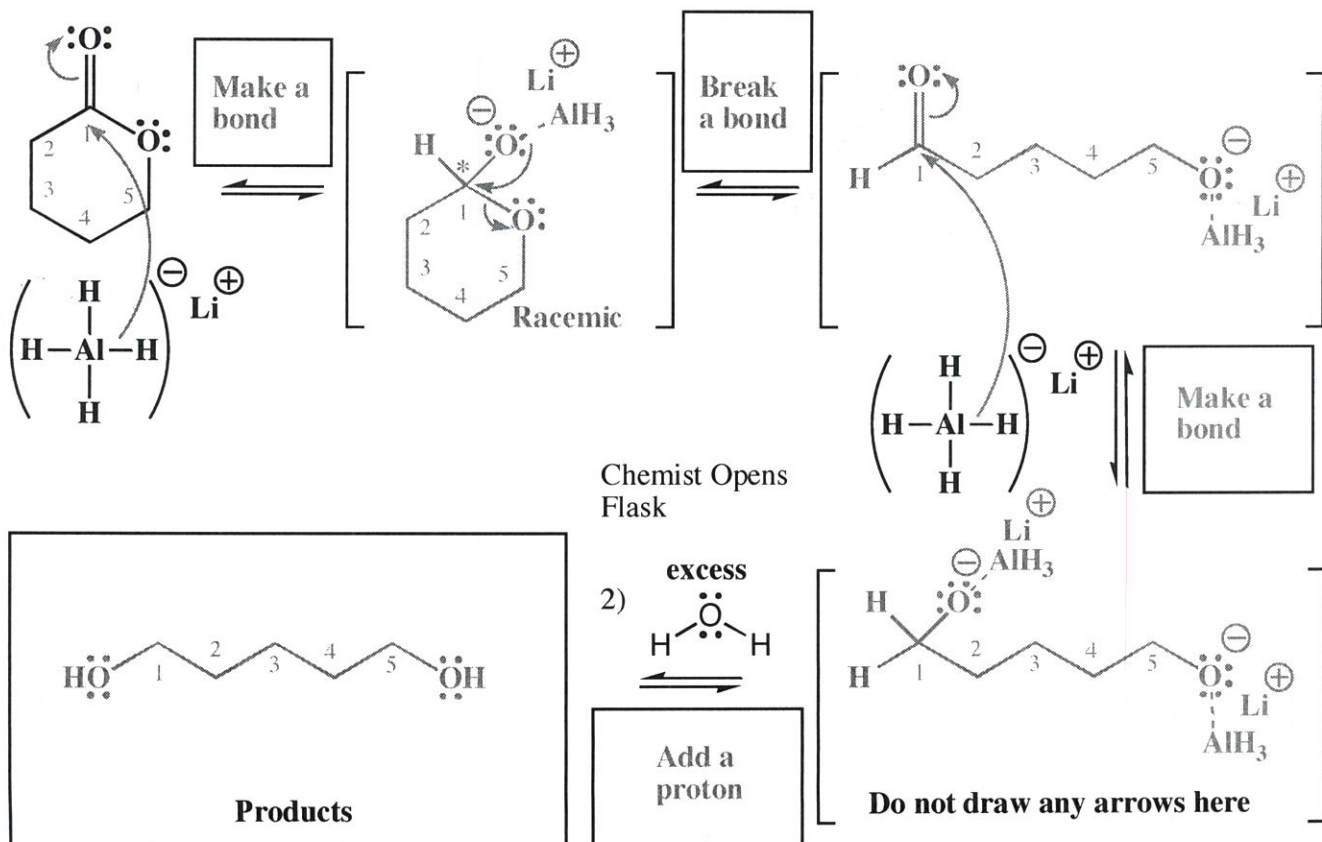
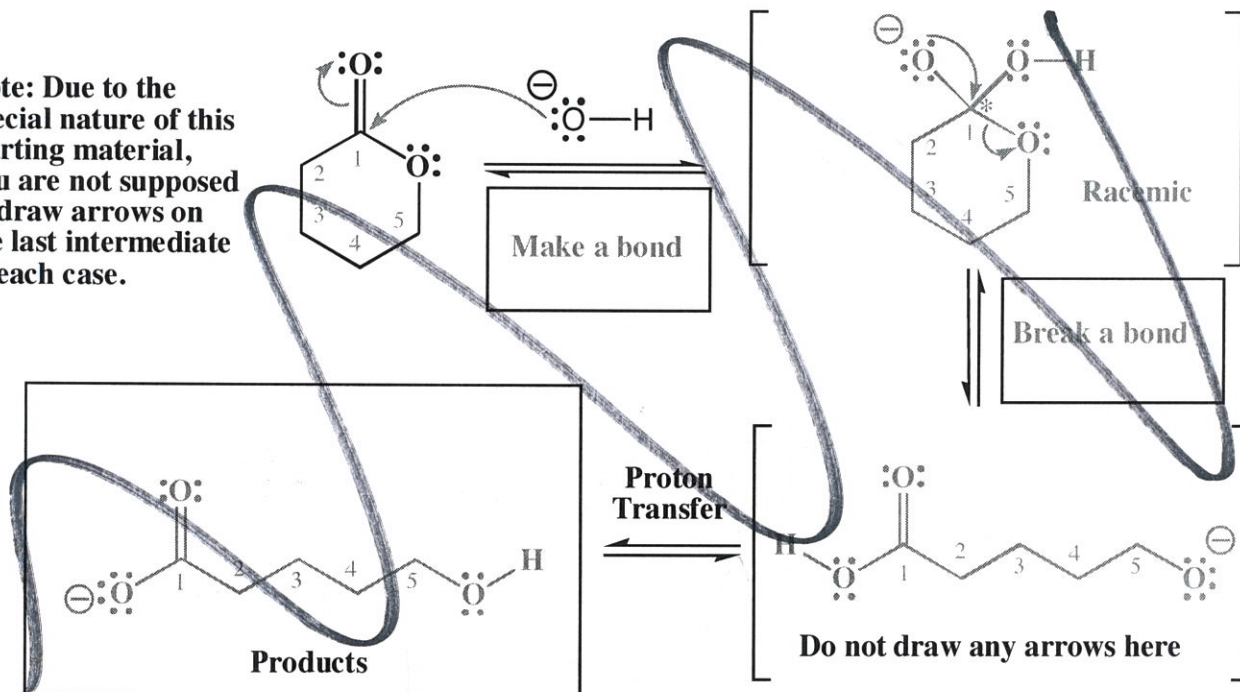
