

NAME (Print): _____

Chemistry 310N
Dr. Brent Iverson
3rd Midterm
April 27, 2006

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!!!!

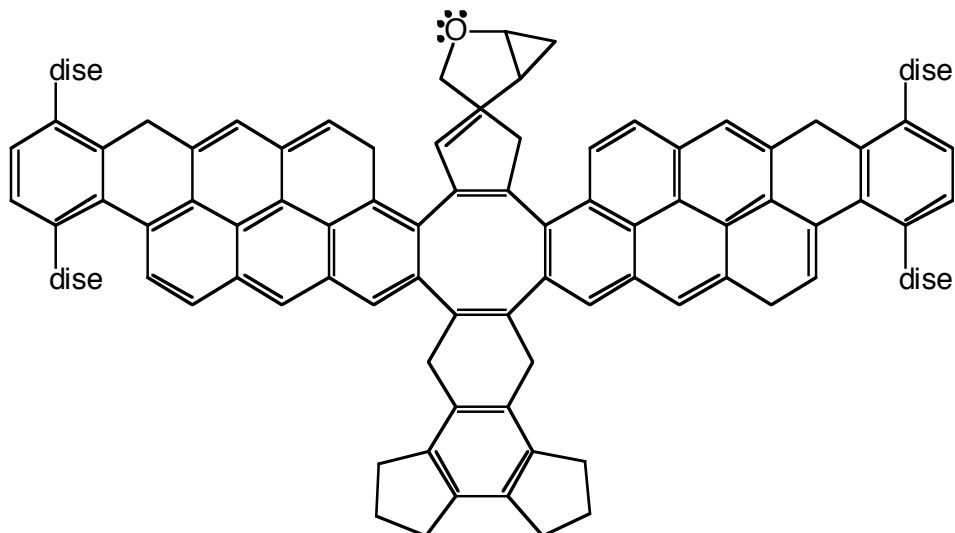
Page	Points
1	(28)
2	(24)
3	(32)
4	(16)
5	(29)
6	(18)
7	(33)
8	(12)
9	(24)
10	(11)
11	(14)
12	(13)
13	(19)
Total	(273)
T Score	

Compound		pK _a
Hydrochloric acid	H-Cl	-7
Protonated alcohol	$\text{RCH}_2\text{OH}_2^{\oplus}$	-2
Hydronium ion	$\text{H}_3\text{O}^{\oplus}$	-1.7
Carboxylic acids	$\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$	3-5
Ammonium ion	$\text{H}_4\text{N}^{\oplus}$	9.2
β-Dicarbonyls	$\text{RC}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CR}'$	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	$\text{RCH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl}$	16
Aldehydes	$\text{RCH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$	18-20
Ketones	$\text{RCH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CR}'$	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	$\text{H}-\text{N}(\text{i}-\text{C}_3\text{H}_7)_2$	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

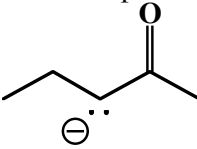
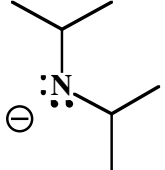
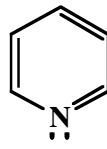
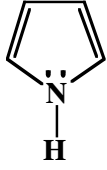
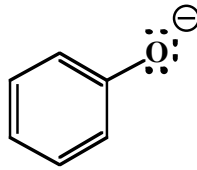
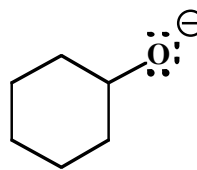
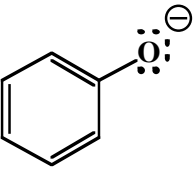
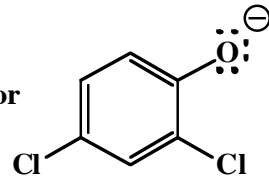
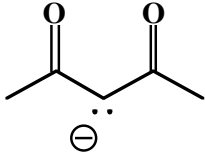
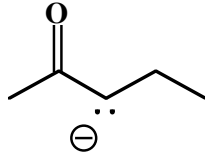
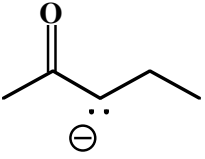
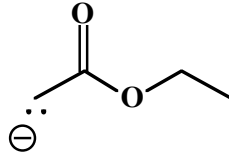
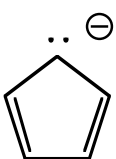
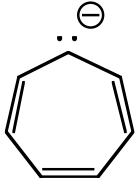
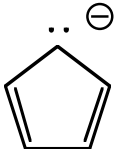

