

NAME (Print): _____

**Chemistry 320N
2nd Midterm Exam
March 13, 2025**

EID _____

SIGNATURE: _____

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

--	--	--

Please Note: Please take your time. You have three hours to take this exam. Please do not rush, we want you to show us everything you have learned this semester so far! Making careless mistakes is not good for anyone! If you find yourself getting anxious because of a problem, skip it and come back. Please do not second guess yourself! Keep track of the questions worth a lot of points. (This does not mean they are hard, it just means we think they cover important material.)

One last thing: I recommend you close your eyes for a moment, then take some nice deep breaths before you begin. **YOU GOT THIS!**

FINALLY, DUE TO SOME UNFORTUNATE RECENT INCIDENTS YOU ARE NOT ALLOWED TO INTERACT WITH YOUR CELL PHONE IN ANY WAY. IF YOU TOUCH YOUR CELL PHONE DURING THE EXAM YOU WILL GET A "0" NO MATTER WHAT YOU ARE DOING WITH THE PHONE. PUT IT AWAY AND LEAVE IT THERE!!!

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
Thiols	RCH_2SH	8-9
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
Primary ammonium	$\text{H}_3\text{N}^+\text{CH}_2\text{CH}_3$	10.5
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	$\text{RCH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl}$	16
Aldehydes	$\text{RCH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$	18-20
Ketones	$\text{RCH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{R}'$	18-20
Esters	$\text{RCH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{OR}'$	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

Signature _____

Pg 1 _____(27)

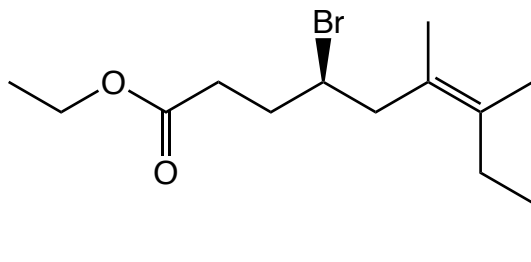
1. (5 pts) What is the most important question in organic chemistry?

2. (10 pts) Amides are best represented as the hybrid of three contributing structures. Draw the second and third important contributing structures in the spaces provided. (No need to draw any arrows for this.)

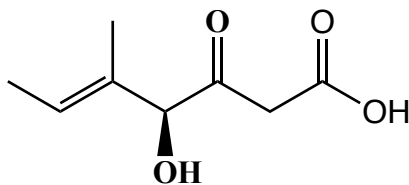


3. (6 pts each) Write an acceptable IUPAC name for the following molecules:

A.



B.

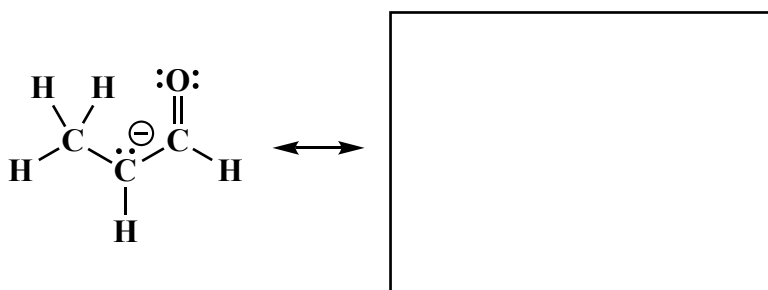


4. (6 pts each) In the box, draw the structure corresponding to the following IUPAC name.

(E)-3-Ethyl-5-oxohex-2-enamide
or (E)-3-Ethyl-5-oxo-2-hexenamide

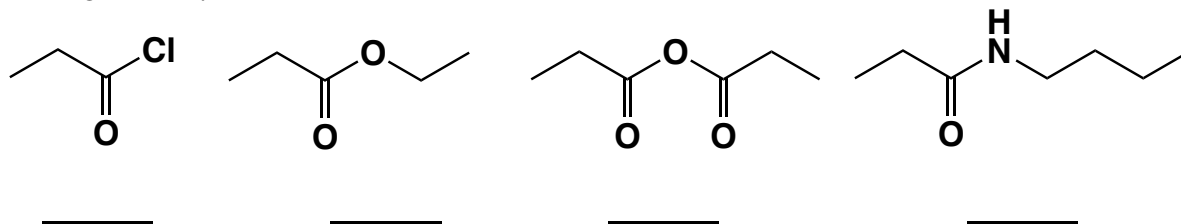


5. (9 pts each) For the two different enolates shown below, draw the other important contributing structures. Make sure to show all electrons and formal charges. You do not need to draw arrows on any of the structures.

