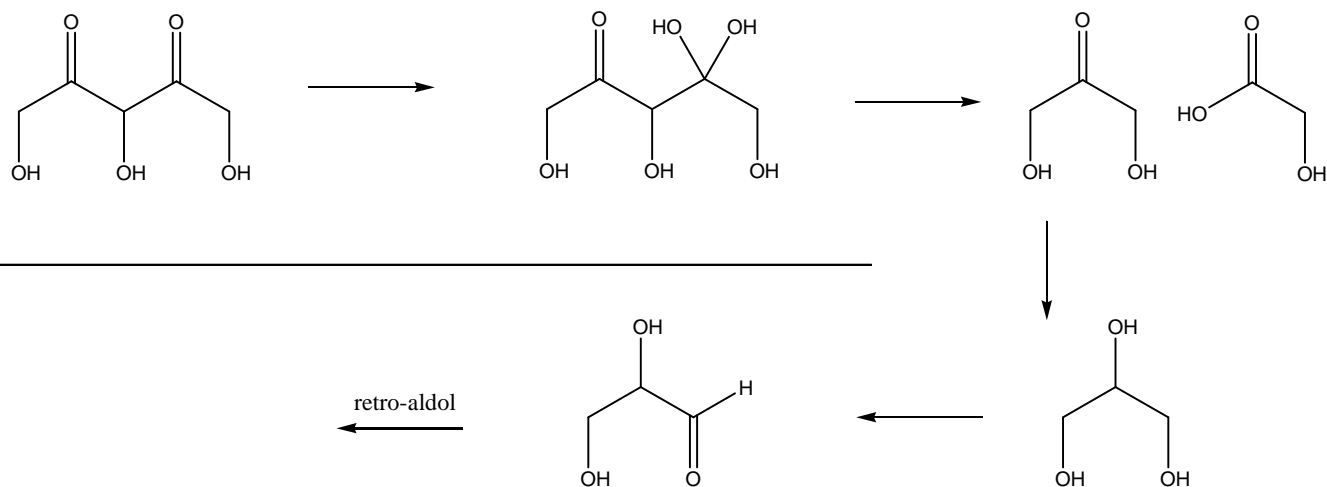
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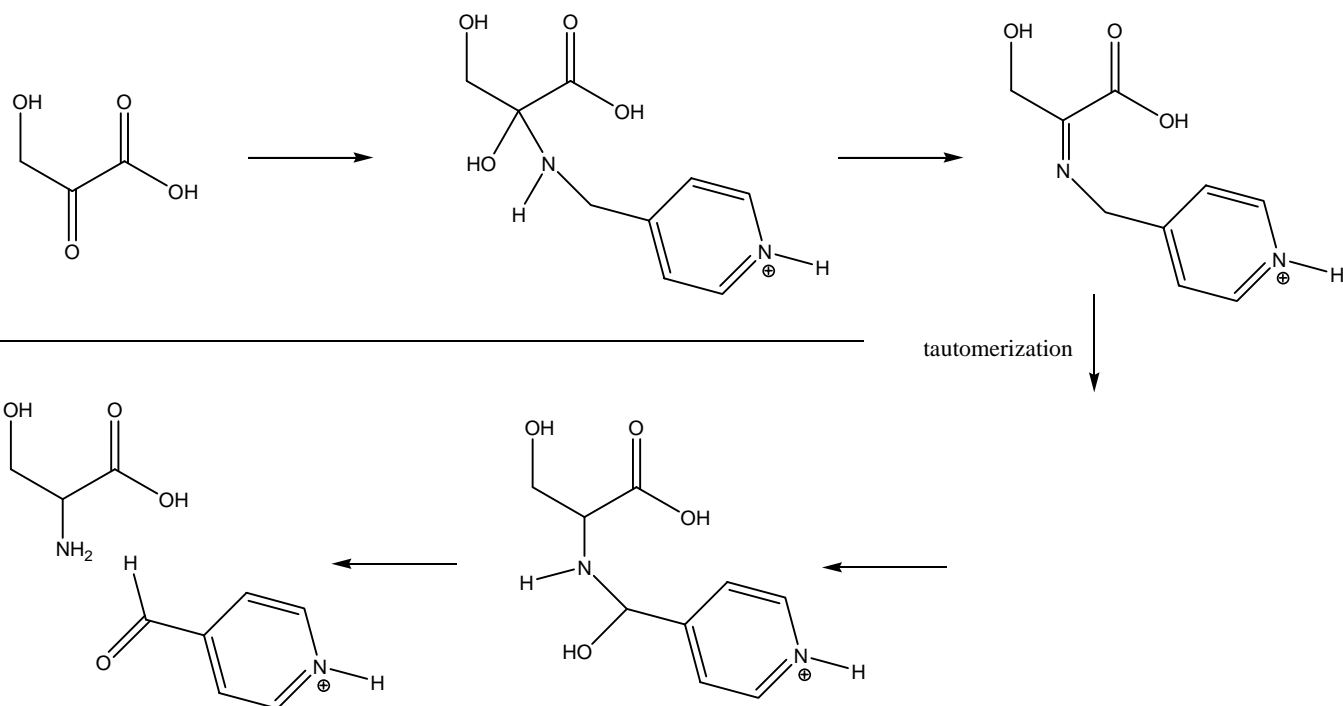