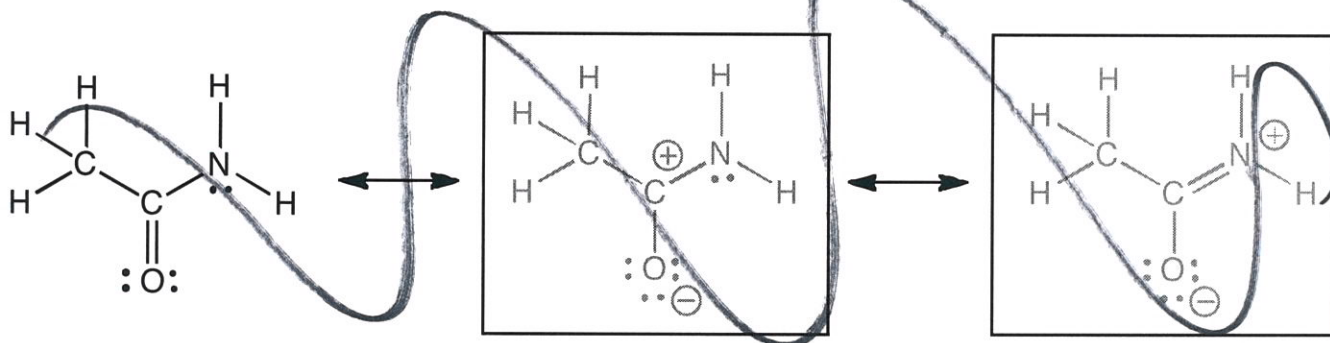