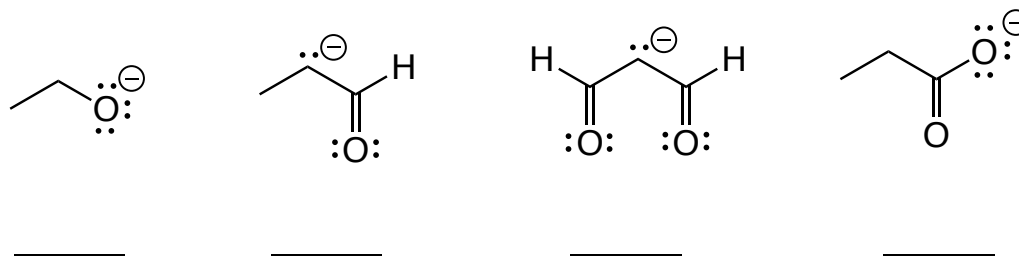


6. (14 pts) These are the ranking questions.

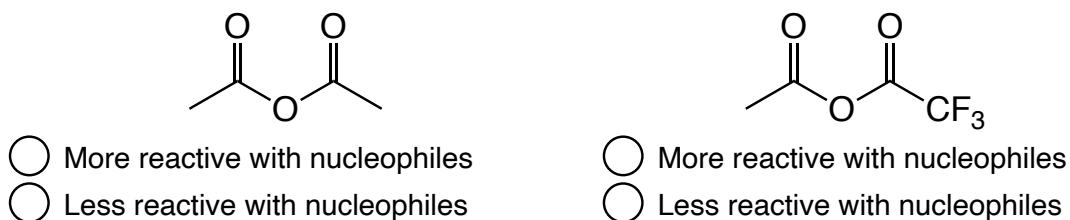
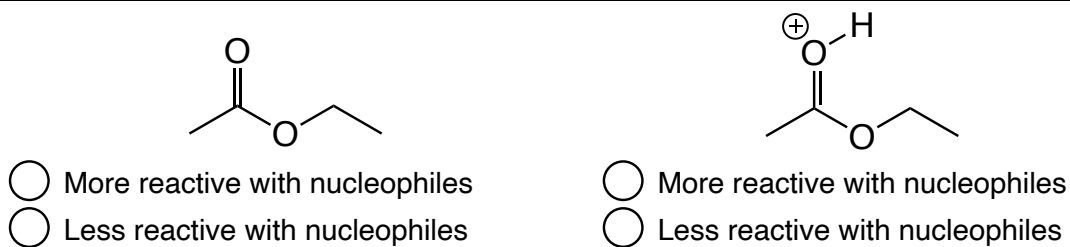
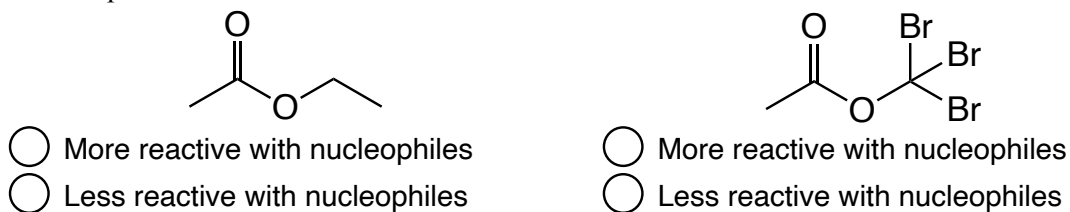
A) Rank the following with respect to reactivity with nucleophiles, WITH A "1" UNDER THE MOST REACTIVE AND "4" UNDER THE LEAST REACTIVE, AND THEN "2" AND "3" AS APPROPRIATE.



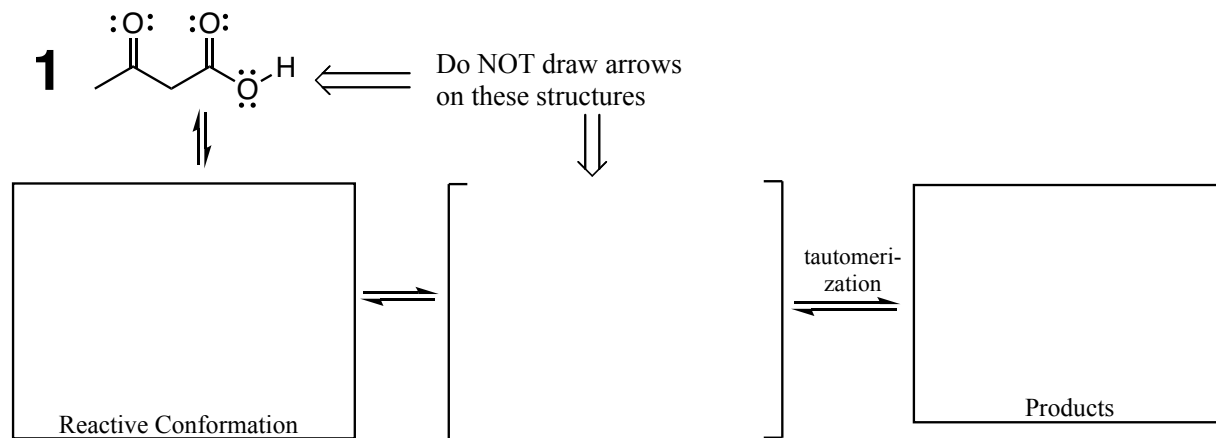
B) Rank the following with respect to anion stability, WITH A "1" UNDER THE MOST STABLE ANION AND "4" UNDER THE LEAST STABLE ANION, AND THEN "2" AND "3" AS APPROPRIATE.