1. (14 points) Suppose a relative of yours is having an MRI. In no more than four sentences, explain to them what is happening when they have the MRI scan. We will be looking for a minimum of 7 key points here.

2. (2 pt. each) Here are a number of statements regarding aromaticity or other general aspects of organic chemistry. 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.	<input type="checkbox"/>	<input type="checkbox"/>
B. According to Huckel's rule, aromatic molecules are flat, monocyclic, all ring atoms have a 2p orbital (no sp ³ ring atoms) and there are 4n + 2 pi electrons (i.e. 2, 6, 10, 14.....).	<input type="checkbox"/>	<input type="checkbox"/>
C. Most reactions you have learned in this class involve nucleophiles reacting with electrophiles.	<input type="checkbox"/>	<input type="checkbox"/>
D. Electrophiles are areas in molecules with relatively high electron density.	<input type="checkbox"/>	<input type="checkbox"/>
E. Nucleophiles are areas in molecules with relatively low electron density.	<input type="checkbox"/>	<input type="checkbox"/>
F. When drawing mechanisms, arrows are used to indicate the flow of electrons from electrophiles to nucleophiles.	<input type="checkbox"/>	<input type="checkbox"/>
G. A strong resonance effect due to aromaticity can stabilize a positive charge, negative charge, or unpaired electron density on atoms attached to an aromatic ring.	<input type="checkbox"/>	<input type="checkbox"/>

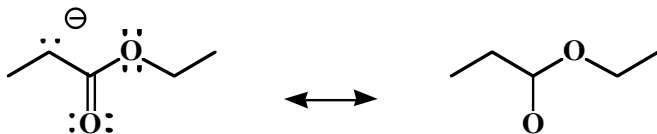
Molecule of the day: The rare central Texas bird of Paradise.

3. (3 pts each) For each pair, circle the molecule that is the **stronger base**. You may refer to the pK_a 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.

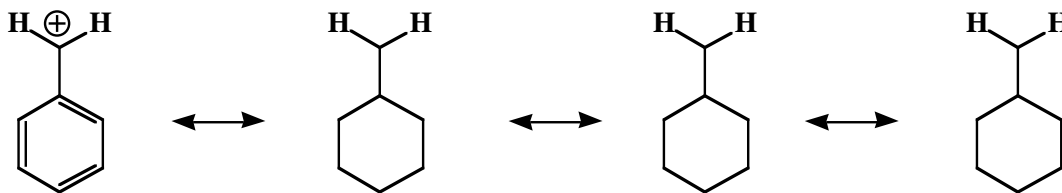
- A)  or  B)  or 
- C)  or  D)  or 
- E)  or  F)  or 
- G)  or  H)  or 

4. (20 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 most important 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.

