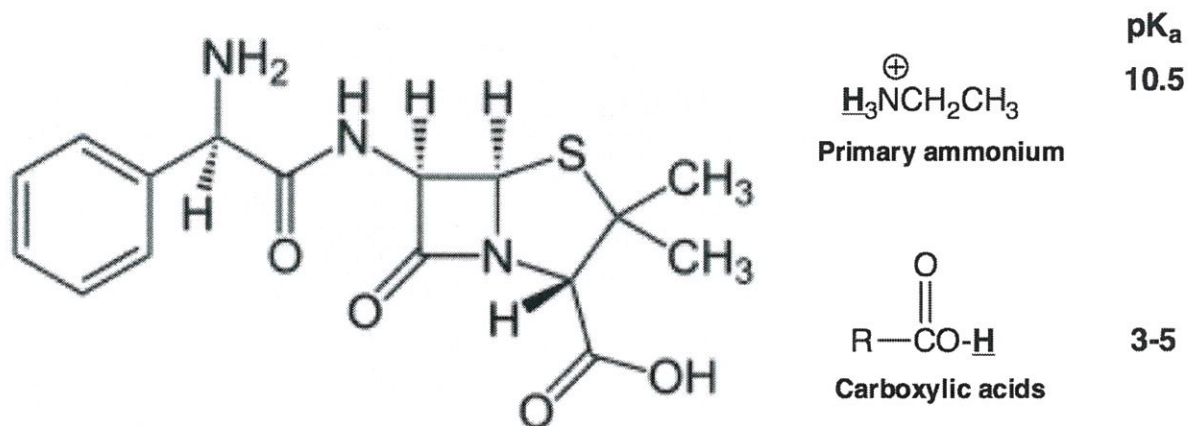


10. (10 points) The following structure is that of ampicillin, a very common antibiotic used in the treatment of many bacterial infections. The following structure was copied directly from a Wikipedia page (<http://en.wikipedia.org/wiki/Ampicillin>). To the right of the structure are listed relevant pK_a values from the table at the beginning of the exam.

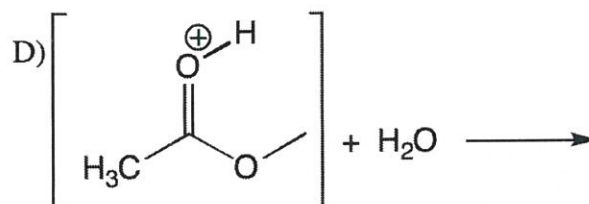
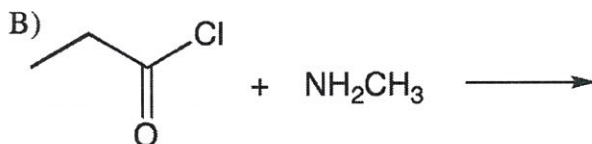
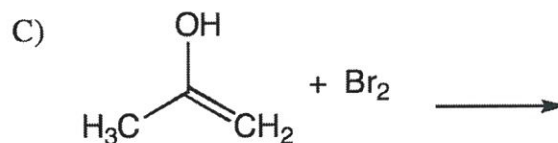
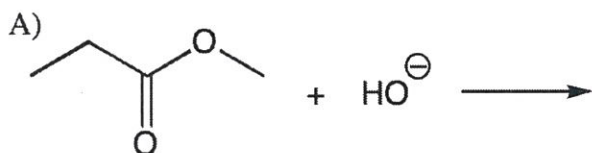


Based on the pK_a values given, what is the total charge on ampicillin in a solution of pH = 2.0? _____

Based on the pK_a values given, what is the total charge on ampicillin in a solution of pH = 7.0? _____

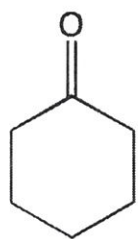
In only two short sentences, describe two very different things that are wrong with the format of the ampicillin structure that I copied from Wikipedia. Hint; one of the answers to this question is related to the two questions you just answered. **You can assume the atoms are all in the correct places in the structure, we do NOT assume you know the structure of ampicillin by heart!**

11. (8 points) In the following reactions, draw a circle around the nucleophile. Note, there is no reason to write any products for these.