C) For each pair of molecules, fill in the circles to indicate which in each pair is more or less reactive with nucleophiles.



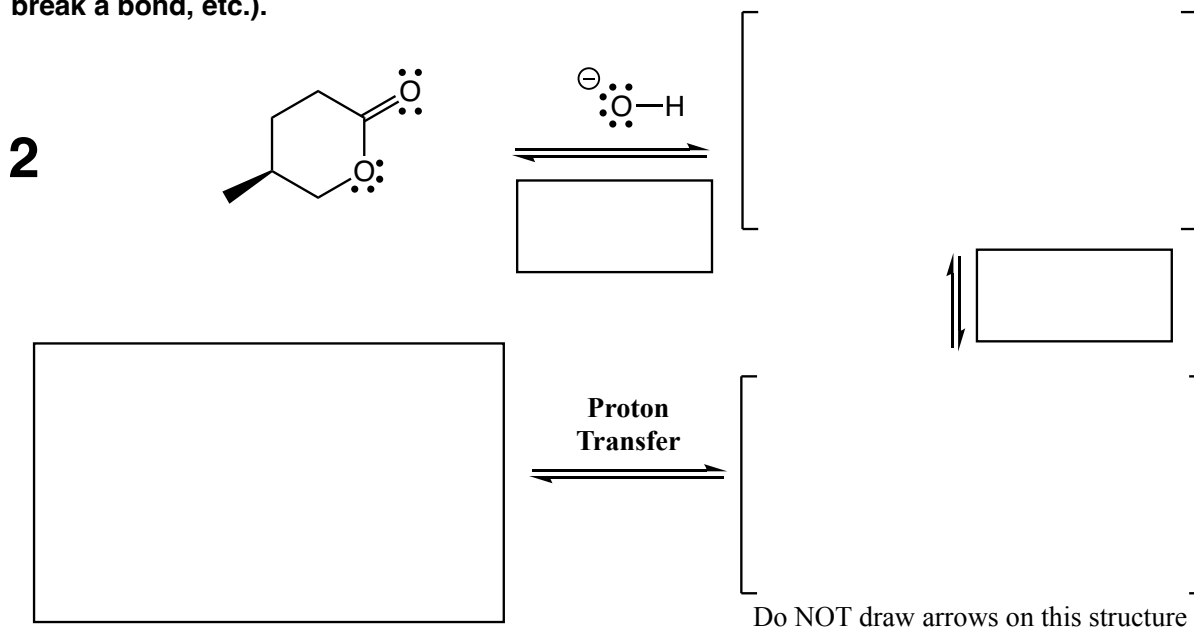
7. (12 pts) Complete the mechanism for the following decarboxylation reaction. **Be sure to show arrows to indicate movement of all electrons on the “Reactive Conformation”, write all lone pairs, all formal charges, and all the products for each step.** Remember, I said all the products for each step. **IF A NEW CHIRAL CENTER IS CREATED IN AN INTERMEDIATE OR PRODUCT, MARK IT WITH AN ASTERISK AND LABEL THE MOLECULE AS RACEMIC IF APPROPRIATE.**



