

NAME (Print): _____

Chemistry 310N
Dr. Brent Iverson
2nd Midterm
March 26, 2009

SIGNATURE: _____

Please print the
first three letters
of your last name
in the three boxes

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Please Note: This test may be a bit long, but there is a reason. I would like to give you a lot of little questions, so you can find ones you can answer and show me what you know, rather than just a few questions that may be testing the one thing you forgot. **I recommend you look the exam over and answer the questions you are sure of first**, then go back and try to figure out the rest. Also make sure to **look at the point totals** on the questions as a guide to help budget your time.

For synthesis problems GO FOR PARTIAL CREDIT EVEN IF YOU DO NOT KNOW THE ENTIRE ANSWER!!!WRITE DOWN WHAT YOU DO KNOW IN THE REACTION SEQUENCE SOMEWHERE. YOU WILL GET PARTIAL CREDIT IF IT IS CORRECT

Note: You must have your answers written in pen if you want a regrade!!!!

Page	Points	
1		(26)
2		(22)
3		(21)
4		(23)
5		(18)
6		(29)
7		(19)
8		(26)
9		(35)
10		(25)
11		(9)
12		(10)
13		(16)
14		(15)
15		(20)
Total		(314)
%		
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HW		
(HW score + Exam Grade) \implies	Total Grade	

Honor Code

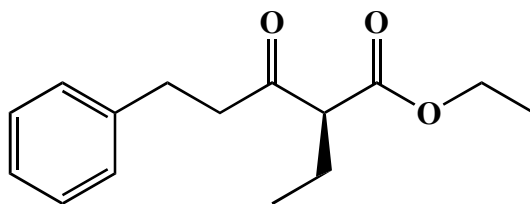
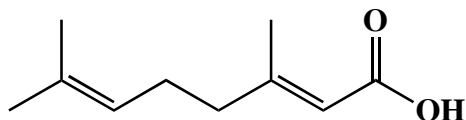
The core values of the University of Texas at Austin are learning, discovery, freedom, leadership, individual opportunity, and responsibility. Each member of the University is expected to uphold these values through integrity, honesty, trust, fairness, and respect toward peers and community.

(Your signature)

Compound		pK _a
Hydrochloric acid	H-Cl	-7
Protonated alcohol	$\text{RCH}_2\text{OH}_2^+$	-2
Hydronium ion	H_3O^+	-1.7
Carboxylic acids	$\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$	3-5
Ammonium ion	H_4N^+	9.2
β-Dicarbonyls	$\text{RC}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{R}'$	10
β-Ketoesters	$\text{RC}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OR}'$	11
β-Diesters	$\text{ROC}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OR}'$	13
Water	HOH	15.7
Alcohols	RCH_2OH	15-19
Acid chlorides	$\text{RC}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl}$	16
Aldehydes	$\text{RC}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$	18-20
Ketones	$\text{RC}-\overset{\text{O}}{\parallel}{\text{C}}-\text{R}'$	18-20
Esters	$\text{RC}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OR}'$	23-25
Terminal alkynes	$\text{RC}\equiv\text{C}-\text{H}$	25
LDA	$\text{H}-\text{N}(\text{i-C}_3\text{H}_7)_2$	40
Terminal alkenes	$\text{R}_2\text{C}=\underset{\text{H}}{\text{C}}-\text{H}$	44
Alkanes	$\text{CH}_3\text{CH}_2-\text{H}$	51

1. (14 points) Suppose a relative of yours is having an MRI. In no more than four sentences, explain to them what is happening when they have the MRI scan. We will be looking for a minimum of 7 key points here.

2. (4 pts each) In the space provided, write the IUPAC name (including stereochemistry where appropriate) for the following two molecules:

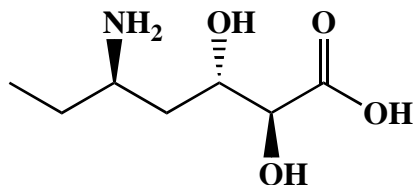


3. (4 pts) In the space provided, draw the following molecule:

(S)-4-Chloro-*N,N*-dimethyl-3-oxohexanamide



4 A) (4 points) In the space provided, write the IUPAC name (including stereochemistry where appropriate) of the following molecule.



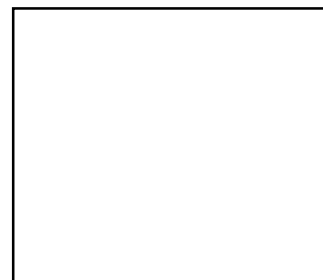
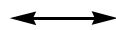
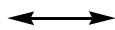
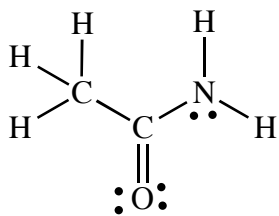
B) (5 points) Although the molecule above can be drawn and named as shown, it would actually never exist in this form. In the space provided, draw the structure of the molecule as it would exist in water at pH = 7.0.



C) (5 points) In the space provided, draw the structure of the molecule as it would exist in water at pH = 1.0.

