Page	Points	
1		(30)
2		(24)
3		(21)
4		(29)
5		(16)
6		(22)
7		(18)
8		(15)
9		(19)
10		(26)
11		(17)
12		(19)
13		(13)
14		(16)
Total		(285)
%		
T Score		
HW		
Total Grade		

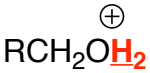
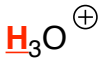
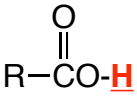
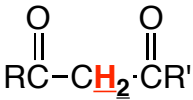
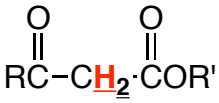
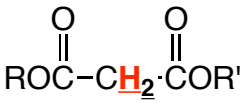
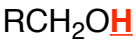
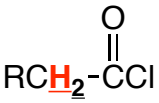
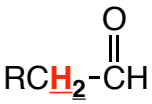
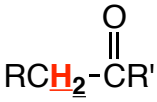
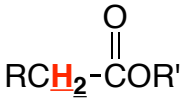
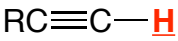
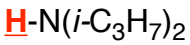
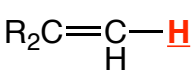
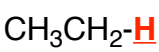
(HW score + Exam Grade) ⟹

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		-7
Protonated alcohol		-2
Hydronium ion		-1.7
Carboxylic acids		3-5
Ammonium ion		9.2
β-Dicarbonyls		10
β-Ketoesters		11
β-Diesters		13
Water		15.7
Alcohols		15-19
Acid chlorides		16
Aldehydes		18-20
Ketones		18-20
Esters		23-25
Terminal alkynes		25
LDA		40
Terminal alkenes		44
Alkanes		51

Signature_____ Pg 1 _____(30)

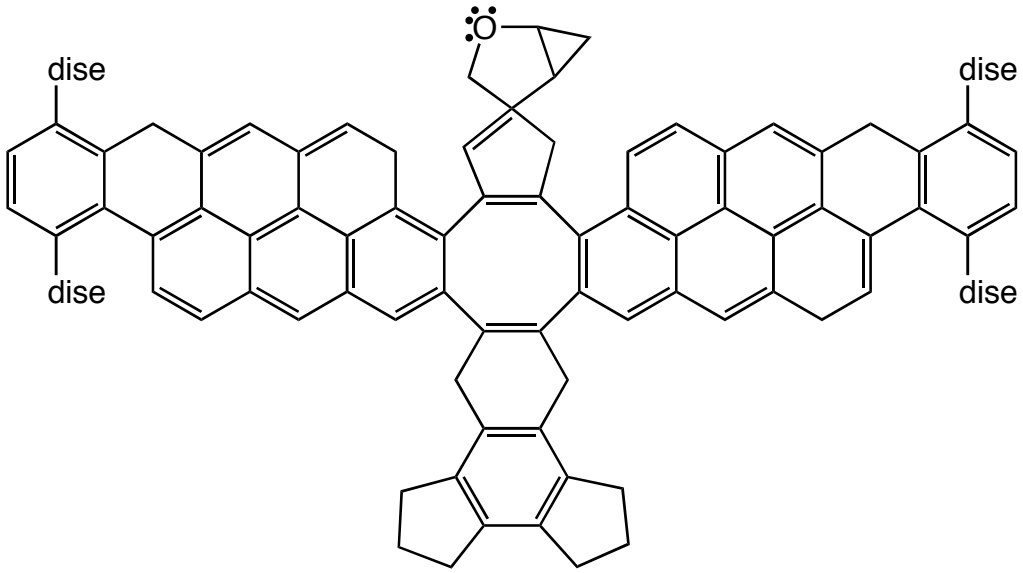
1. (14 points) Suppose a relative of yours is having an MRI. In no more than four sentences, explain to them what is happening when they have the MRI scan. We will be looking for a minumum of 7 key points here.

The popular medical diagnostic technique of **magnetic resonance imaging (MRI)** is based on the **same principles as NMR**, namely the **flipping (i.e. resonance) of nuclear spins of protons** by **radio frequency irradiation** when a patient is placed in a **strong magnetic field**. **Magnetic field gradients** are used to gain imaging information, and **rotation of the gradient around the center of the object** gives imaging in an entire plane **(i.e. slice inside patient)**. In an MRI image, you are looking at **individual slices** that **when stacked make up the three-dimensional image** of **relative amounts of protons, especially the protons from water and fat, in the different tissues**.

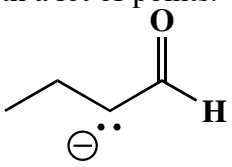
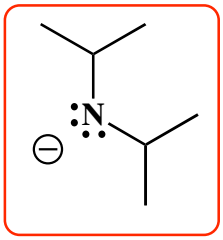
2. (2 pt. each) Here are a number of statements regarding aromaticity. Do not second guess yourself, this is not meant to be tricky! **Check the appropriate box to indicate whether the statement is true or false.**

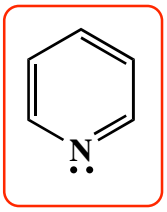
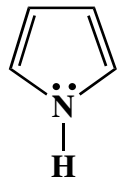
	True	False
A. When using molecular orbital theory, it is best to think of electron density as being like waves, since it is described mathematically using wave equations.	X	
B. According to Huckel's rule, aromatic molecules are flat, monocyclic, all ring atoms have a 2p orbital (no sp3 ring atoms) and there are 4n + 2 pi electrons (i.e. 2, 6, 10, 14.....).	X	
C. When drawing mechanisms or resonance contributing structures, the arrows indicate where positive or negative charges are moving between structures.		X
D. When drawing mechanisms or resonance contributing structures, the arrows indicate where pairs of electrons are moving between structures.	X	
E. It is generally stabilizing to have pi electrons delocalized over several atoms with adjacent 2p orbitals, a situation referred to as conjugation.	X	
F. Aromaticity is a powerful stabilizing interaction, so that atoms with lone pairs will adopt a hybridization state to maximize aromaticity in a molecule.	X	
G. When trying to understand where charges are in charged aromatic molecules, you can draw resonance contributing structures and get the right answer.	X	
H. Resonance contributing structures can be used to explain why aromatic rings can stabilize molecules with attached atoms that possess a positive charge, negative charge, or radical.	X	

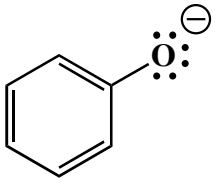
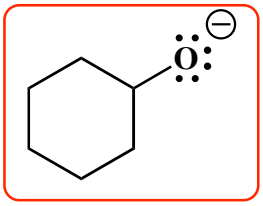
Molecule of the day: The rare central Texas bird of Paradise.

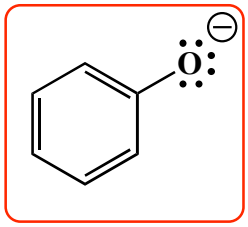
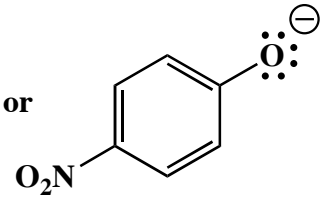


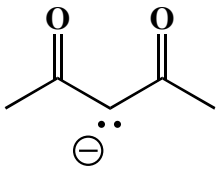
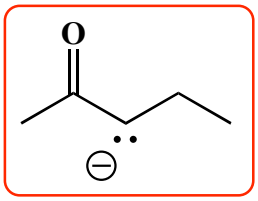
3. (3 pts each) For each pair, circle the molecule that is the **stronger base**. You may refer to the pKa table provided, or use any other chemical logic we have taught you to predict the answers. This is not meant to be tricky, but you might want to take your time here as there is much think about and this is worth a lot of points.