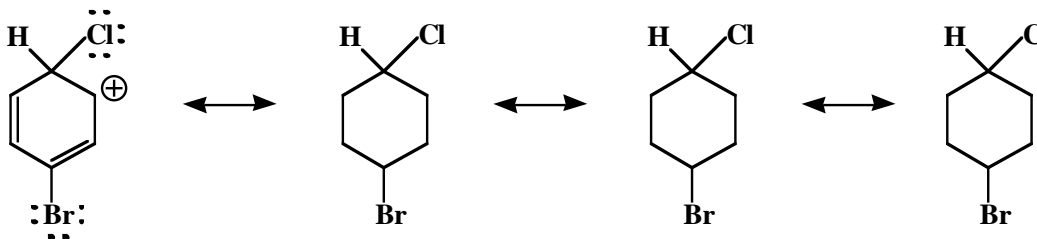
A. An enolate



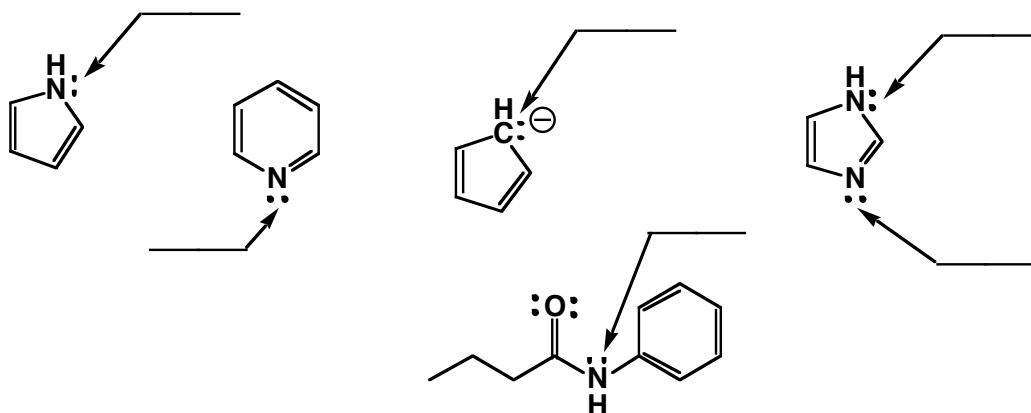
B. The benzyl cation



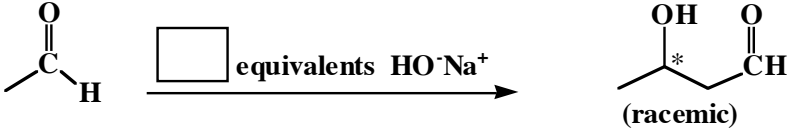
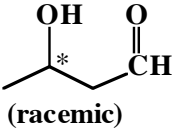
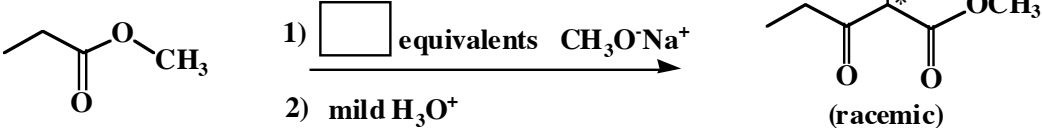
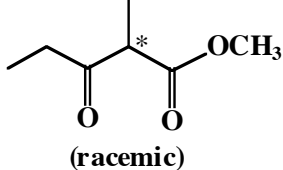