Draw arrows on this structure

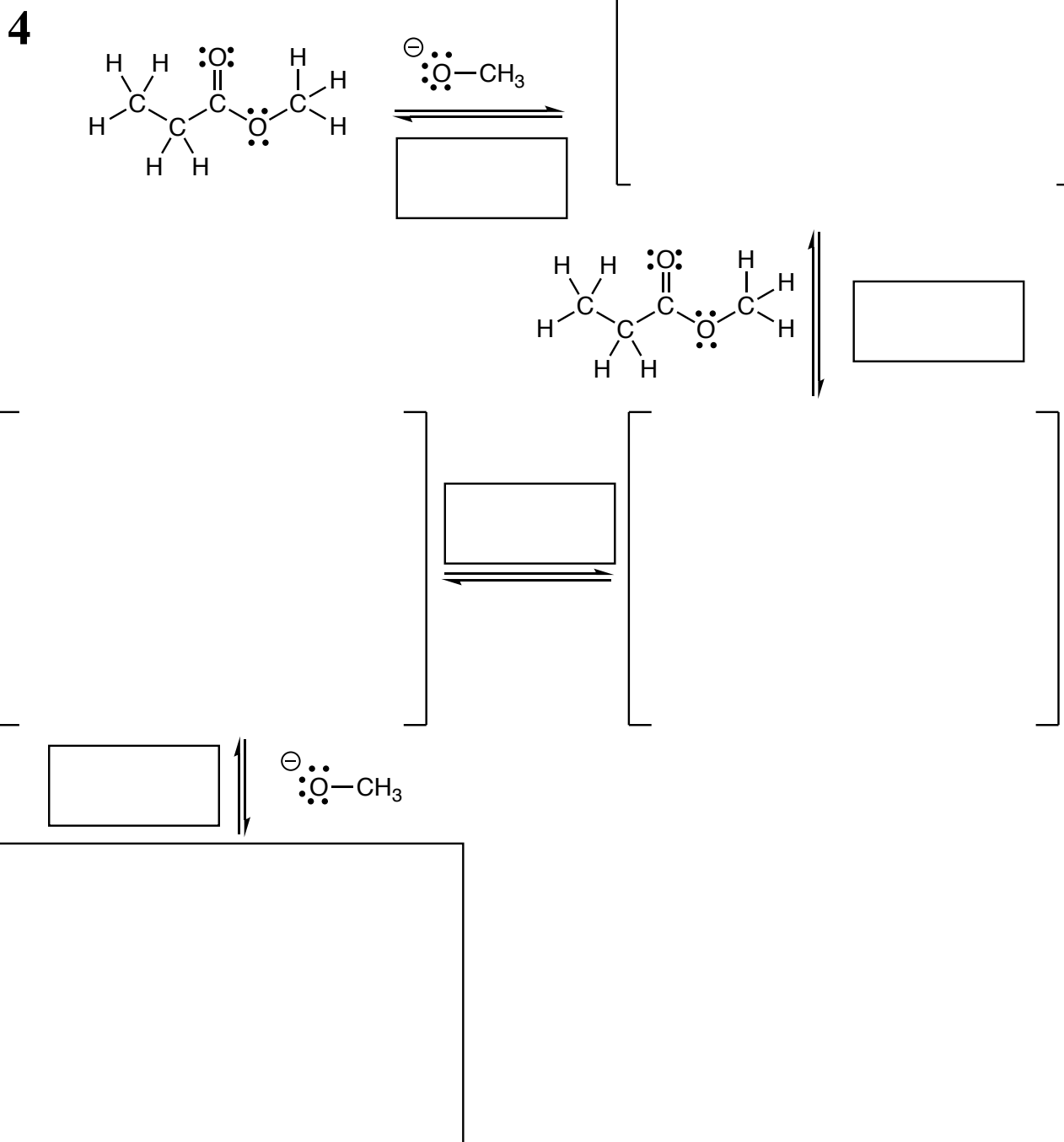
Note you will have to write a balanced equation for the above mechanism on page 7

8. (12 pts) Complete the mechanism for the following reaction of a lactone and hydroxide. **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 THE MOLECULE 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 you will have to write a balanced equation for the above mechanism on the page 7

10. (23 pts) Complete the mechanism for the following Claisen condensation 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 PRODUCT, MARK IT WITH AN ASTERISK AND LABEL THE MOLECULE 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.).



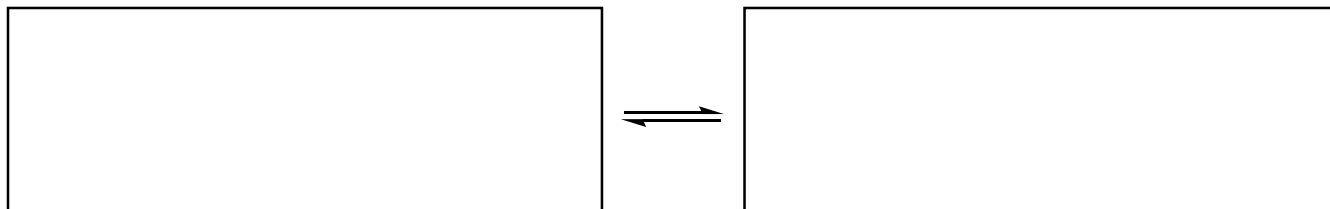
Note you will have to write a balanced equation for the above mechanism on PAGE 7