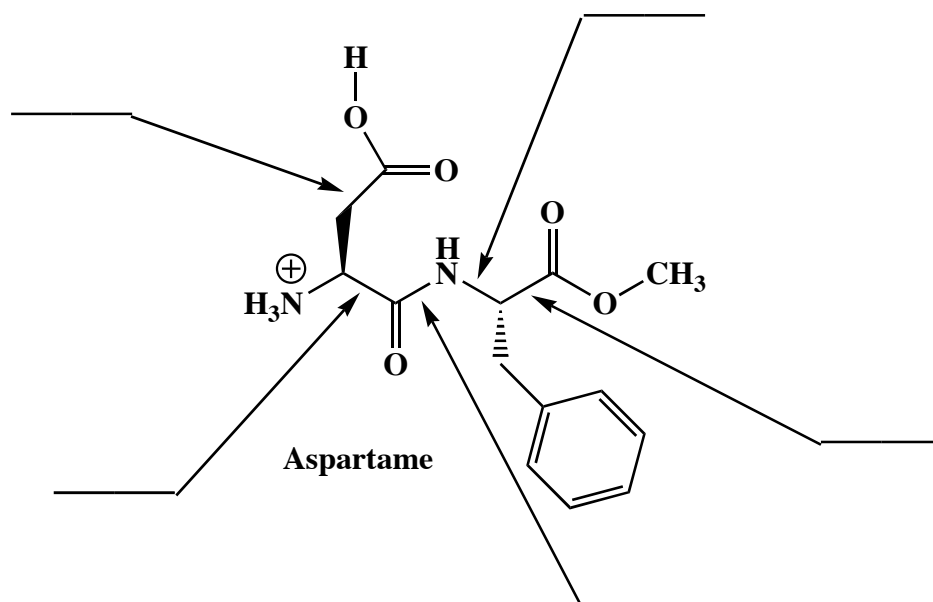


5. (8 points) Draw the two most important resonance contributing structures of the amide shown below. Be sure to show all lone pairs and formal charges. You do not have to draw arrows on this one.



6. (6 pts) List two attributes of amide bonds that lead to stabilization of the folded structures of proteins.

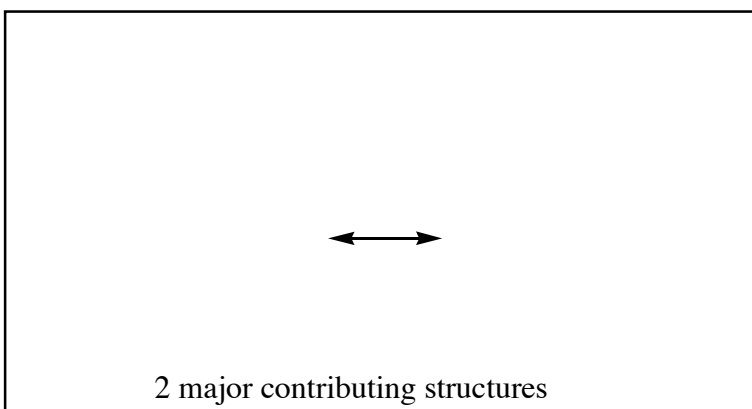
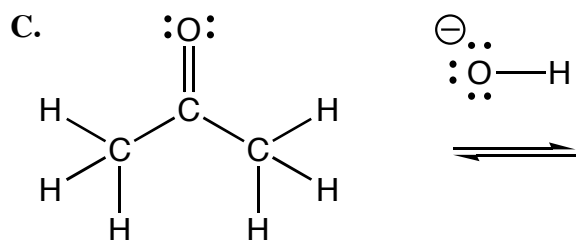
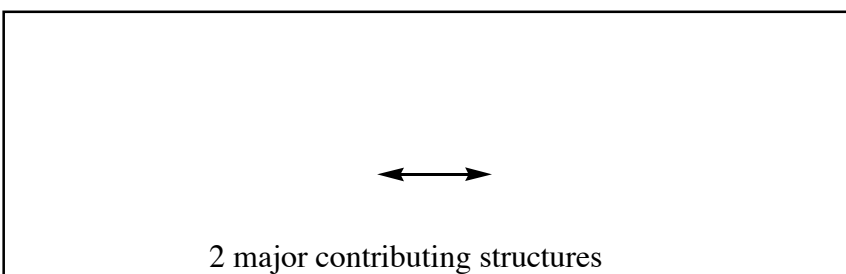
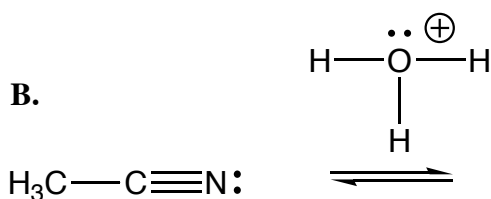
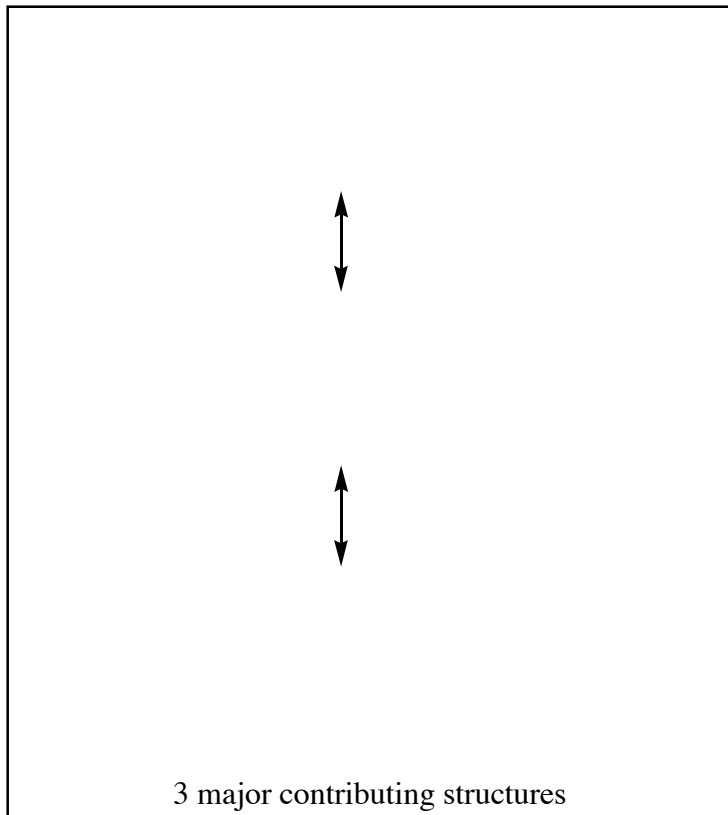
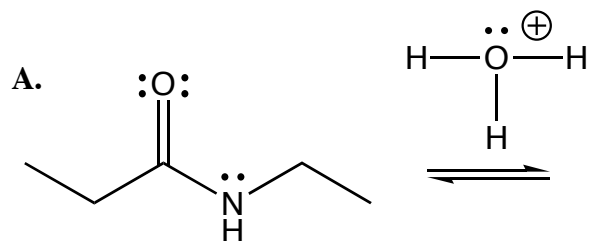
7. (15 points) Aspartame is the sweetener used in diet coke. Its structure is shown below. Because of carbonation and added phosphoric acid, the pH of diet coke is relatively acidic, near 2.0.