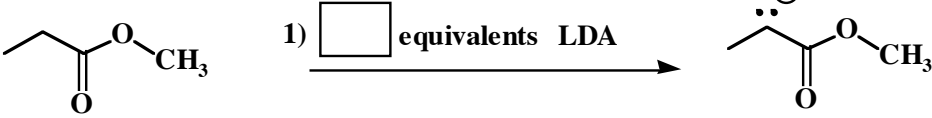
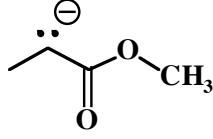
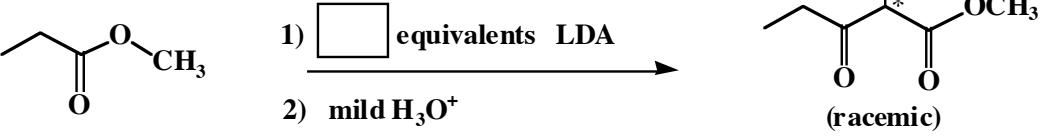
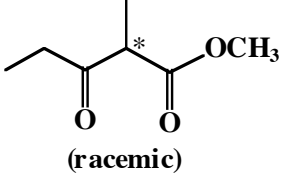
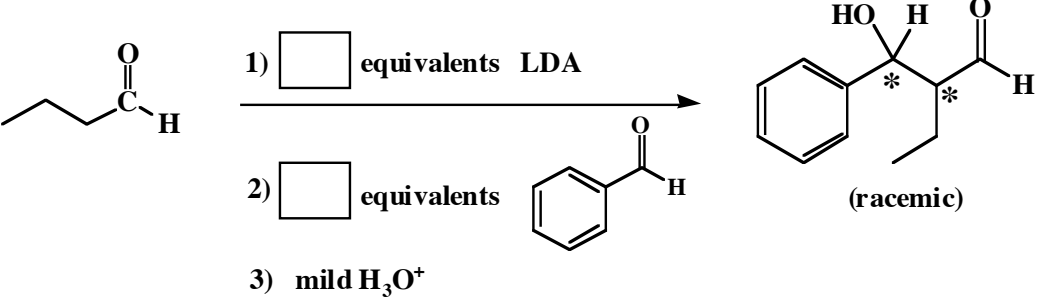
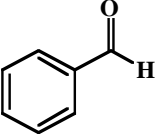
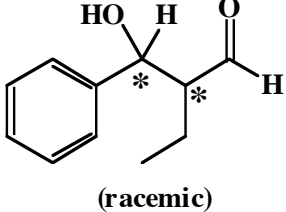