Signature _____

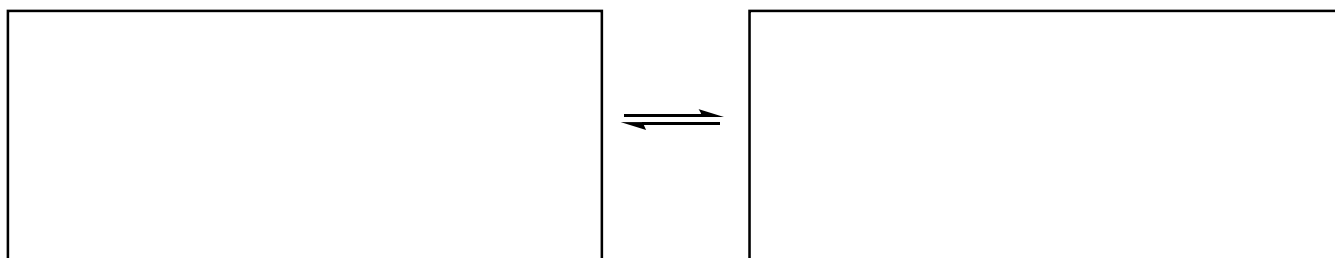
Pg 7 _____(17)

11. (17 pts) Write BALANCED equations for the four mechanisms, 1-4, that you drew on the last three pages. Only include molecules consumed or created during the reactions. In addition, you must use whole numbers when designating stoichiometries, not fractions or decimals. This is not asking to give equivalents, but rather balanced equations for each reaction.

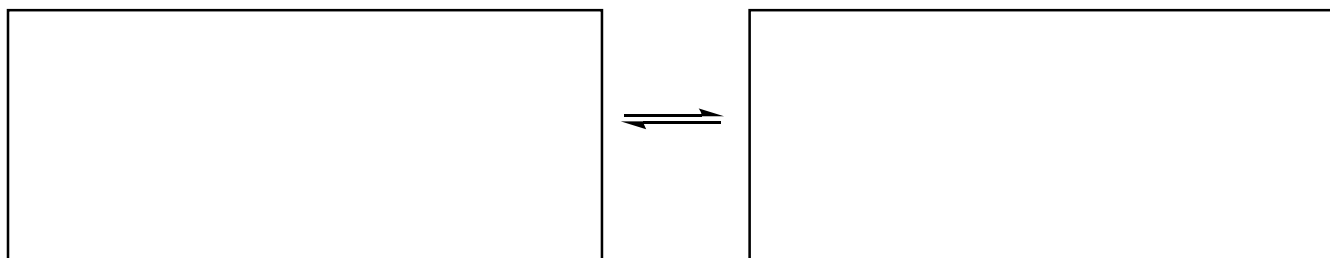
Write a balanced equation for the overall process described by mechanism 1 from page 4



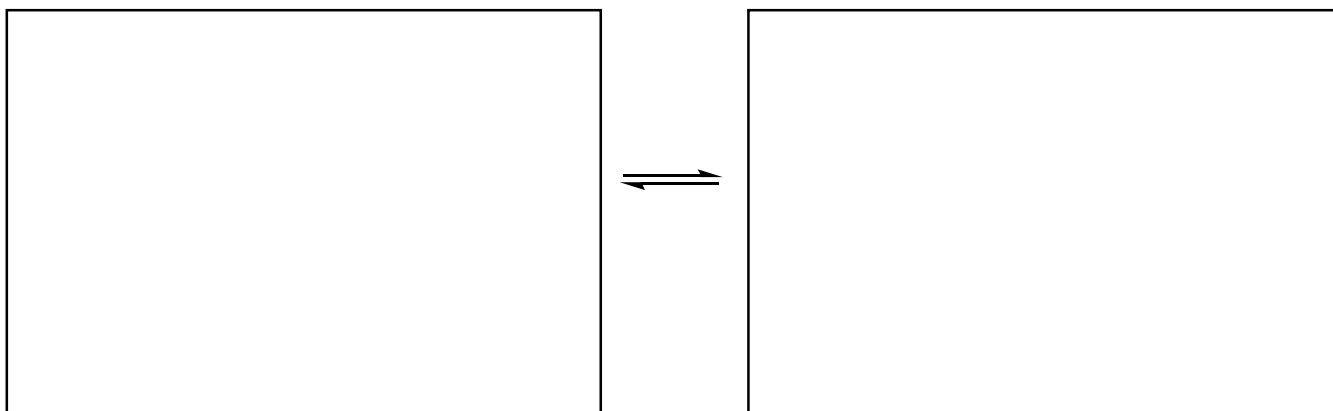
Write a balanced equation for the overall process described by mechanism 2 from page 4