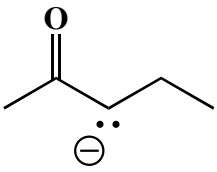
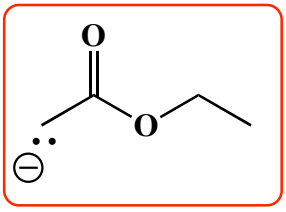
A)  **or** 

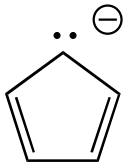
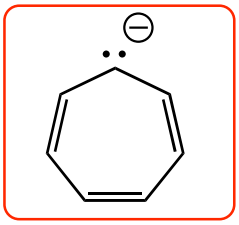
B)  **or** 

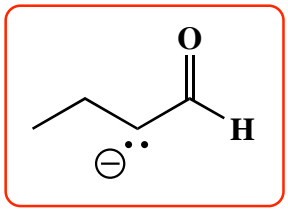
C)  **or** 

D)  **or** 

E)  **or** 

F)  **or** 

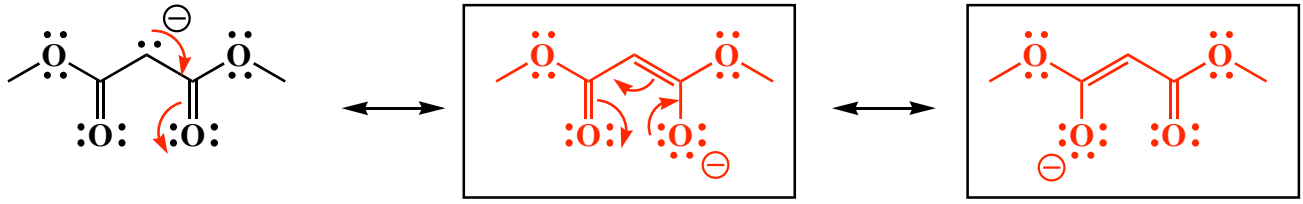
G)  **or** 

H)  **or** 

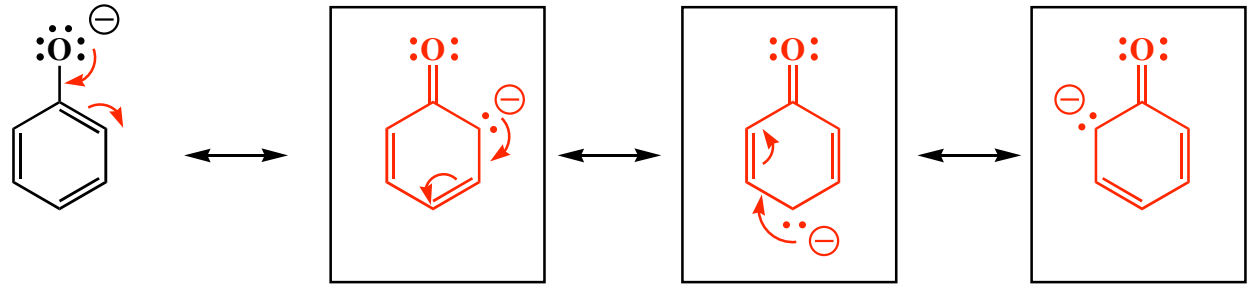
In each case, select the less stable anion, or when applicable, the anion derived from the weaker acid (higher pKa value).

4. (21 pts) Resonance contributing structures are important for both units covered by this exam, namely enolates and aromatic molecules. On the following, **draw the indicated number of <u>most important</u> resonance contributing structures. Show all lone pairs, pi bonds and formal charges. Use arrows to indicate the redistribution of electrons on each molecule to the left, that leads to the contributing structure you draw immediately to its right.** (Only the structure on the farthest right on each line has no arrows on it). We drew template structures for you to save time.

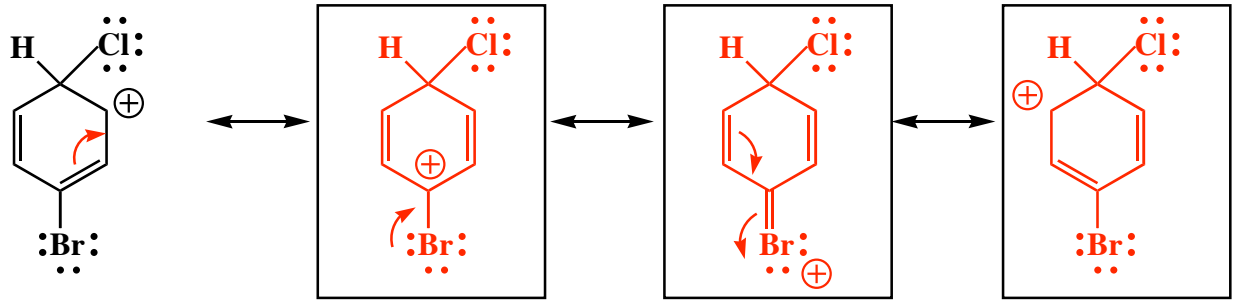
A. An enolate **2 pts each question to get arrows correct** **1 pt per correct structure**



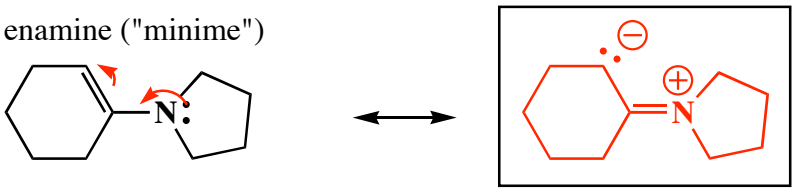
B. The phenoxide anion



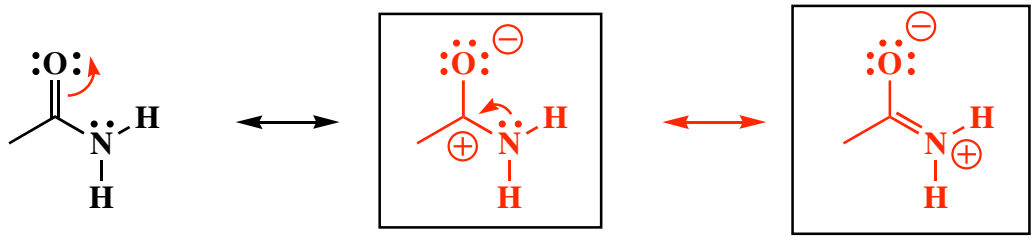
C. An arenium ion



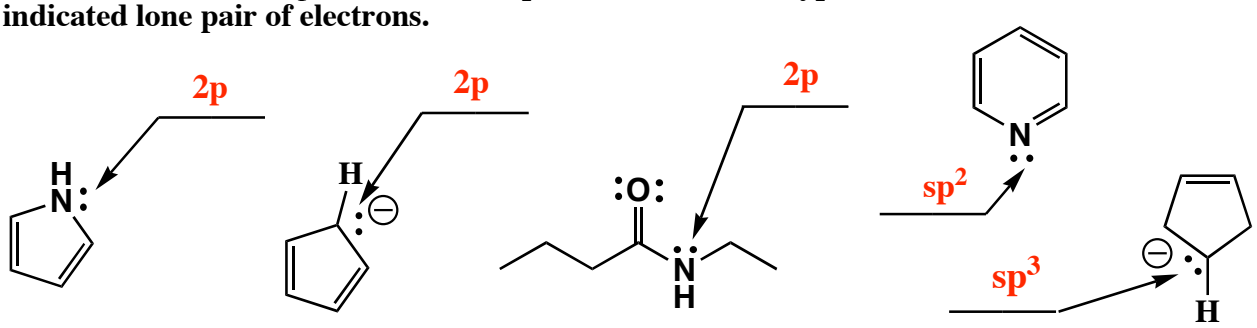
D. An enamine ("minime")