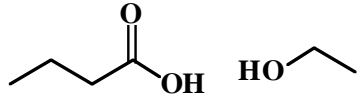
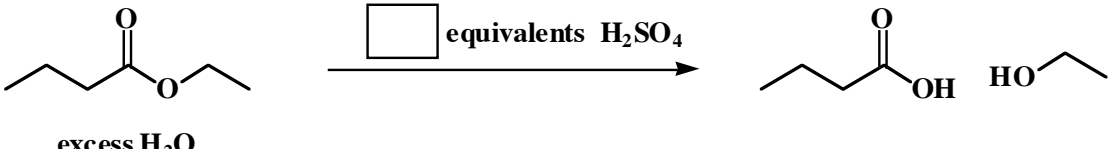
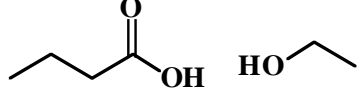
C. An arenium ion



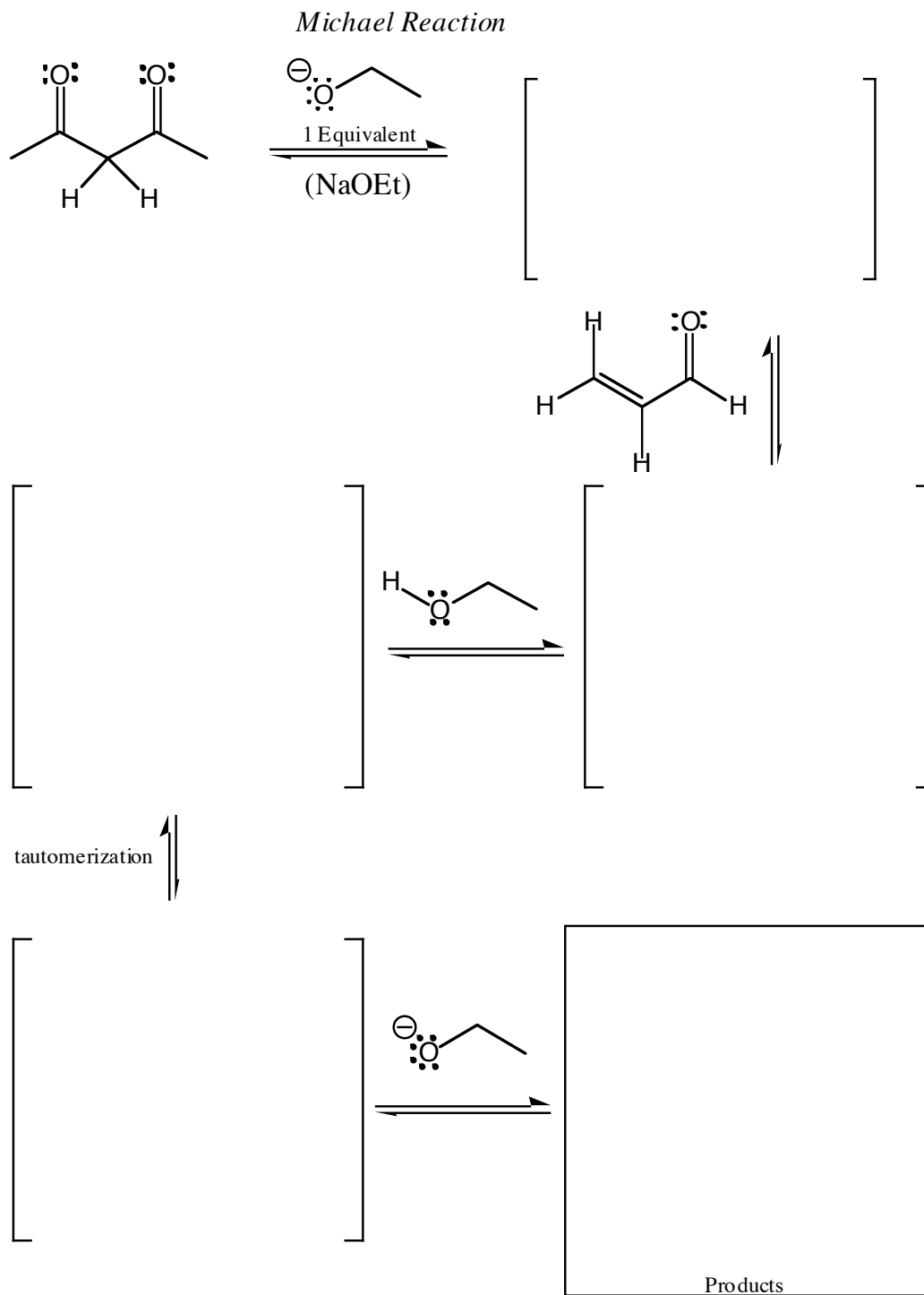
5. (2 pts each answer) Many important properties of molecules depend on the type of hybrid orbital that contains a lone pair. **On the line provided, write the type of orbital that contains the indicated lone pair of electrons.**