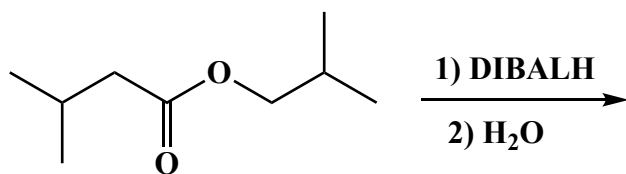
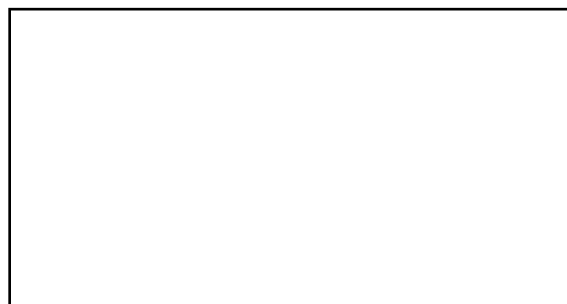
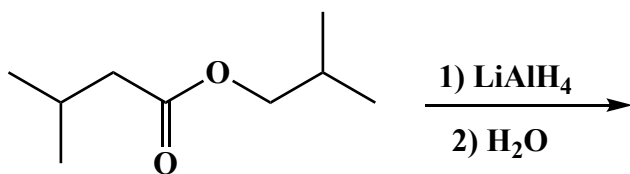
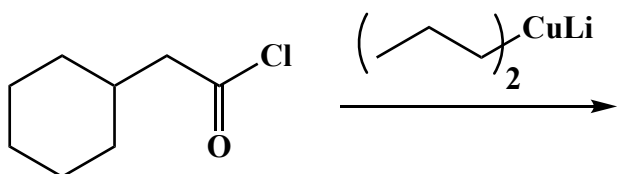
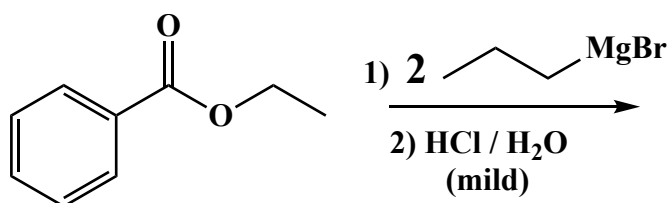
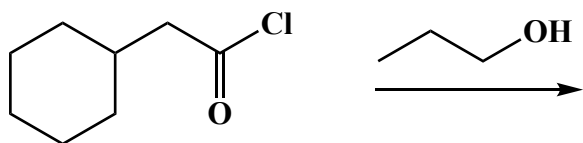
Write a balanced equation for the overall process described by mechanism 3 from page 5



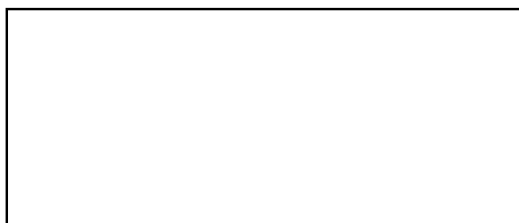
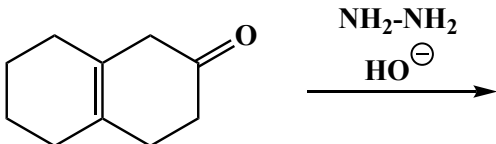
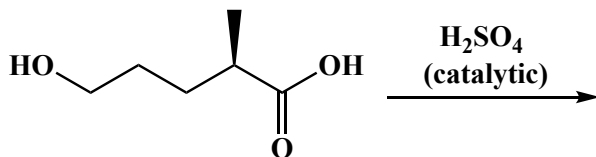
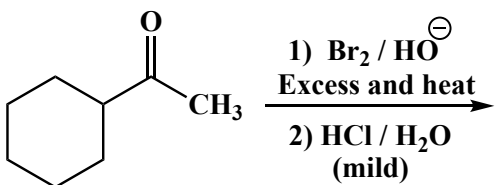
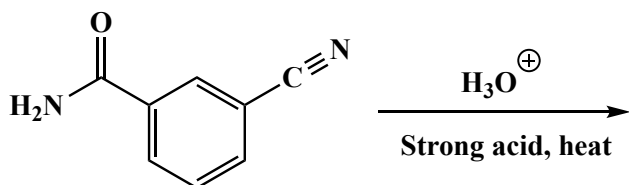
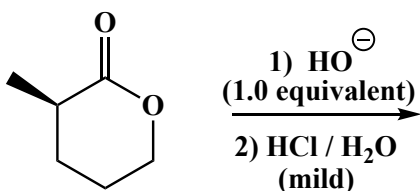
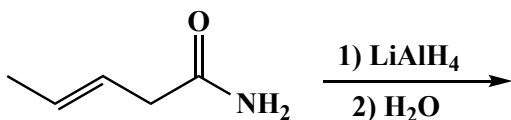
Write a balanced equation for the overall process described by mechanism 4 from page 6