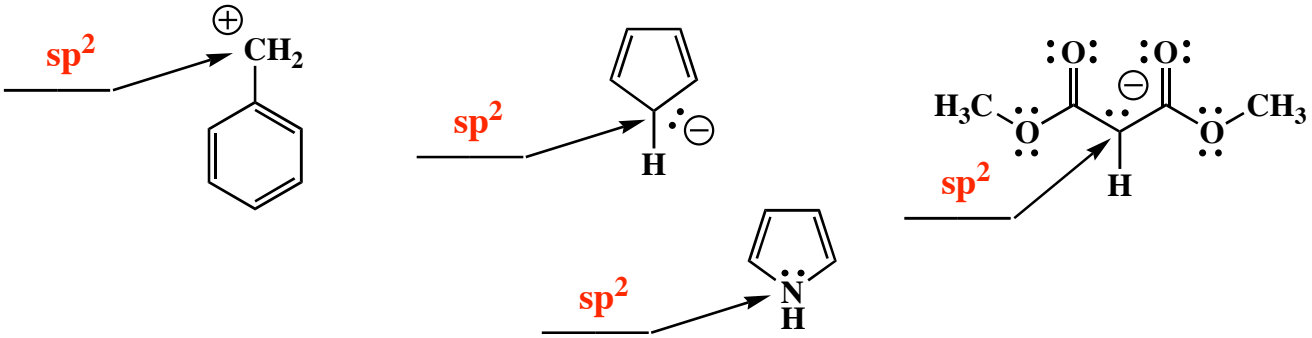
E. Here is a trip into the past (last midterm), an amide



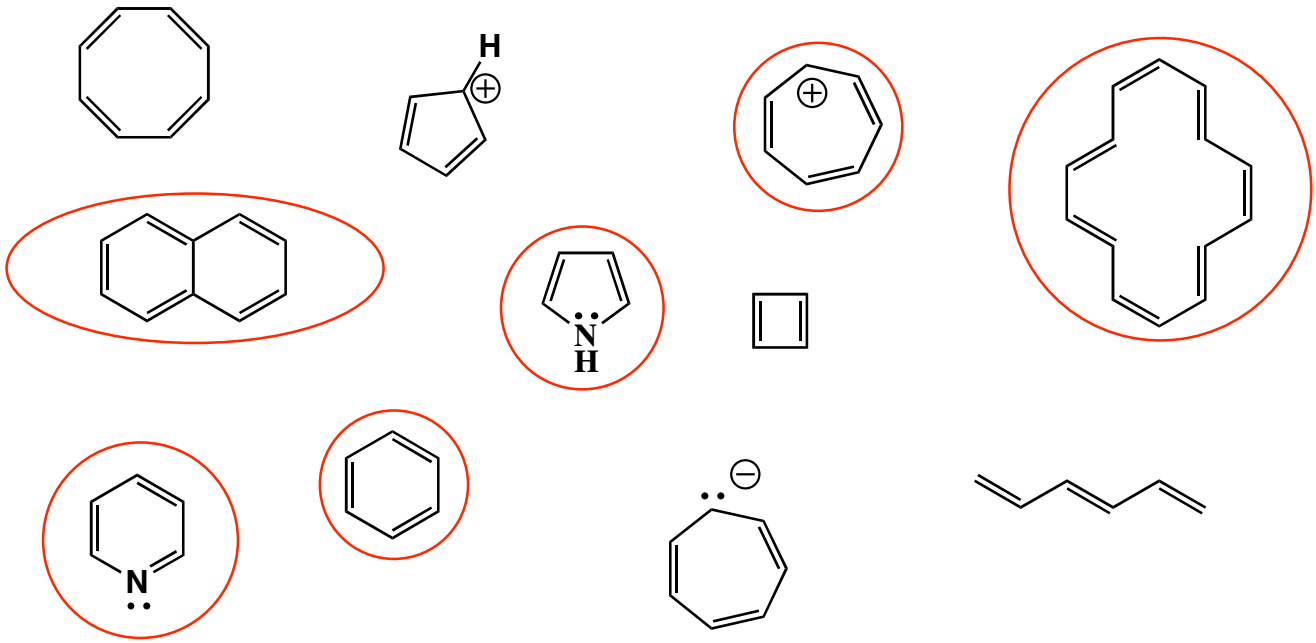
5. (2 pts each answer) Many important properties of molecules depend on the type of hybrid orbital that contains a lone pair. **On the line provided, write the type of orbital that contains the indicated lone pair of electrons.**



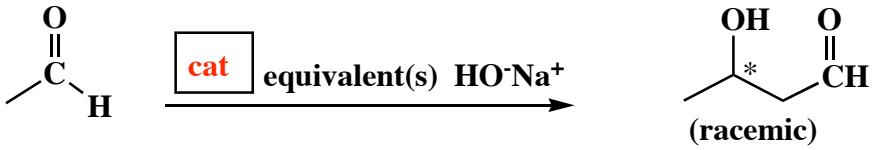
6. (2 pts each) State the hybridization state of the indicated atoms.

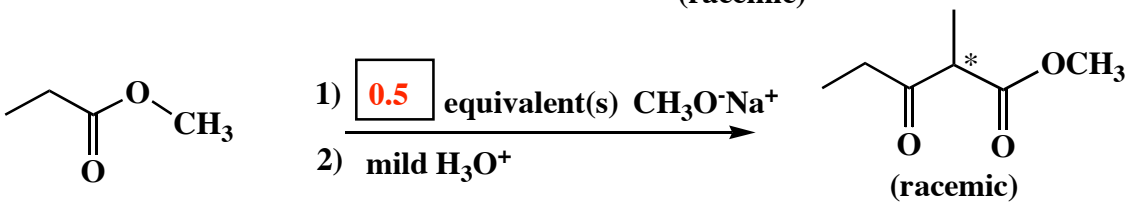


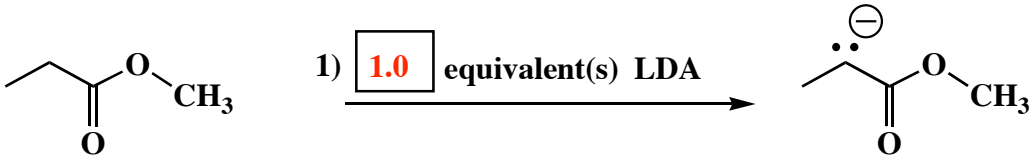
7. (1 pt. each answer) Below, circle all the molecules that can be called aromatic. (Do not make any mark on, around, or beside any molecule below that cannot be considered aromatic.