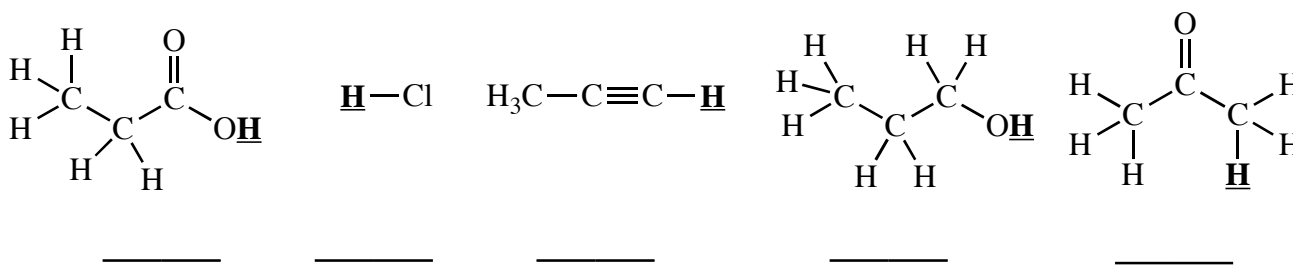
A) (5 pts) For each bond indicated by the arrows on the above drawing, write "YES" or "NO" in the spaces provided to say whether the given bond can rotate (YES) or not (NO) at room temperature.

B) (10 pts) Diet coke loses its sweetness over time, especially if heated. Can you suggest a likely reason for this based on the chemistry you have learned? We are only looking for two sentences or less here.

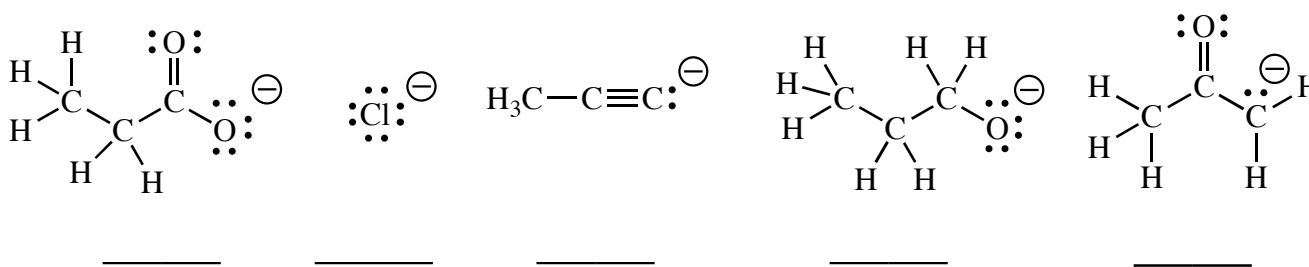
8. (23 points) In many of the mechanisms we have seen, there are charged intermediates encountered that are stabilized by resonance delocalization. For the following steps that come from different mechanisms, **place arrows on the structures on the left to show the flow of electrons that lead to a charged intermediate.** Next **draw all the intermediates created as well as the indicated number of major contributing structures.** Be sure to show all charges and lone pairs. Note, you only have to place arrows on the structures on the left side, not any of the contributing structures. **Finally make sure you show all intermediates made in the steps indicated.**