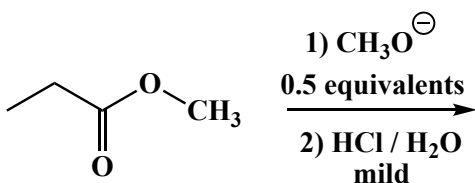
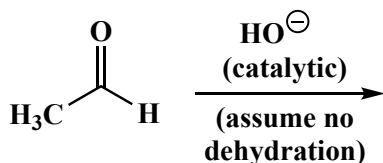
13. (3 or 5 pts.) Write all of the organic product(s) that will occur for each transformation. If a new chiral center is created and a racemic mixture is formed, you must draw both enantiomers and write "racemic" under the structure. Use wedges (\blacktriangleleft) and dashes (\cdots) to indicate stereochemistry. **For these, you need to write all of the products of the reactions except for the products containing metals.**



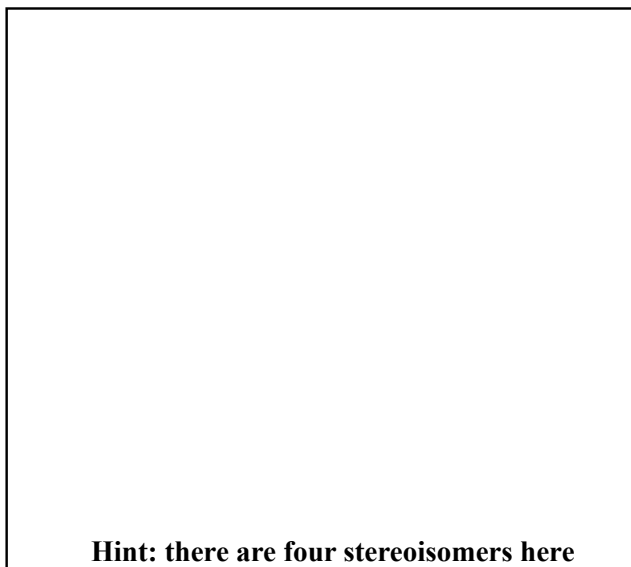
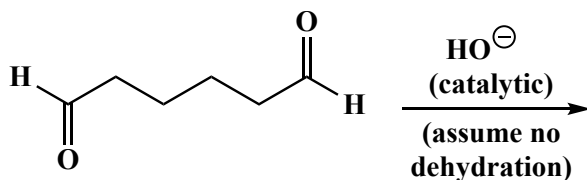
14. (3 or 5 pts.) Write all of the organic product(s) that will occur for each transformation. If a new chiral center is created and a racemic mixture is formed, you must draw both enantiomers and write "racemic" under the structure. Use wedges (\blacktriangleleft) and dashes (\dashv) to indicate stereochemistry. **For these, you need to write all of the products of the reactions except for the products containing metals.**



15. (5 or 9 pts.) Write all of the organic product(s) that will occur for each transformation. If a new chiral center is created and a racemic mixture is formed, you must draw both enantiomers and write "racemic" under the structure. Use wedges (\blacktriangleleft) and dashes (\dashv) to indicate stereochemistry. **For these, you need to write all of the products of the reactions except for the products containing metals.**

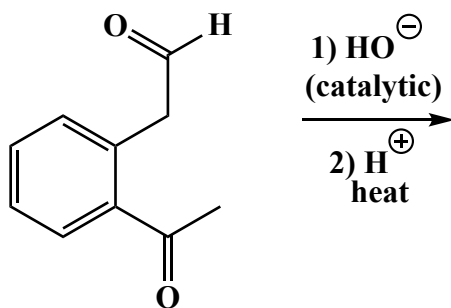
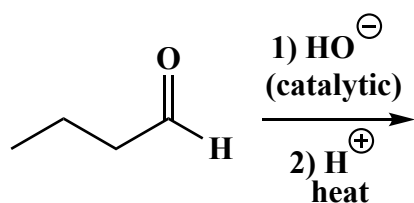


This is a hard one!!



16. (4 or 6 pts.) Write the predominant product that will occur for each transformation. If a new chiral center is created and a racemic mixture is formed, you must draw both enantiomers and write "racemic" under the structure. Use wedges (\blacktriangleleft) and dashes (\cdots) to indicate stereochemistry. **For these, you need to write all of the products of the reactions except for the products containing metals.**

There is a lot to think about here. Please take your time. ASSUME THESE DEHYDRATES.