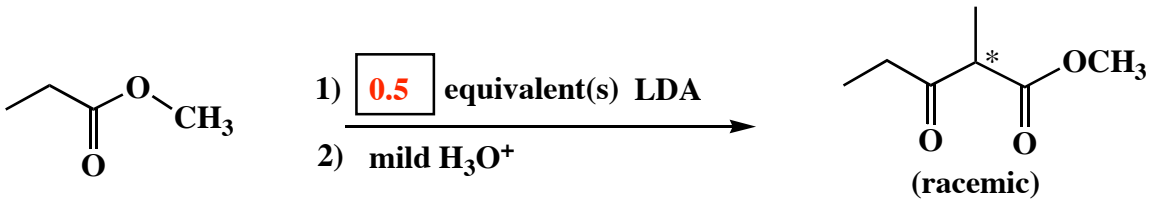


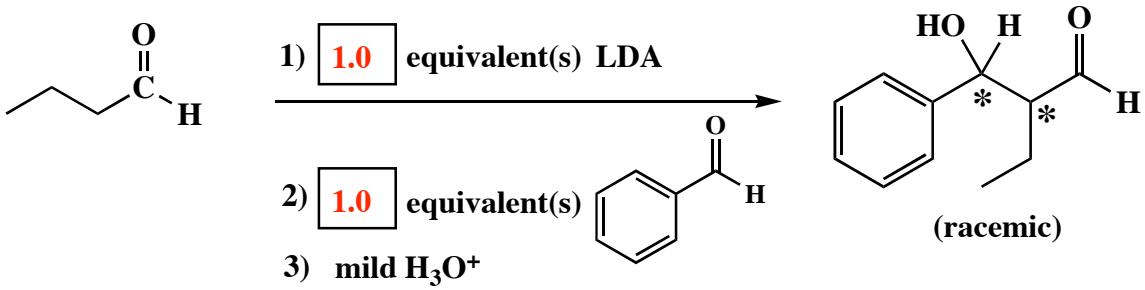
8. (2 pts each) In each of the boxes over an arrow, **write the *minimum* number of equivalents** of the specified reagent required to carry out the reaction shown **to completion**. If only a catalytic amount is needed, write "**CAT**". Note: **You must assume the carbonyl compound starting material is initially present in an amount of 1.0 equivalent.**

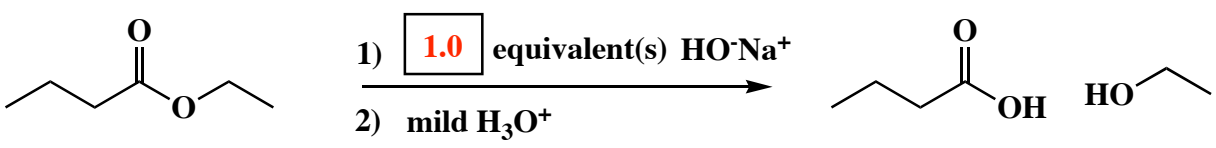
A) 

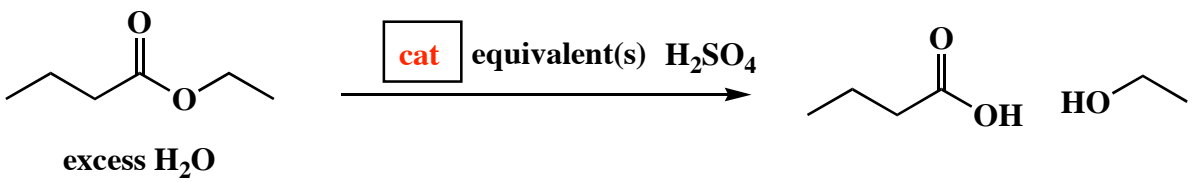
B) 

C) 

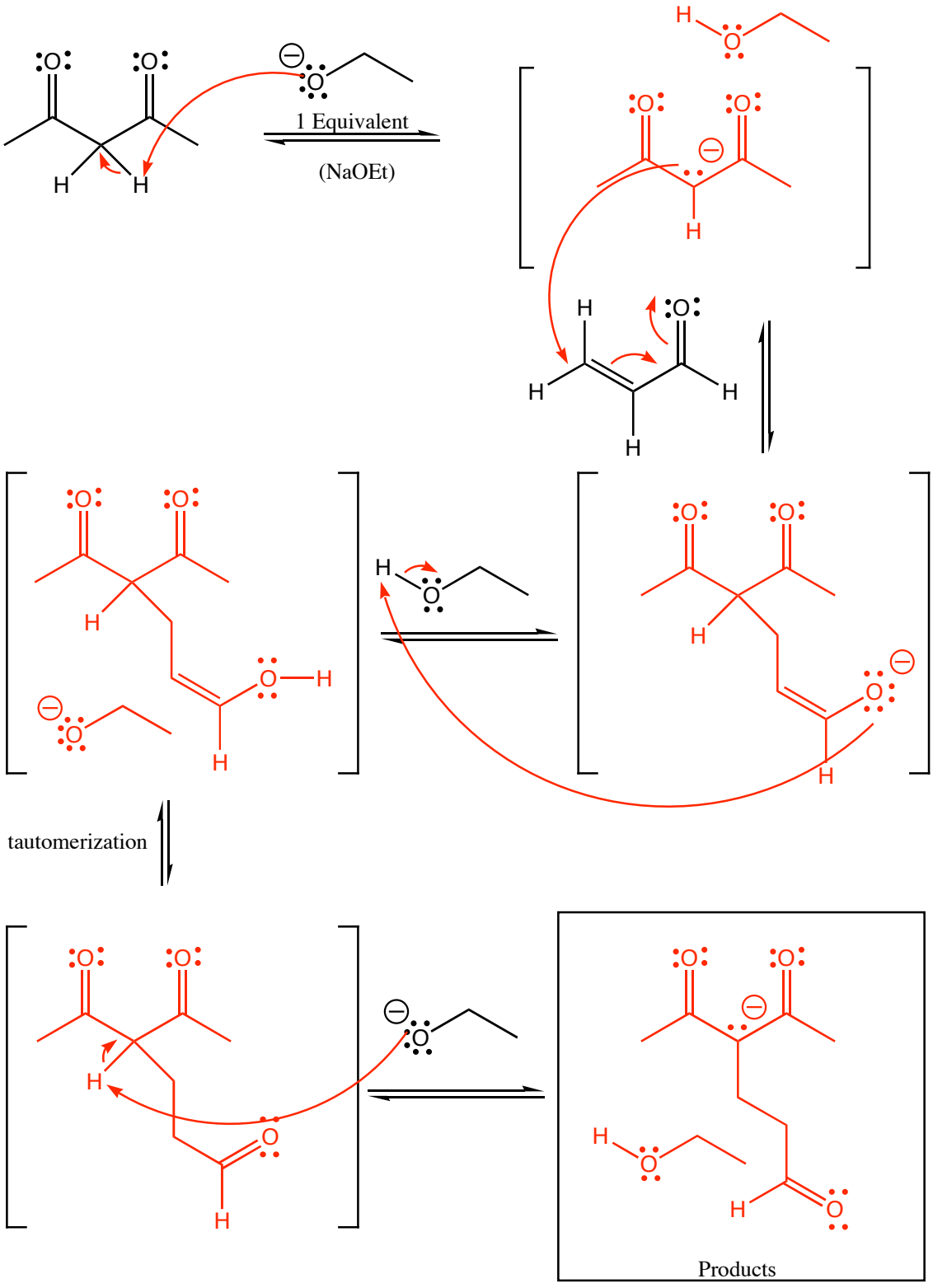
D) 

E) 

F) 

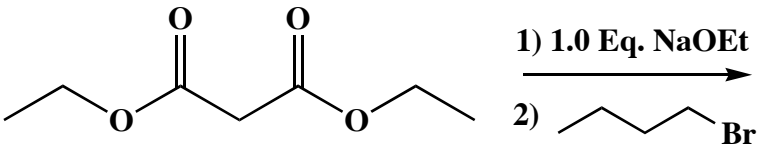
G) 

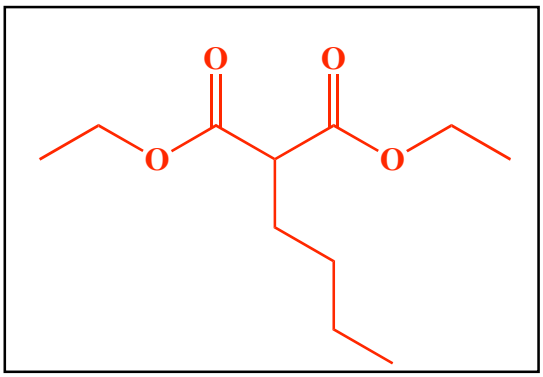
9. (22 pts) Complete the mechanism below that shows a Michael reaction. Use arrows to show the movement of all electrons, and be sure to draw all lone pairs of electrons and all formal charges. If a racemic product is formed, just put an asterisk (*) next to the chiral center and write "racemic" under it.