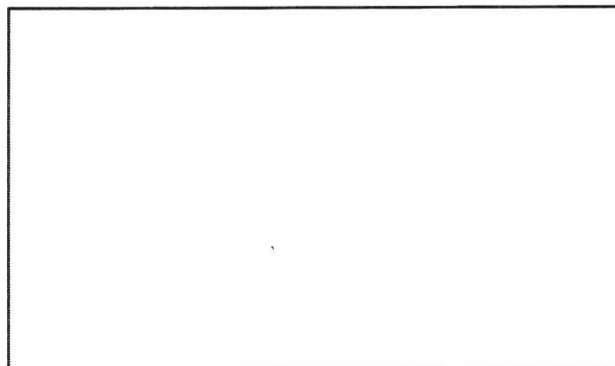
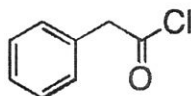


15. (14 points) For the following sequences of reactions, draw the final organic product or products after ALL the steps have been completed. You do not need to draw the molecules synthesized along the way, **only the last product that is formed**. If a new chiral center is created in the reaction that produces a racemic mixture, label the chiral center with an asterisk (*) and write "*racemic*" underneath.

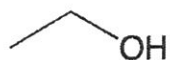
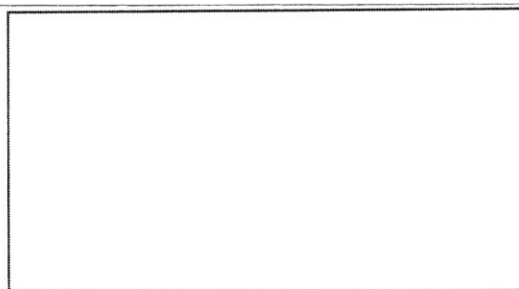
(6 pts)

1) LiAlH_4 2) H_2O

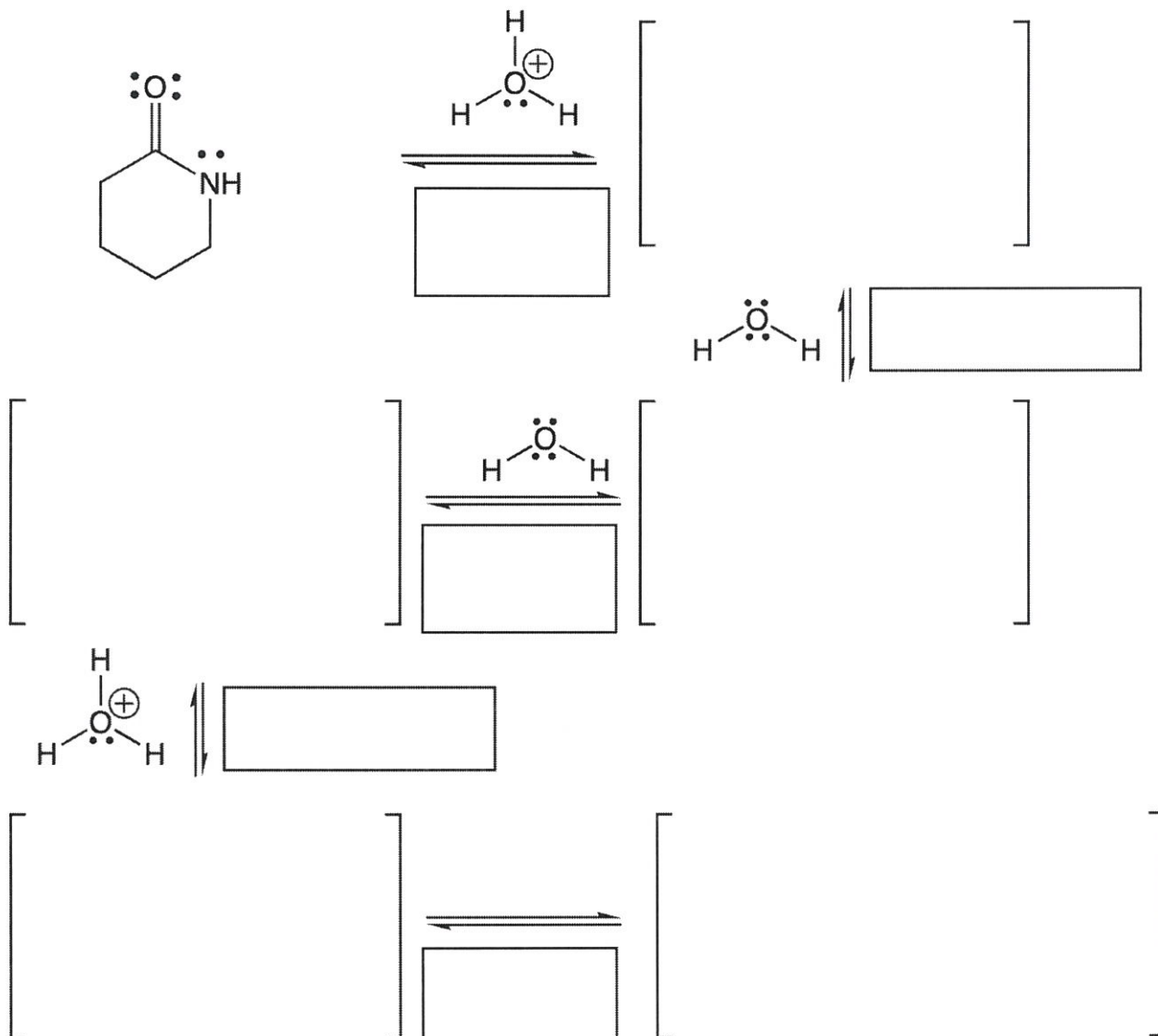
3)