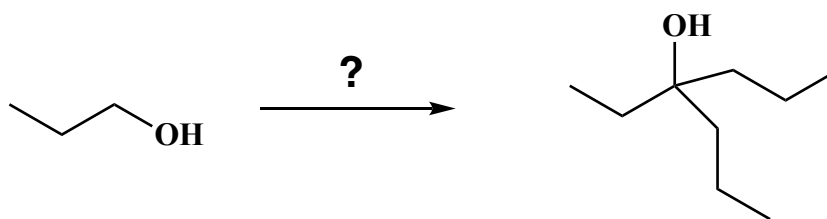


Signature _____

Pg 13 _____(16)

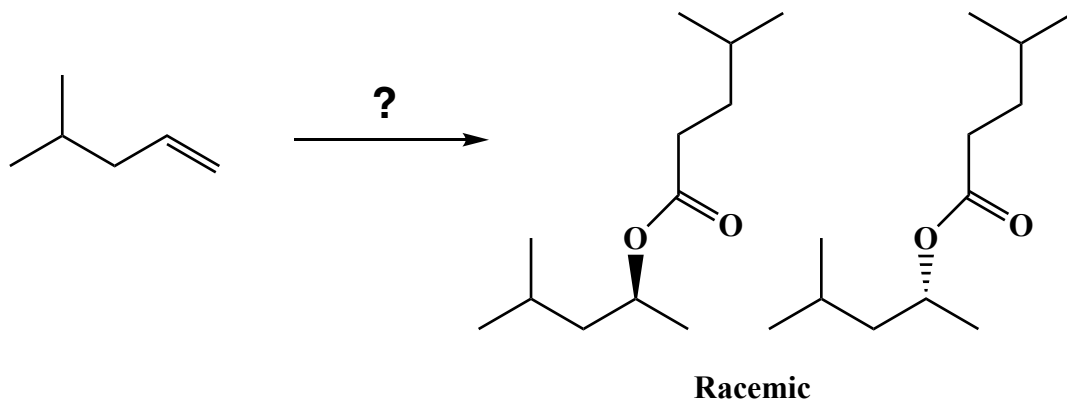
17. These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned provided that the product(s) you draw for each step is/are the predominant one(s). Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction. You must draw all stereoisomers formed, and use wedges and dashes to indicate chirality at each chiral center. Write racemic when appropriate. **All the carbons of the product must come from carbons of the starting material.**

A) (16 pts)



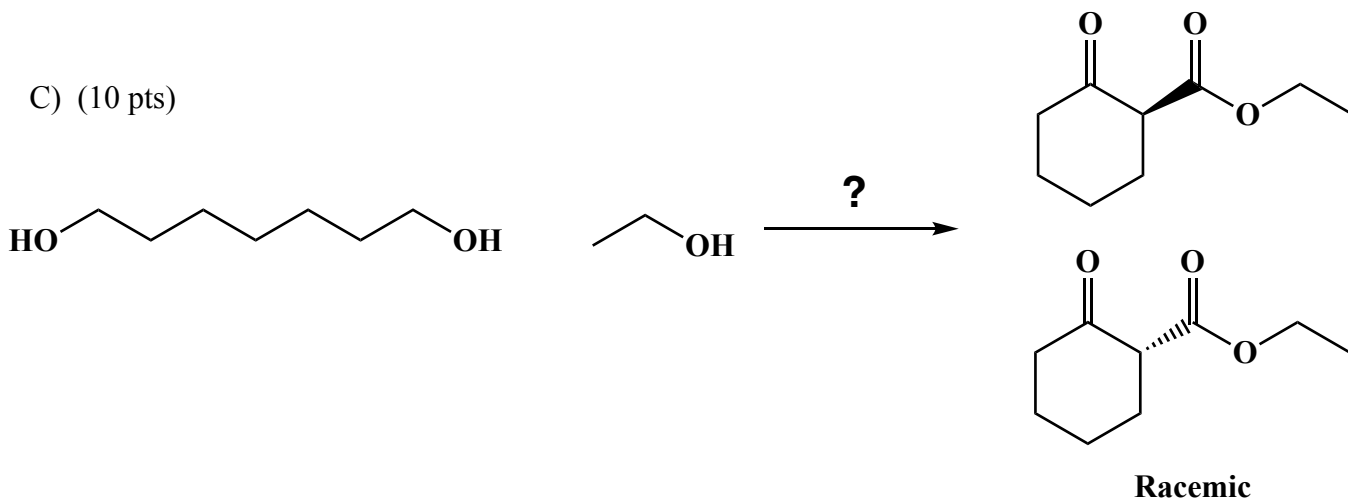
17. These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned provided that the product(s) you draw for each step is/are the predominant one(s). Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction. You must draw all stereoisomers formed, and use wedges and dashes to indicate chirality at each chiral center. Write racemic when appropriate. **All the carbons of the product must come from carbons of the starting material.**

B) (13 pts)



17. 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 provided that the product(s) you draw for each step is/are the predominant one(s). 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. You must draw all stereoisomers formed, and use wedges and dashes to indicate chirality at each chiral center. Write racemic when appropriate. **All the carbons of the product must come from carbons of the starting material.**

C) (10 pts)



I hope you all have a wonderful spring break. Please make a promise to yourself to take some time to do things you really enjoy. **YOU DESERVE IT**, after all, you are in OChem II! And, of course, all of next week make sure to **EXERCISE EVERY CHANCE YOU GET**. Our 3.1 mile challenge is coming up the first week of April!