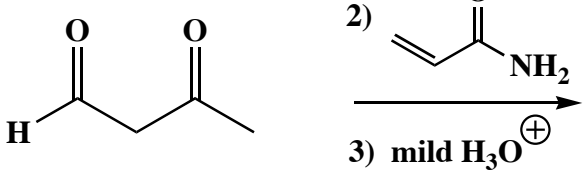
10. (3 or 5 pts each) For the following reactions, draw the predominant product or products. **When a new chiral center is created, mark it with an asterisk (*) and if a racemic mixture is produced, you must write "racemic" under your structure. If an E,Z mixture is produced as the result of a dehydration step, write "E,Z mixture", but you only have to draw one isomer, not both.** These directions are different than you may have seen before, and are intended to make it easier for you. You should read them again so you know what we want.

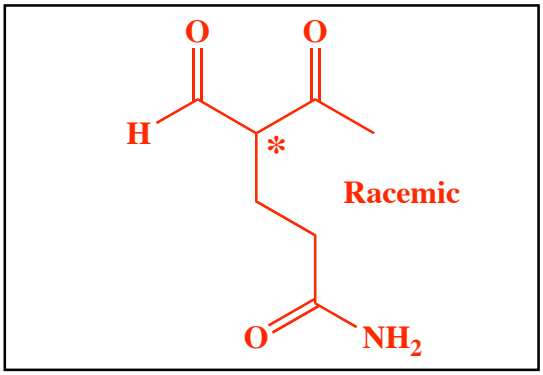
A)



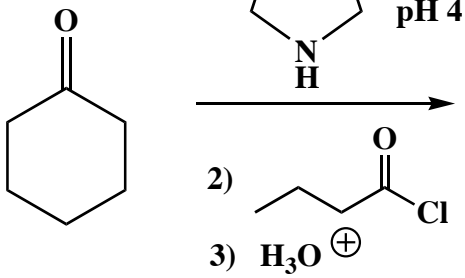


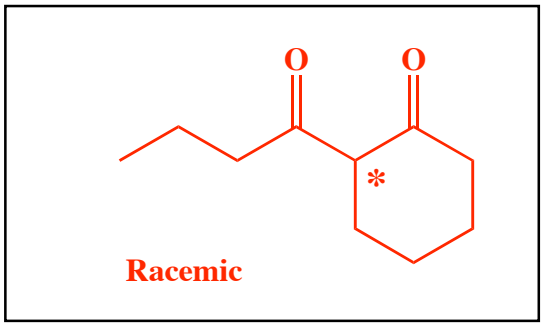
B)



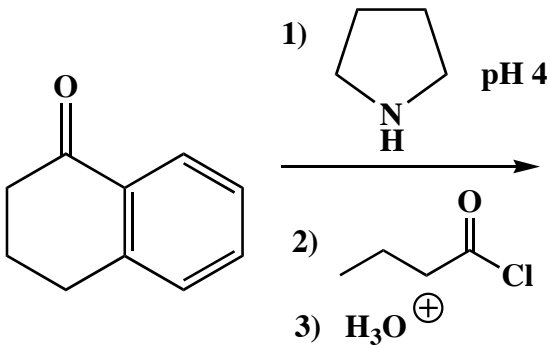


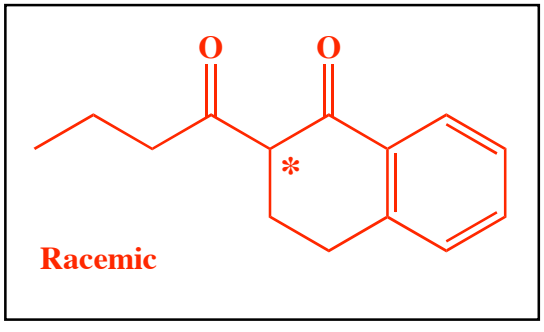
C)





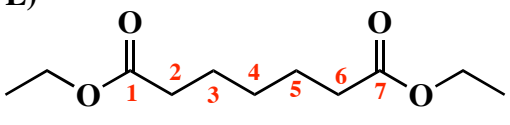
D)



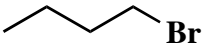


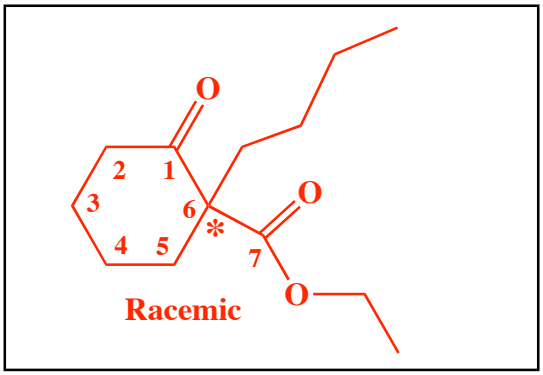
10. (3 or 5 pts each) For the following reactions, draw the predominant product or products. **When a new chiral center is created, mark it with an asterisk (*) and if a racemic mixture is produced, you must write "racemic" under your structure. If an E,Z mixture is produced as the result of a dehydration step, write "E,Z mixture", but you only have to draw one isomer, not both.** These directions are different than you may have seen before, and are intended to make it easier for you. You should read them again so you know what we want.

E)

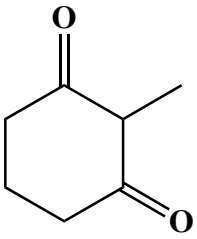


1) 1.0 Eq. NaOEt

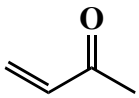
2) 



F)



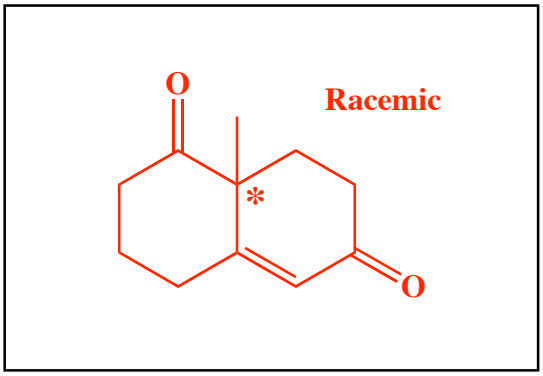
1) catalytic NaOH

2) 

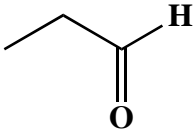
3) $H_3O^{\oplus}$

heat

(assume dehydration takes place)



G)

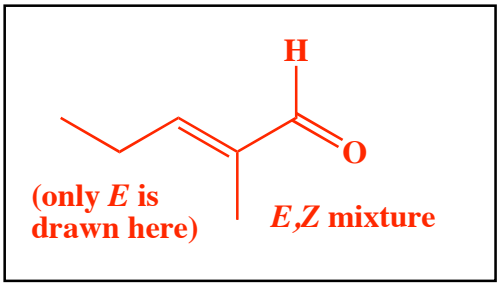


1) catalytic NaOH

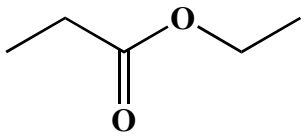
2) $H_3O^{\oplus}$

heat

(assume dehydration takes place)

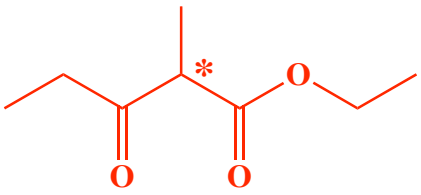


11. (3 or 5 pts each) For the following reactions, draw the predominant product or products. **When a new chiral center is created, mark it with an asterisk (*) and if a racemic mixture is produced, you must write "racemic" under your structure. If an E,Z mixture is produced as the result of a dehydration step, write "E,Z mixture", but you only have to draw one isomer, not both.** These directions are different than you may have seen before, and are intended to make it easier for you. You should read them again so you know what we want.