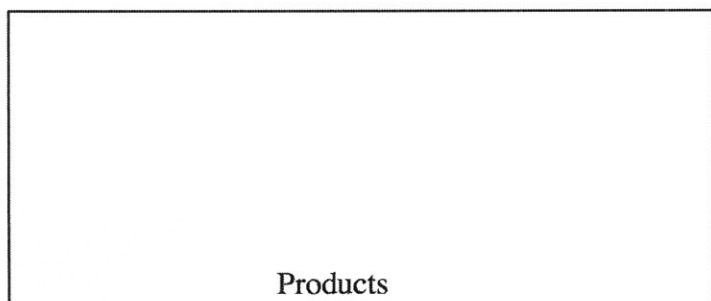
(8 pts)

1) PBr_3 2) $\text{Mg}^\circ/\text{ether}$ 3) CO_2 4) $\text{HCl}, \text{H}_2\text{O}$ (Mild acid)5) SOCl_2 6) 2 

13. (29 pts.) Complete the mechanism for the following acid catalyzed lactam hydrolysis reaction. Be sure to show arrows to indicate movement of all electrons, write all lone pairs, all formal charges, and all the products for each step. Remember, I said all the products for each step. IF A NEW CHIRAL CENTER IS CREATED IN AN INTERMEDIATE OR THE PRODUCTS, MARK IT WITH AN ASTERISK AND LABEL AS "RACEMIC" IF RELEVANT. *IN THE BOX BY EACH SET OF ARROWS, WRITE WHICH OF THE 4 MECHANISTIC ELEMENTS IS INDICATED IN EACH STEP OF YOUR MECHANISM (For example, "Add a proton").*



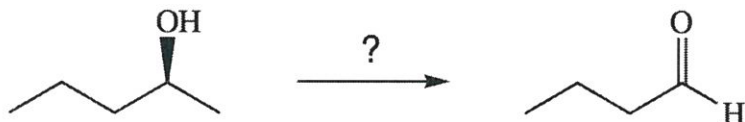
No need to draw arrows on the above structure



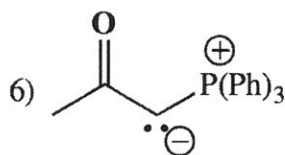
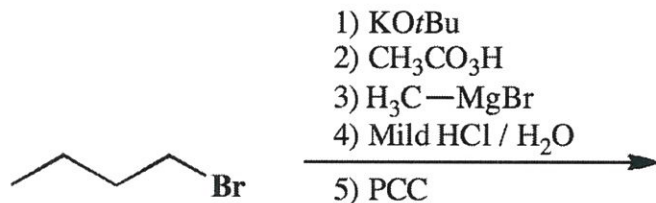
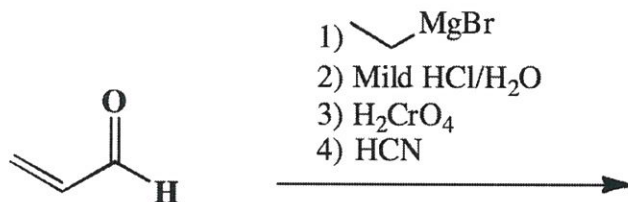
Proton Transfer

19. (10 pts) Using any reagents turn the starting material into the indicated product. All carbon atoms must come from the starting material. Draw all molecules synthesized along the way. When in doubt, draw the molecule! Hint: this should look familiar as a homework problem.

All of the carbons of the product must come from the given starting material.



14. (7 pts each) For the following sequences of reactions, work through all the different steps and then write the final product(s). Assume only the predominant product is formed at each step. You must indicate stereochemistry with wedges and dashes. You must draw all stereoisomers produced as predominant products and write "racemic" under the structures when appropriate. **We are only grading your final product(s) here.**



Signature _____

Pg 12 _____ (19)

13. These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned. Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction. If you make a racemic mixture, draw both structures and make sure to write "racemic" next to them.

(19 pts) **All of the carbon atoms of the products must come from the starting materials for this one!**