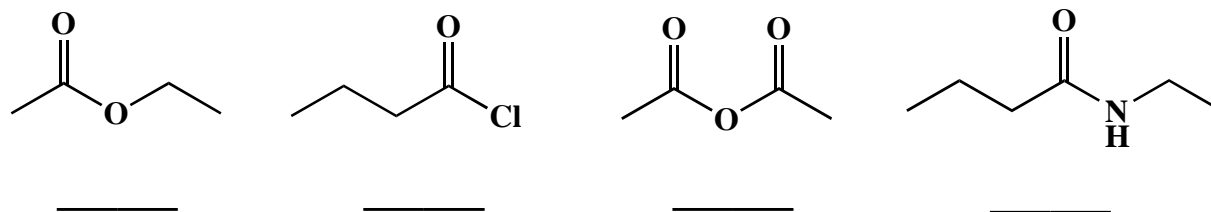
9. (5 pts) Rank all of the following with respect to relative acidity. The acidic H atom in question is indicated in bold and with an underline for each molecule. **Place a 1 under the most acidic molecule, and a 5 under the least acidic molecule.**



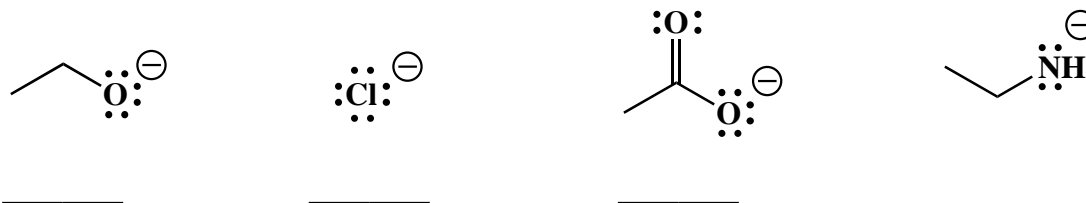
10. (5 pts.) Rank the following in terms of anion stability, with a **1 under the anion that is the most stable** and a **5 under the anion that is least stable.**



11. (4 pts.) Rank the following in terms of reaction with a strong nucleophile such as HO⁻, with a **1 under the molecule that is most reactive**, and a **4 under the molecule that is least reactive.**

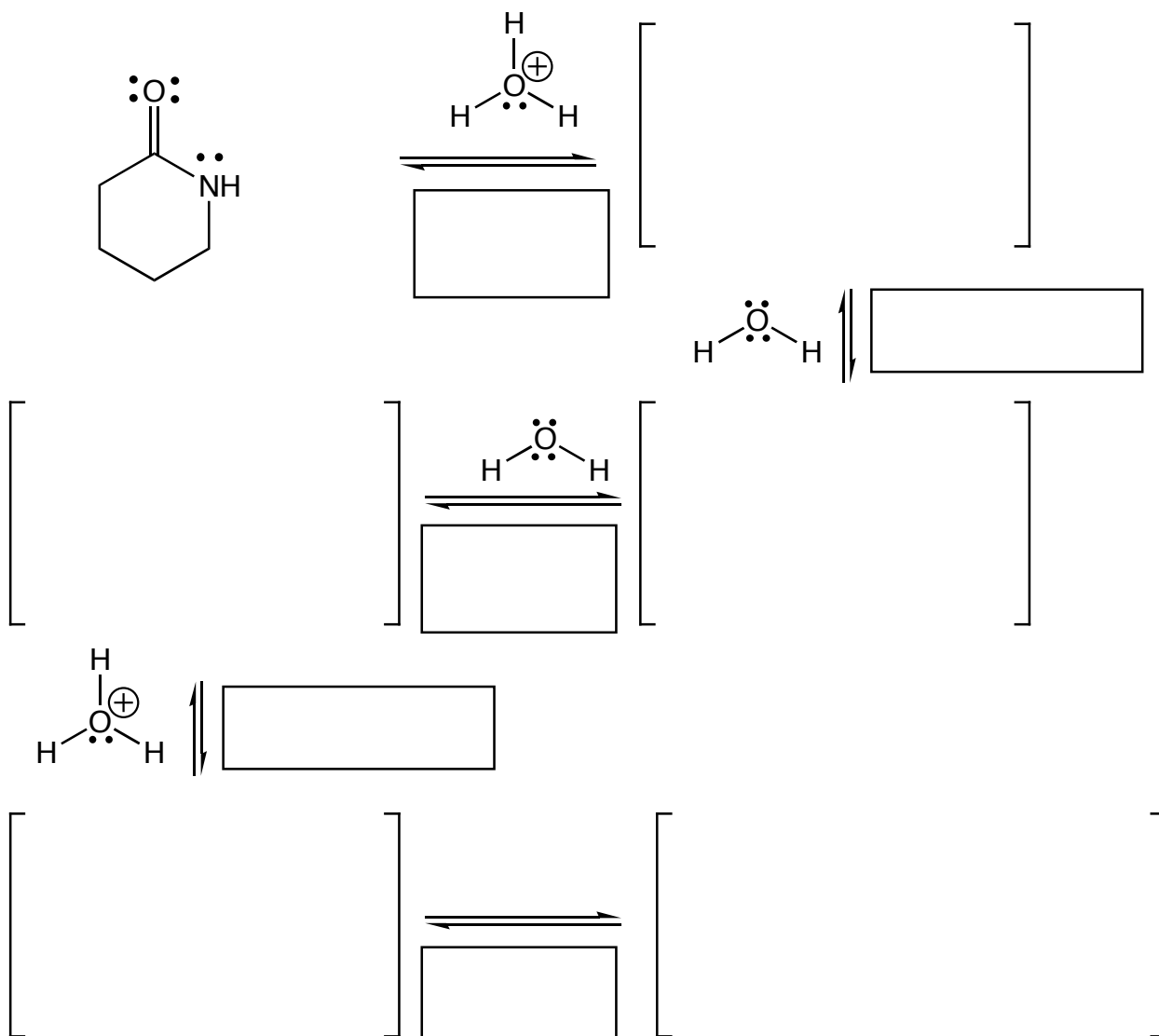


12. (4 pts.) Rank the following in terms of anion stability, with a **1 under the anion that is the most stable** and a **4 under the anion that is least stable.**