1) 0.5 Eq. NaOEt

2) mild $H_3O^{\oplus}$



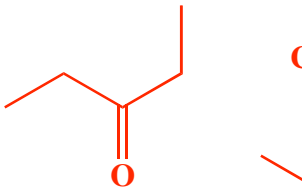
racemic

1) Strong $H_3O^{\oplus}$

2) Heat

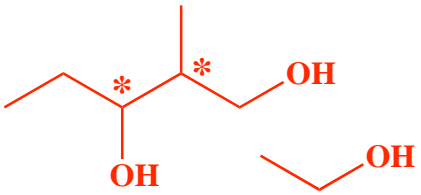
1) Excess $LiAlH_4$

2) mild $H_3O^{\oplus}$



CO_2

Draw all the carbon containing products of the combined steps



racemic

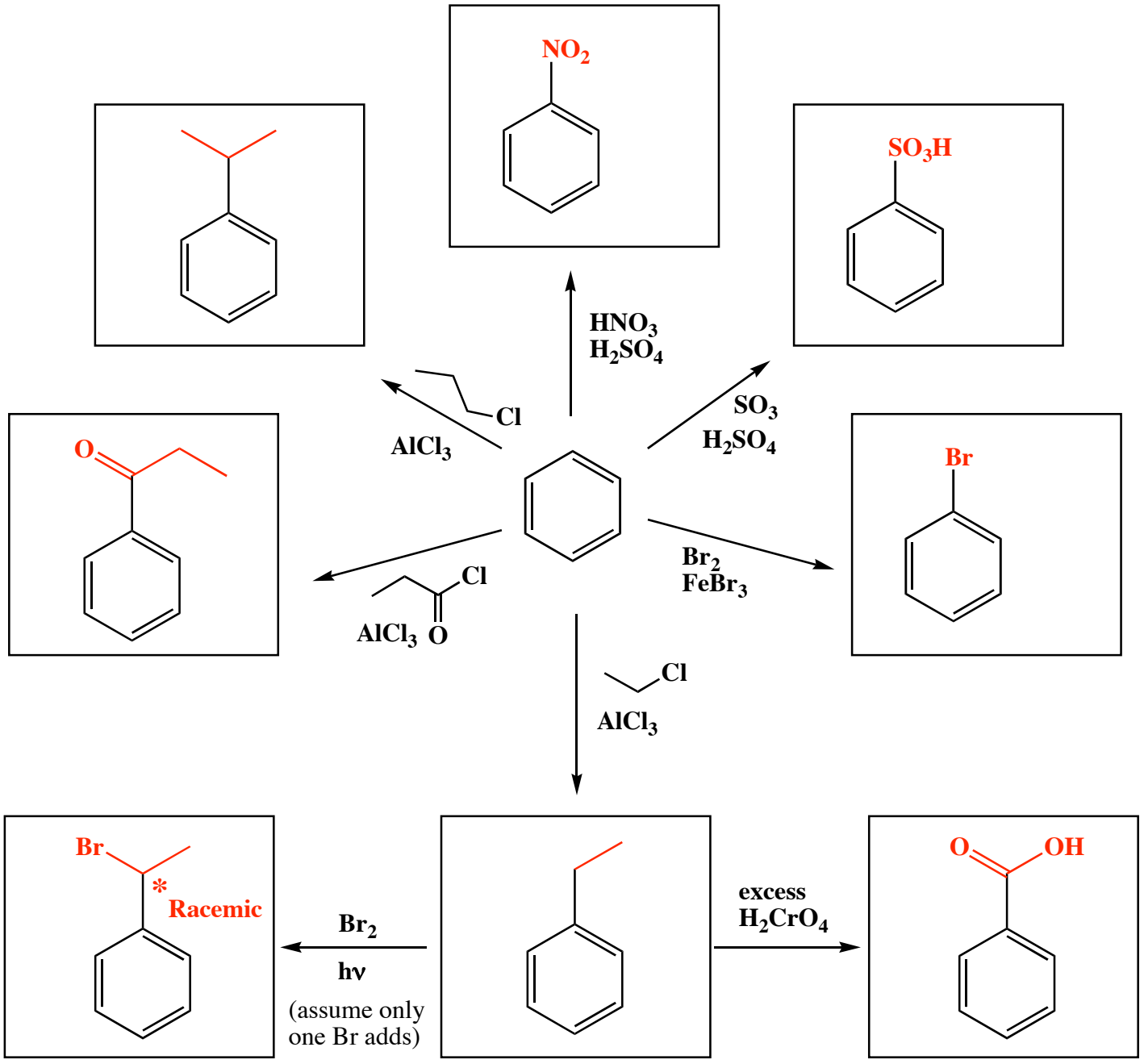
Notice This

(4 pts)

How many stereoismers are there for the largest product in the box immediately above

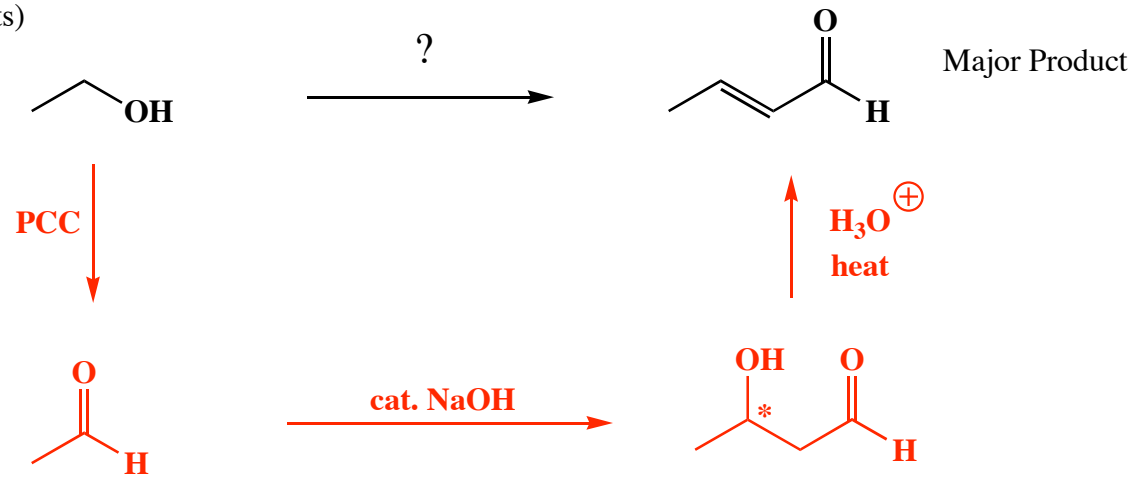
4

10. (3 or 5 pts each) For the following reactions, draw the predominant product or products. **When a new chiral center is created, mark it with an asterisk (*) and if a racemic mixture is produced, you must write "racemic" under your structure. If an E,Z mixture is produced as the result of a dehydration step, write "E,Z mixture", but you only have to draw one isomer, not both.** These directions are different than you may have seen before, and are intended to make it easier for you. You should read them again so you know what we want.