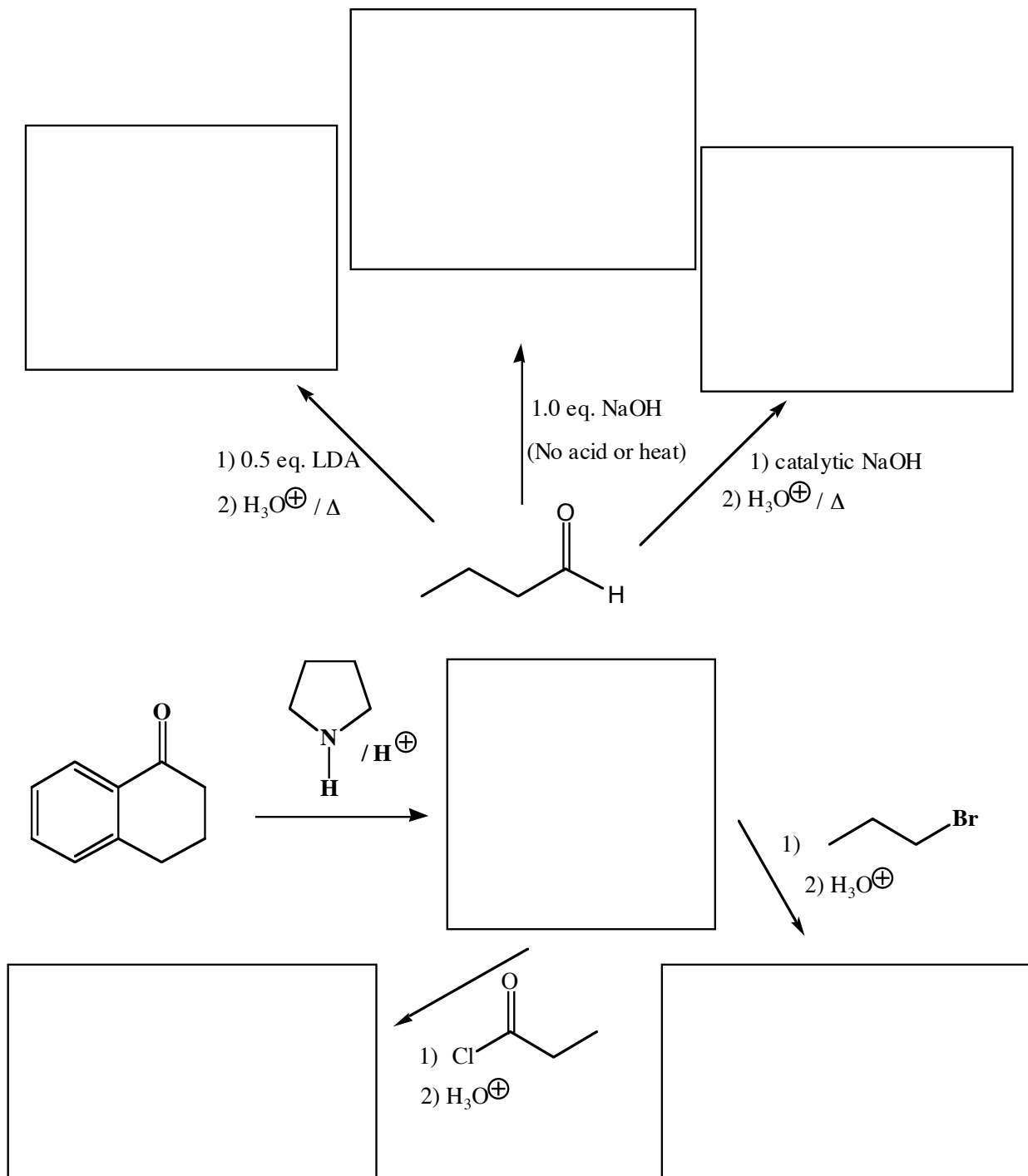
6. (2 pts each) In each of the boxes over an arrow, write the minimum number of equivalents of the specified reagent required to carry out the reaction shown **to completion**. If only a catalytic amount is needed, write "CAT". Note: You must assume the carbonyl compound starting material is initially present in an amount of 1.0 equivalent.

- A)  equivalents HO^-Na^+ 
- B)  1) equivalents $\text{CH}_3\text{O}^-\text{Na}^+$
2) mild H_3O^+ 
- C)  1) equivalents LDA 
- D)  1) equivalents LDA
2) mild H_3O^+ 
- E)  1) equivalents LDA
2) equivalents 
3) mild H_3O^+ 
- F)  1) equivalents HO^-Na^+
2) mild H_3O^+ 
- G)  equivalents H_2SO_4
excess H_2O 