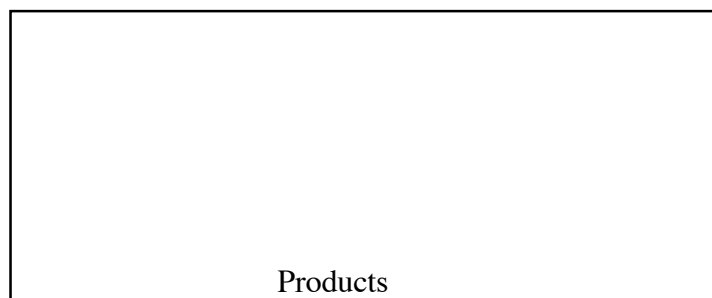
Please reread the directions to make sure you did not rank backwards!

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").

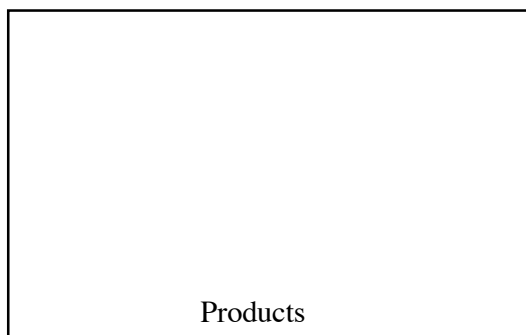
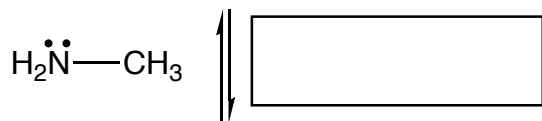
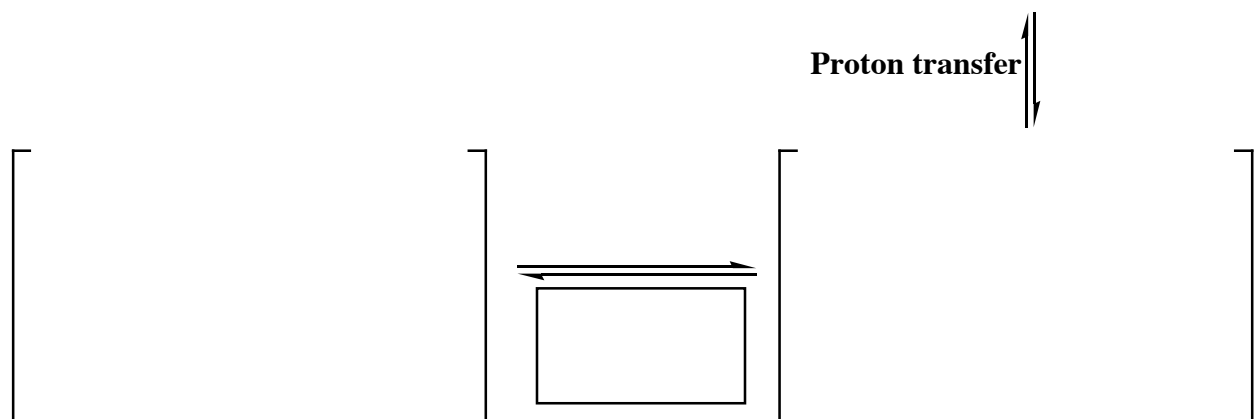
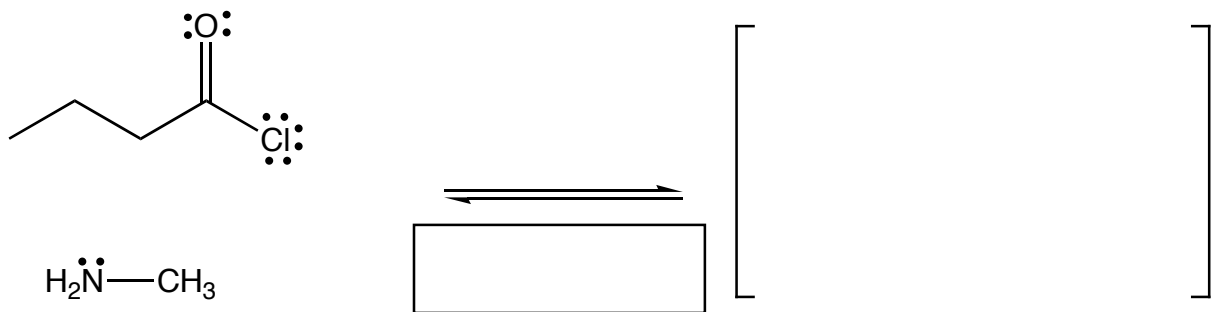