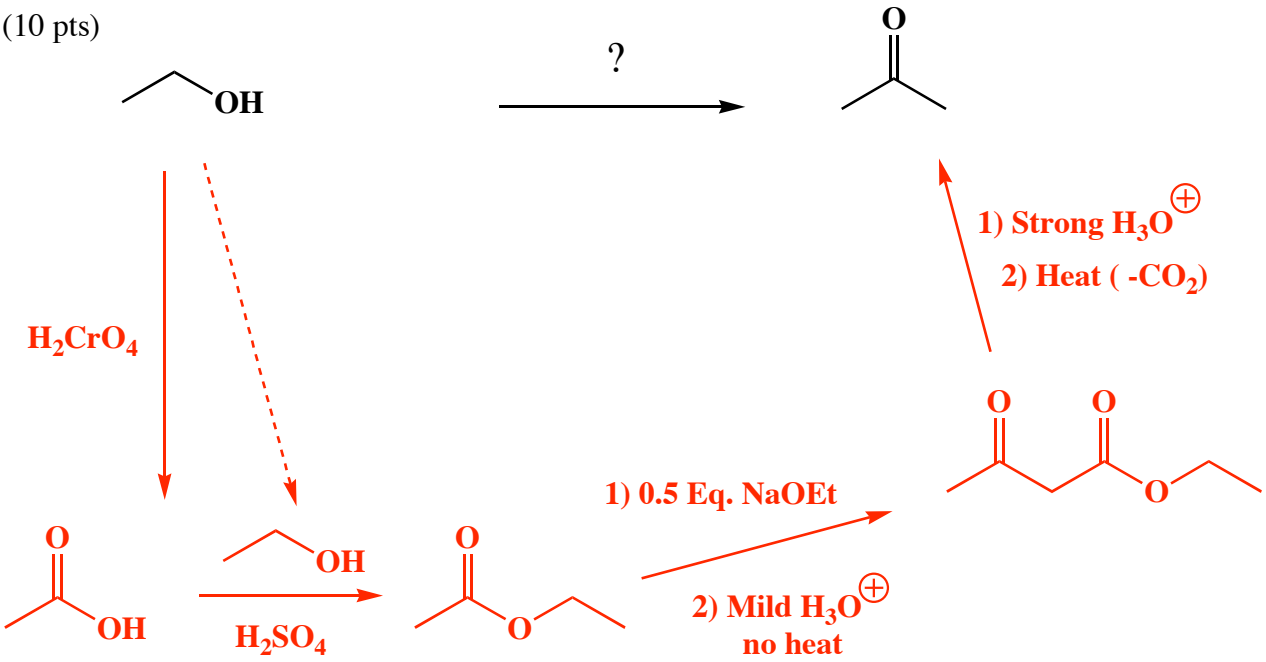


11. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

A) (7 pts)

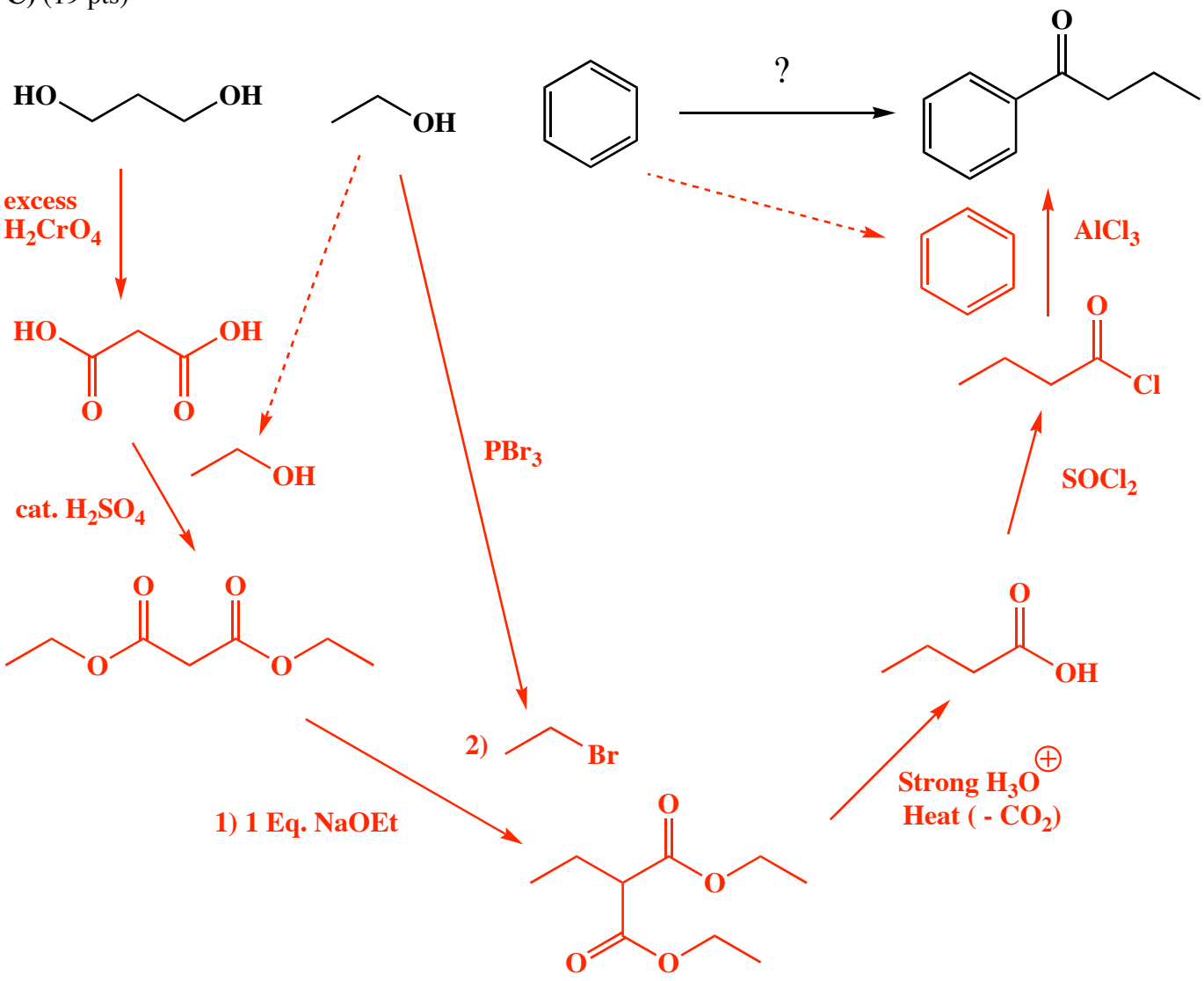


B) (10 pts)