13. (30 pts) Complete the mechanisms for the following two lactone reactions. Be sure to show arrows to indicate movement of all electrons, write all lone pairs, all formal charges, and all the products for each step. Remember, I said all the products for each step. IF A NEW CHIRAL CENTER IS CREATED IN AN INTERMEDIATE OR PRODUCT, MARK IT WITH AN ASTERISK AND LABEL IT AS RACEMIC IF APPROPRIATE. In the boxes provided, write which of the 4 mechanistic elements describes each step (make a bond, break a bond, etc.).

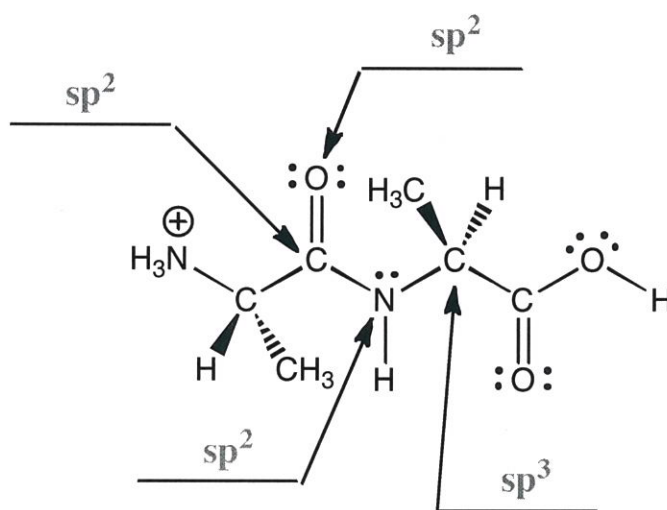
Note: Due to the special nature of this starting material, you are not supposed to draw arrows on the last intermediate in each case.



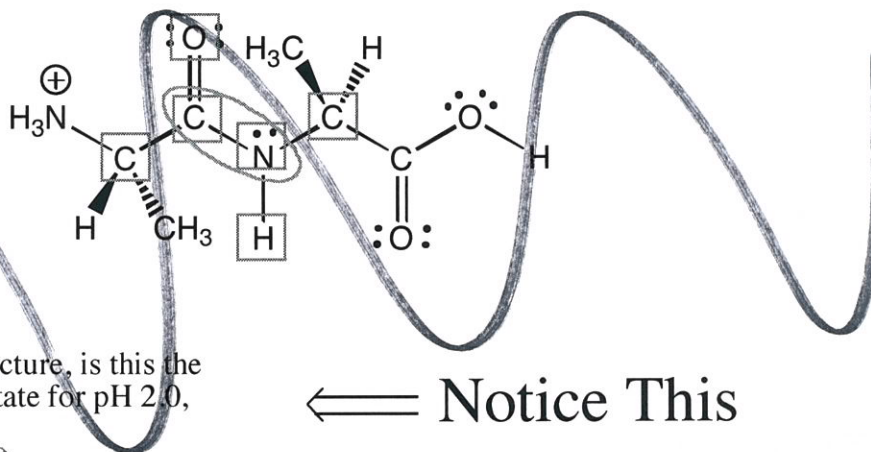
3. (10 points) Draw the two most important resonance contributing structures of the amide shown below. Be sure to show all lone pairs and formal charges. You do not have to draw arrows on this one.



4. (4 points) On the lines, indicate the hybridization state of each atom indicated by the arrows.



5. (5 points) On the following structure 1) Draw a box around all the atoms that are ALWAYS in the same plane as the amide carbonyl group (C=O) and 2) circle all of the C-N bonds that DO NOT ROTATE.