No need to draw arrows on the above structure

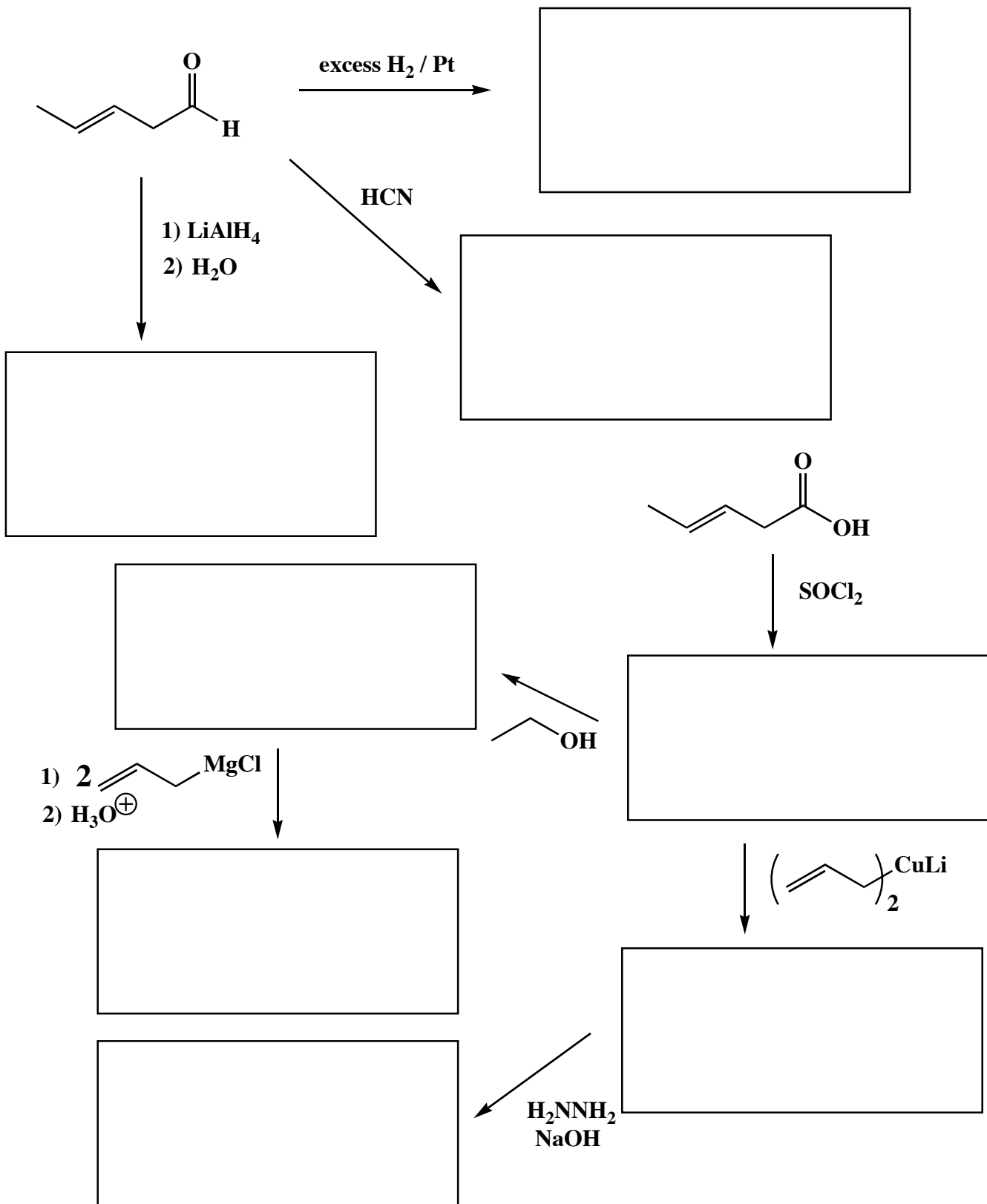
Proton Transfer



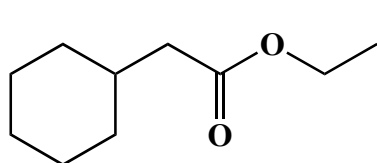
14. (19 pts.) Complete the mechanism for the following reaction between an acid chloride and an amine. Be sure to show arrows to indicate movement of all electrons, write all lone pairs, all formal charges, and all the products for each step. Remember, I said all the products for each step. IF A NEW 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").*



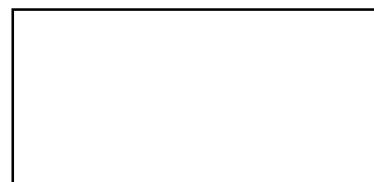
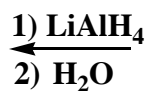
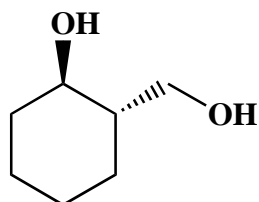
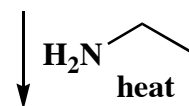
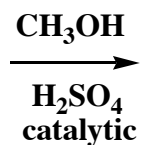
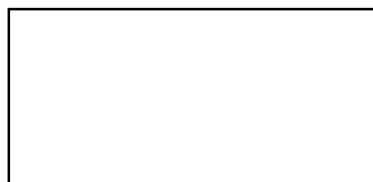
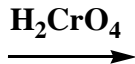
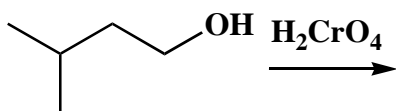
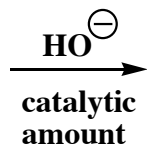
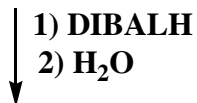
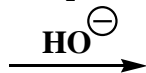
16. (26 pts) In the spaces provided, draw all products containing C atoms from the starting material. When in doubt, draw them! When a new chiral center is created put an asterisk next to the chiral center and write "racemic" when racemic mixtures are formed. Also, for aldol reactions DO NOT DEHYDRATE, but draw the initial product formed.