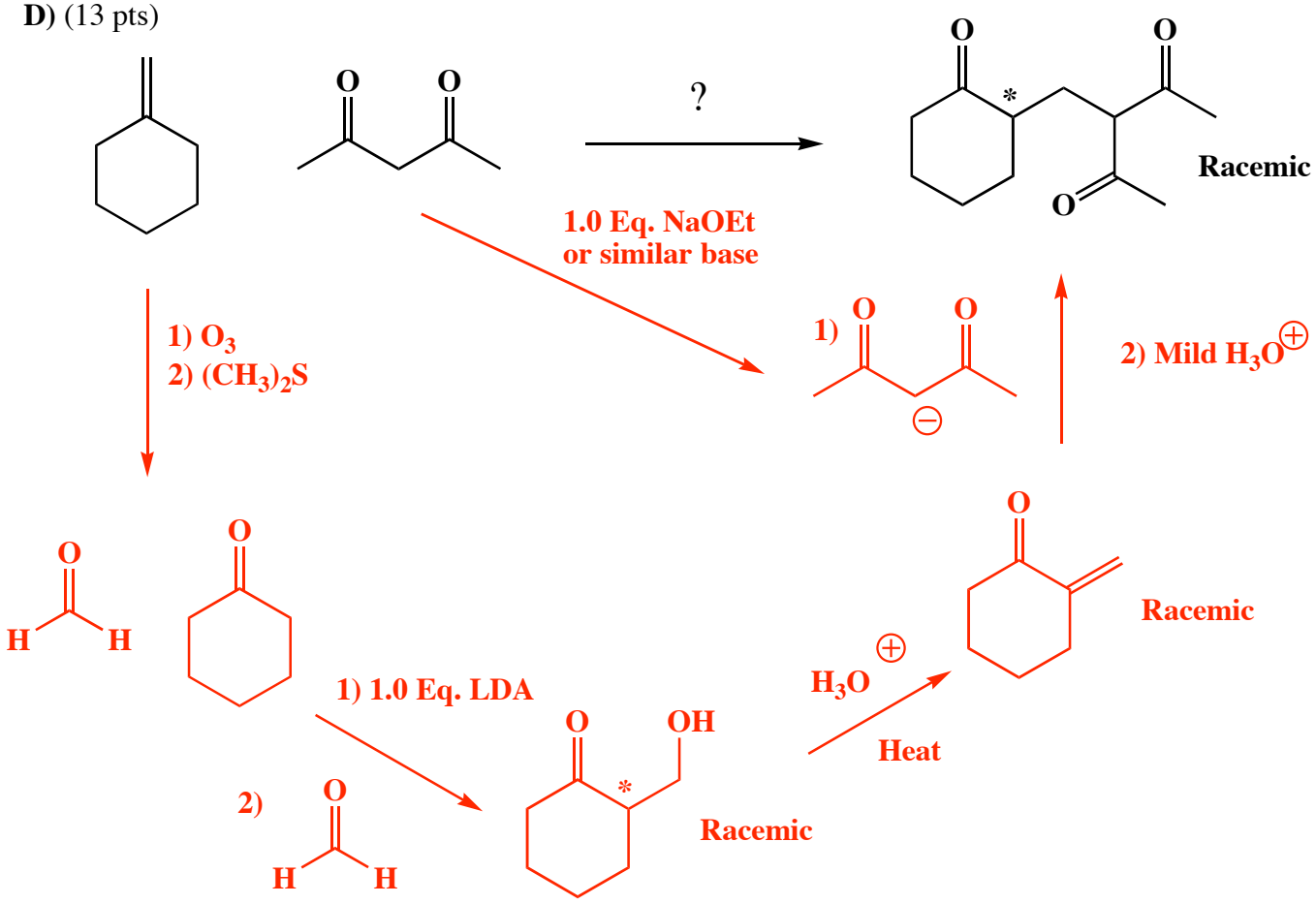
11. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

C) (19 pts)



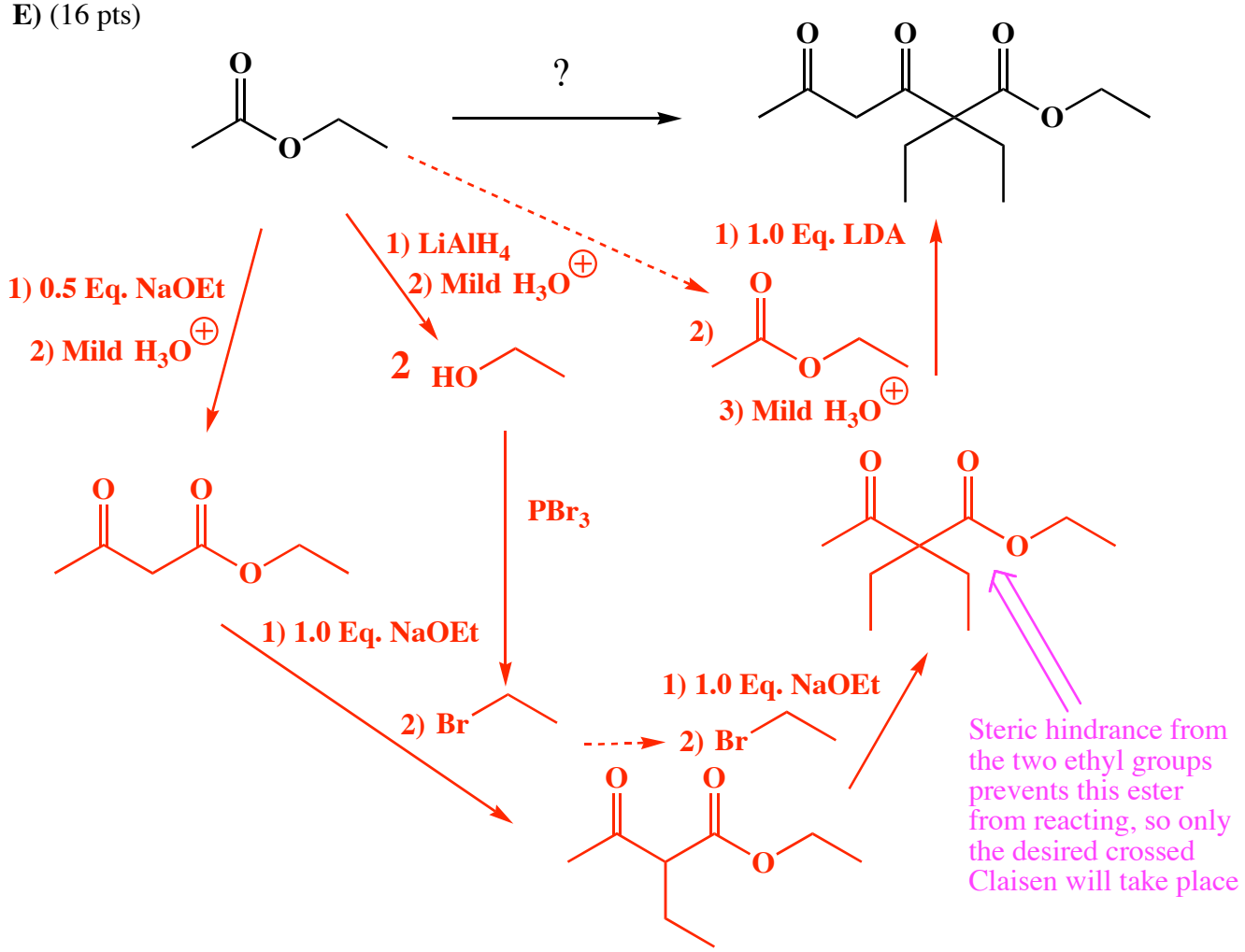
11. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

D) (13 pts)



11. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

E) (16 pts)



NAME (Print): _____

SIGNATURE: _____

Chemistry 310N
Dr. Brent Iverson
3rd Midterm
April 24, 2008

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

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 IS 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!!!!