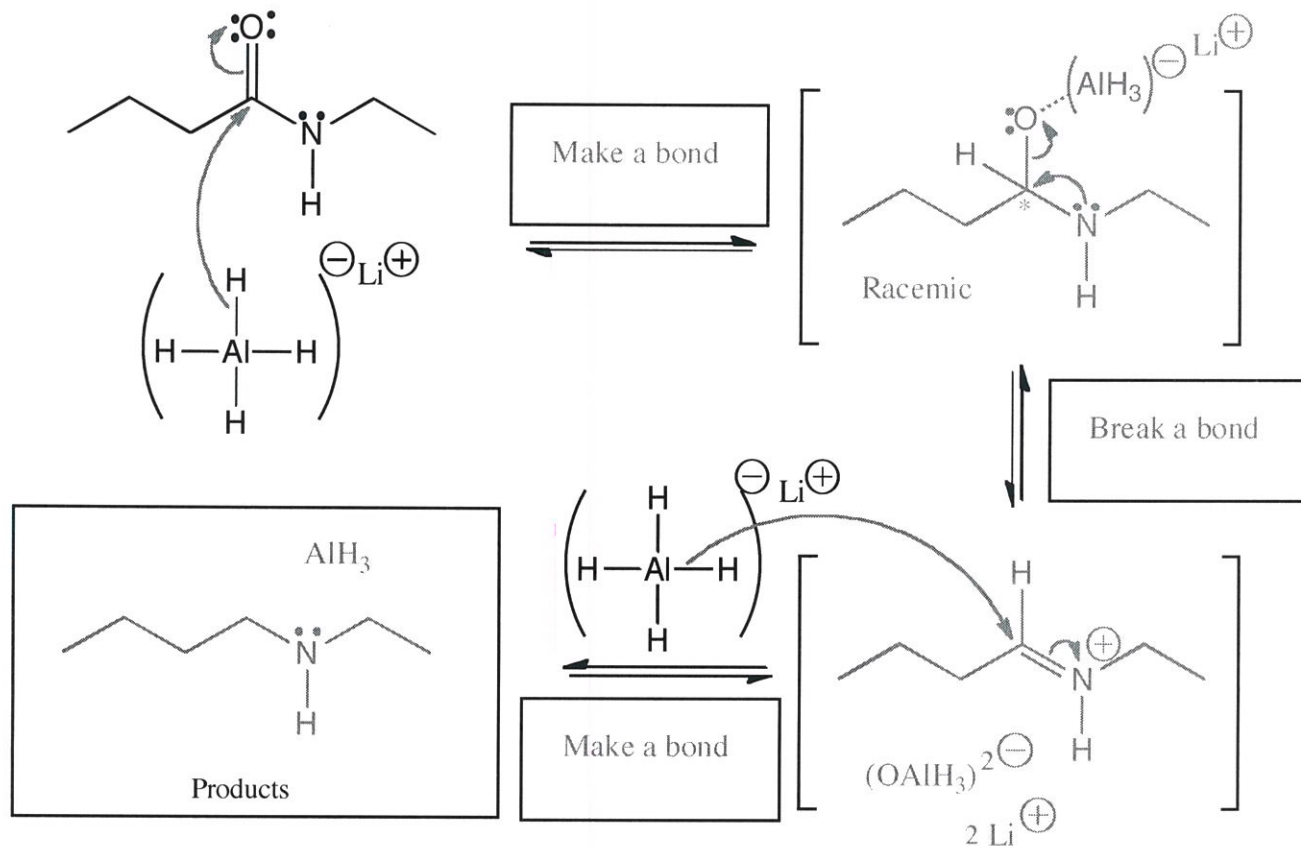


(2 pts) For the above structure, is this the appropriate protonation state for pH 2.0, 7.0, or 10.0?

2.0

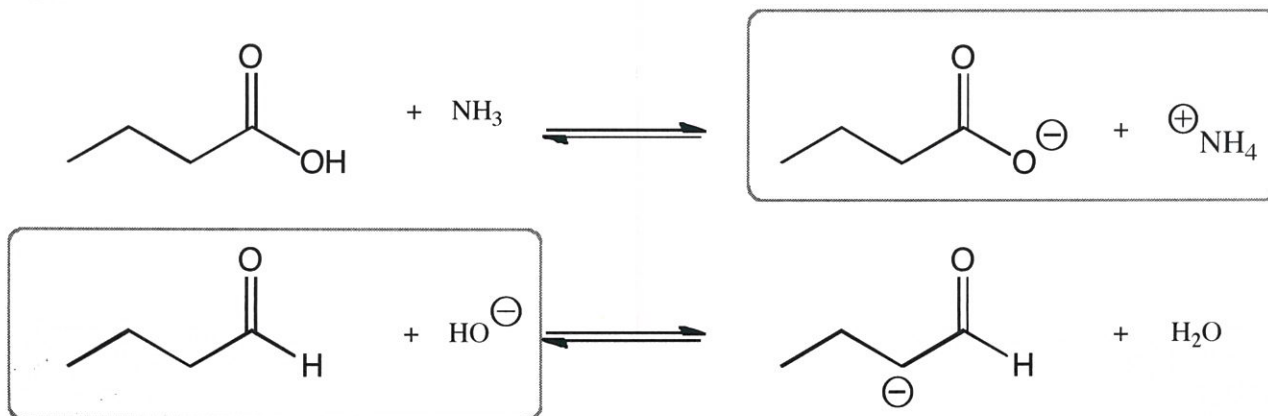
← Notice This

13. (16 pts.) Complete the mechanism for the following reduction of an amide using LiAlH_4 . 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").

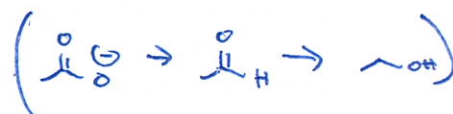
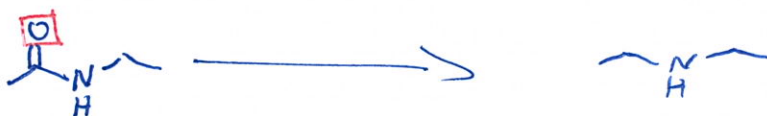


Note: In this reaction the chemist opens the flask and adds water in a second step that quenches any excess LiAlH_4 . Therefore, you need a second step to add water when using this reaction in synthesis even though it is not shown in the mechanism above.