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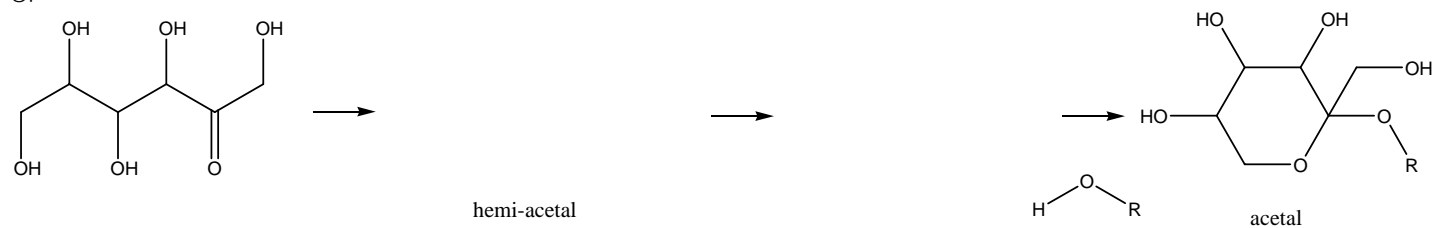
c.



d.

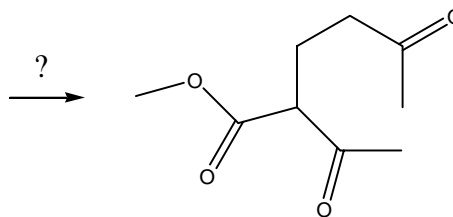


e.

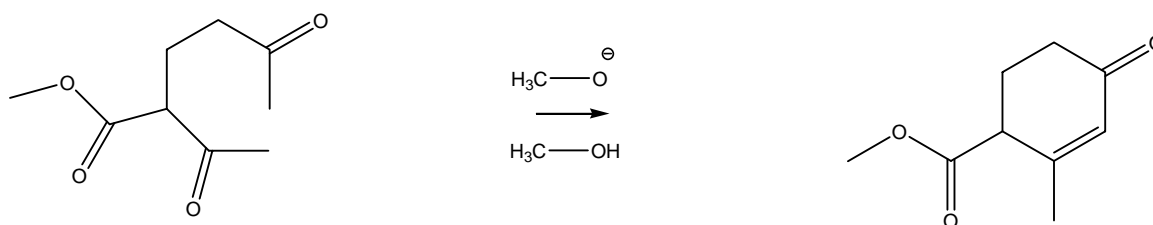


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8. a. Provide the necessary starting materials and a complete arrow pushing mechanism to explain formation of the indicated product (show proper curved arrow conventions, lone pairs as two dots and single electrons as one dot). You only need to show the most important resonance structure and ( $\leftrightarrow$  Res.) whenever resonance is present. The necessary starting structures will be supplied for 3 points (10 pts)

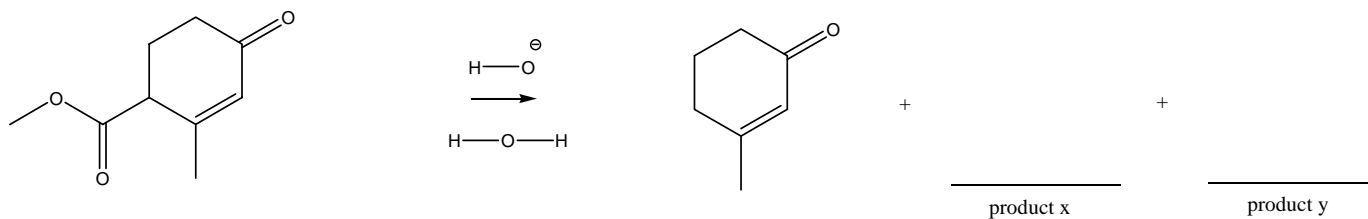


- b. Provide a detailed mechanism for the next step of the synthesis. You only need to show the most important resonance structure and ( $\leftrightarrow$  Res.) whenever resonance is present. (8 pts)



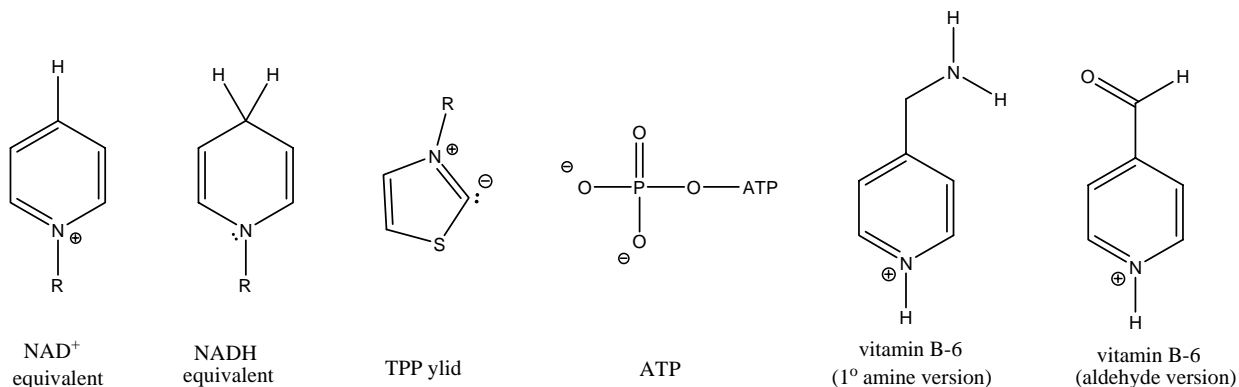
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c. Provide a detailed mechanism for the next step of the synthesis. You only need to show the most important resonance structure and ( $\leftrightarrow$  Res.) whenever resonance is present. Indicate what products x and y are. (10 pts)




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Simplified co-factors for the bio-organic game problems, if needed.



The pessimist complains about the wind, the optimist expects it to change and the realist adjusts the sails.

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