16. (35 pts) In the spaces provided, draw all products containing C atoms from the starting material. When in doubt, draw them! When a new chiral center is created put an asterisk next to the chiral center and write "racemic" when racemic mixtures are formed. Also, for aldol reactions DO NOT DEHYDRATE, but draw the initial product formed.



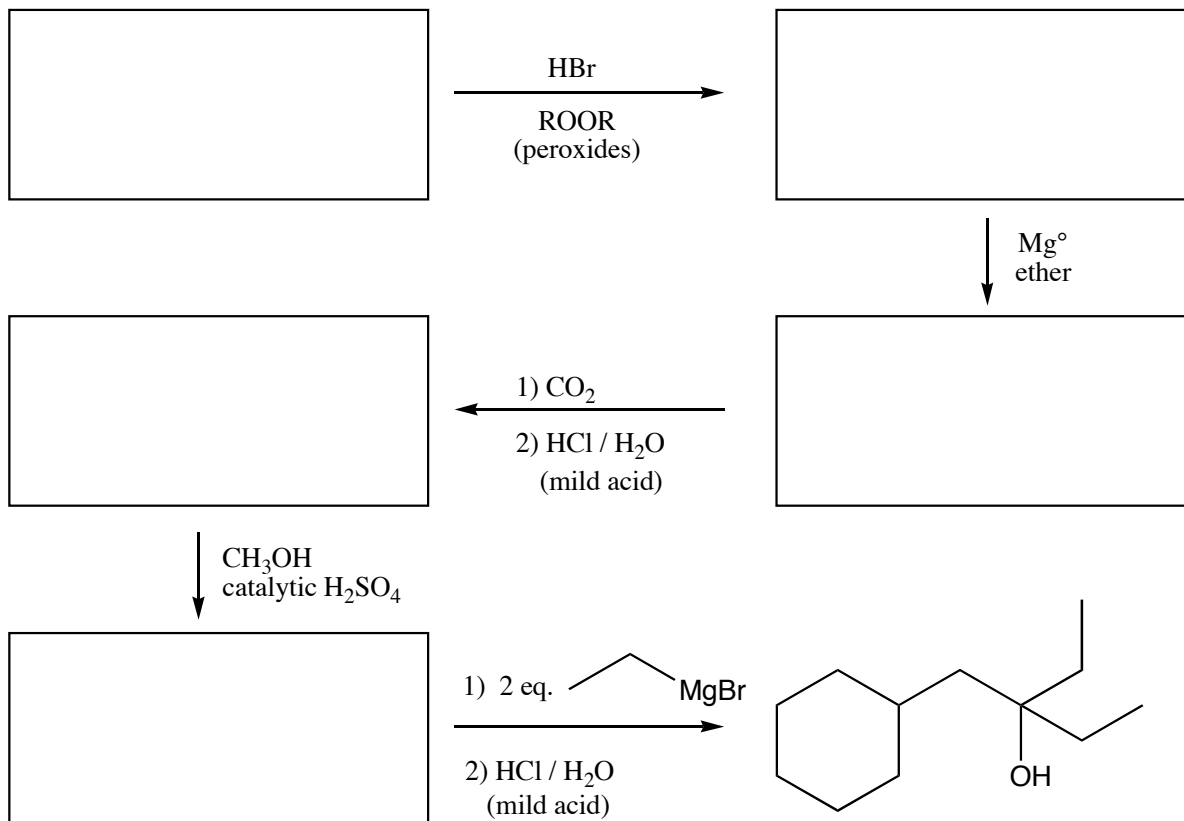
1.0 equivalent



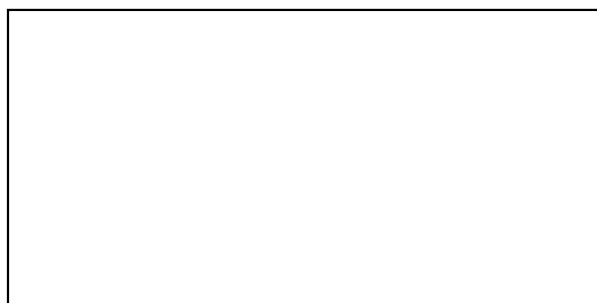
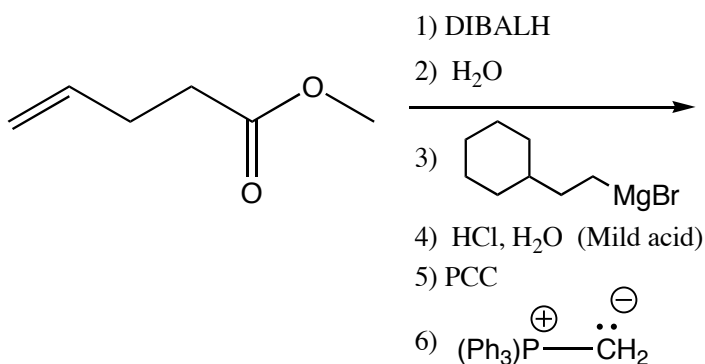
heat



17. (15 pts) This is the same but backwards. In the spaces provided, draw all synthetic intermediates containing C atoms, working backwards from the product. When in doubt, draw them! When a new chiral center is created put an asterisk next to the chiral center and write "racemic" when racemic mixtures are formed. Also, for aldol reactions DO NOT DEHYDRATE, but draw the initial product formed.