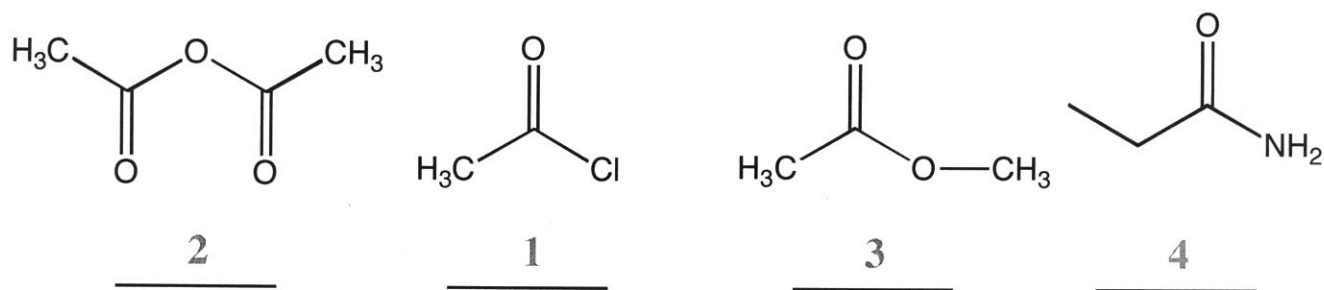
14. (6 pts) For the following equations that describe acid-base reactions, **circle the side that predominates at equilibrium.**



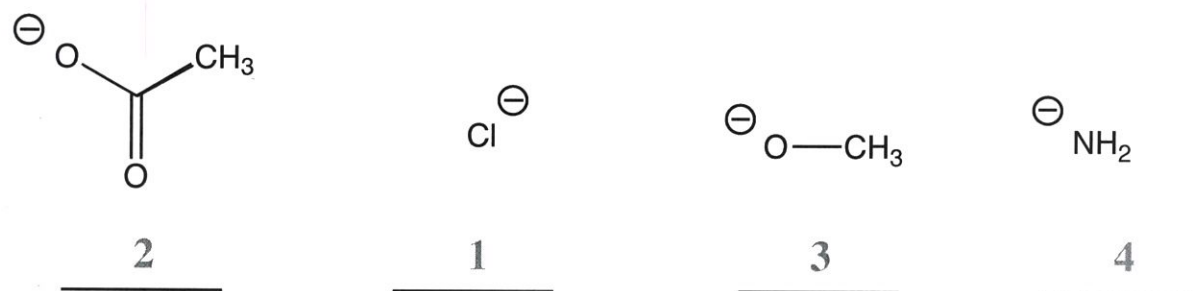
For each substrate, predict the product following a reduction using LiAlH_4 (followed by a water workup). Also, think through the mechanism and box the oxygen atom that departs during the reaction if applicable.



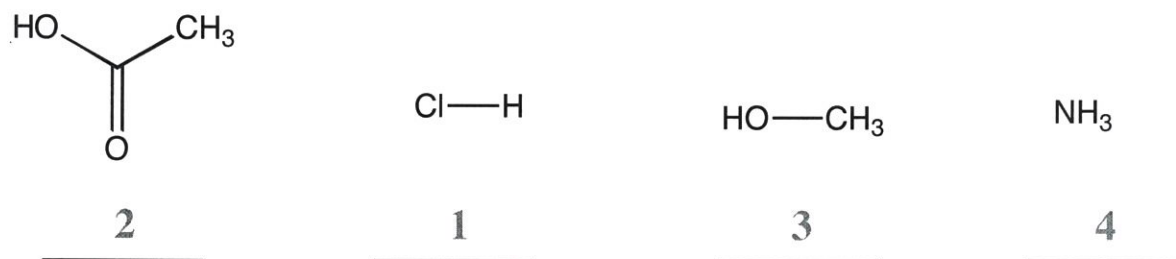
6. (4 points) Rank the following carboxylic acid derivatives with respect to reactivity with a nucleophile. Write a 1 under the most reactive, and a 4 under the least reactive derivative.



7. (4 points) Rank the following with respect to anion stability. Write a 1 under the most stable anion, and a 4 under the least stable anion.



8. (4 points) Rank the following in terms of relative acidity, with a 1 under the most acidic, and a 4 under the least acidic molecule.



9. (4 points) Rank the following in terms of relative acidity, with a 1 under the most acidic, and a 4 under the least acidic molecule.