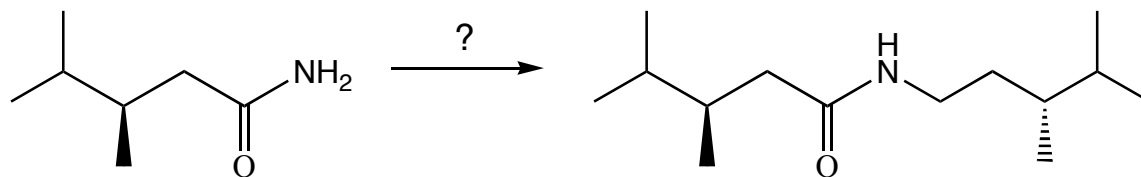
18. (10 points) For the following sequences of reactions, draw the predominant organic product or products after ALL the steps. You do not need to draw the intermediates formed along the way. If a new chiral center is created in the reaction that produces a racemic mixture, label the chiral center with an asterisk (*) and write "racemic" underneath. You do not have to draw all of the enantiomers.



You can use the back of the previous page as scratch paper

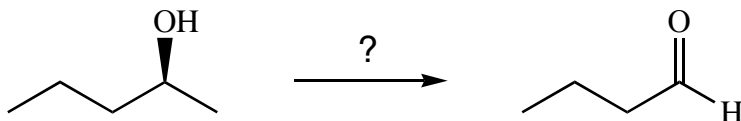
18. (9 pts) Using any reagents turn the starting material into the indicated product. All carbon atoms must come from the starting material. Draw all molecules synthesized along the way. When in doubt, draw the molecule! Hint: this should look familiar as a homework problem.

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



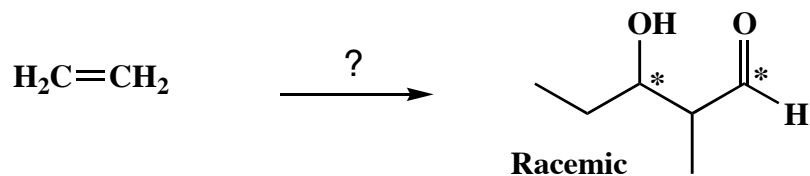
19. (10 pts) Using any reagents turn the starting material into the indicated product. All carbon atoms must come from the starting material. Draw all molecules synthesized along the way. When in doubt, draw the molecule! Hint: this should look familiar as a homework problem.

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



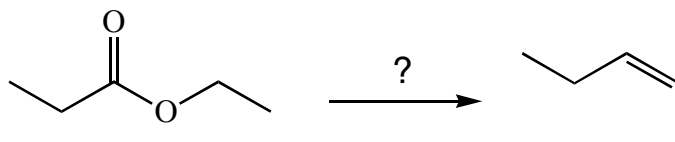
20. (16 pts) Using any reagents turn the starting material into the indicated product. All carbon atoms must come from the starting material. Draw all molecules synthesized along the way. When in doubt, draw the molecule! Hint: this should look familiar as a homework problem.

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



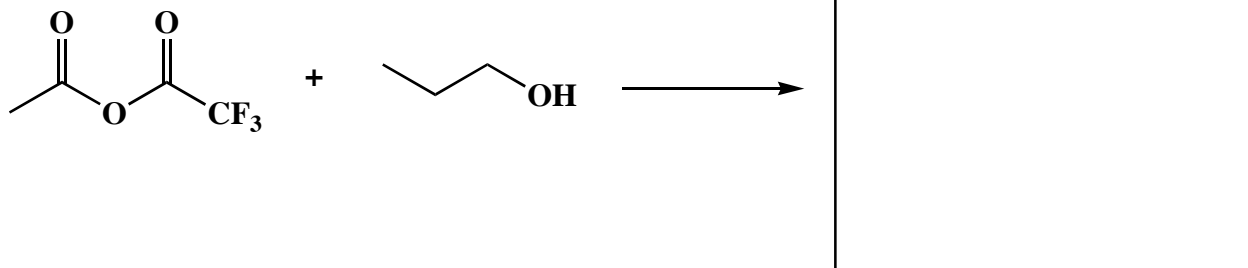
20. (15 pts) Using any reagents turn the starting material into the indicated product. All carbon atoms must come from the starting material. Draw all molecules synthesized along the way. When in doubt, draw the molecule! Hint: this should look familiar as a homework problem.

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



20. (20 pts) Here is an apply what you know question. You have not seen this reagent before, but you have learned fundamental principles of reactivity that will lead you to the correct answer.

A. (5 pts) Write all of the products for the predominant reaction that takes place when the following reagents are added together.



B. (5 pts) In no more than two sentences explain your answer to part A.

C. (5 pts) Draw a circle around the reagent that reacts faster with various nucleophiles.



D. (5 pts) In no more than two sentences explain your answer to part C.