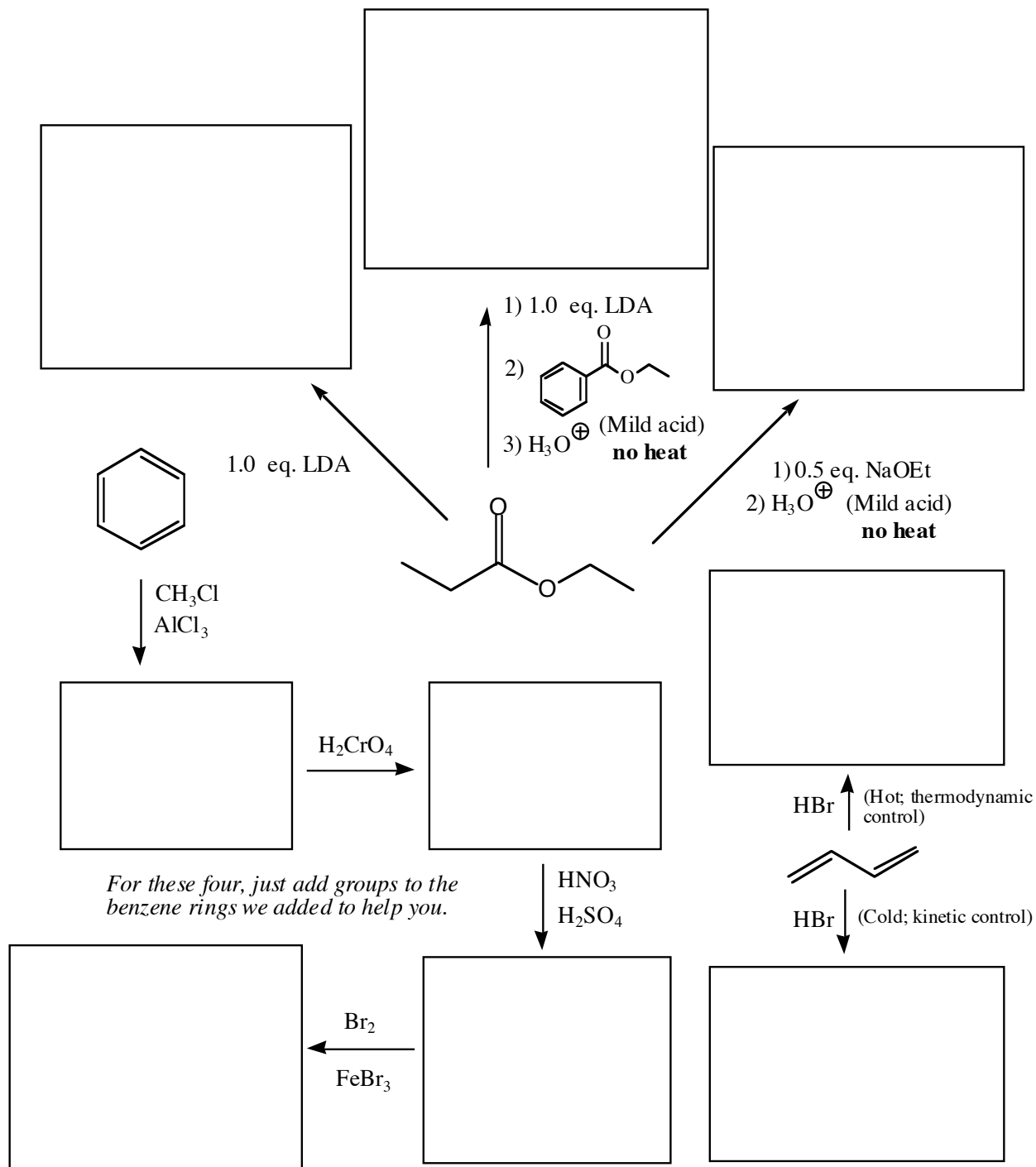
7. (29 pts each) Complete the following mechanism for the Michael reaction. Make sure to show all lone pairs, all formal charges and use arrows to indicate the flow of all electrons. You must draw all products that are made in each step. This should look familiar, as it is identical to the mechanism sheet handed out in class.



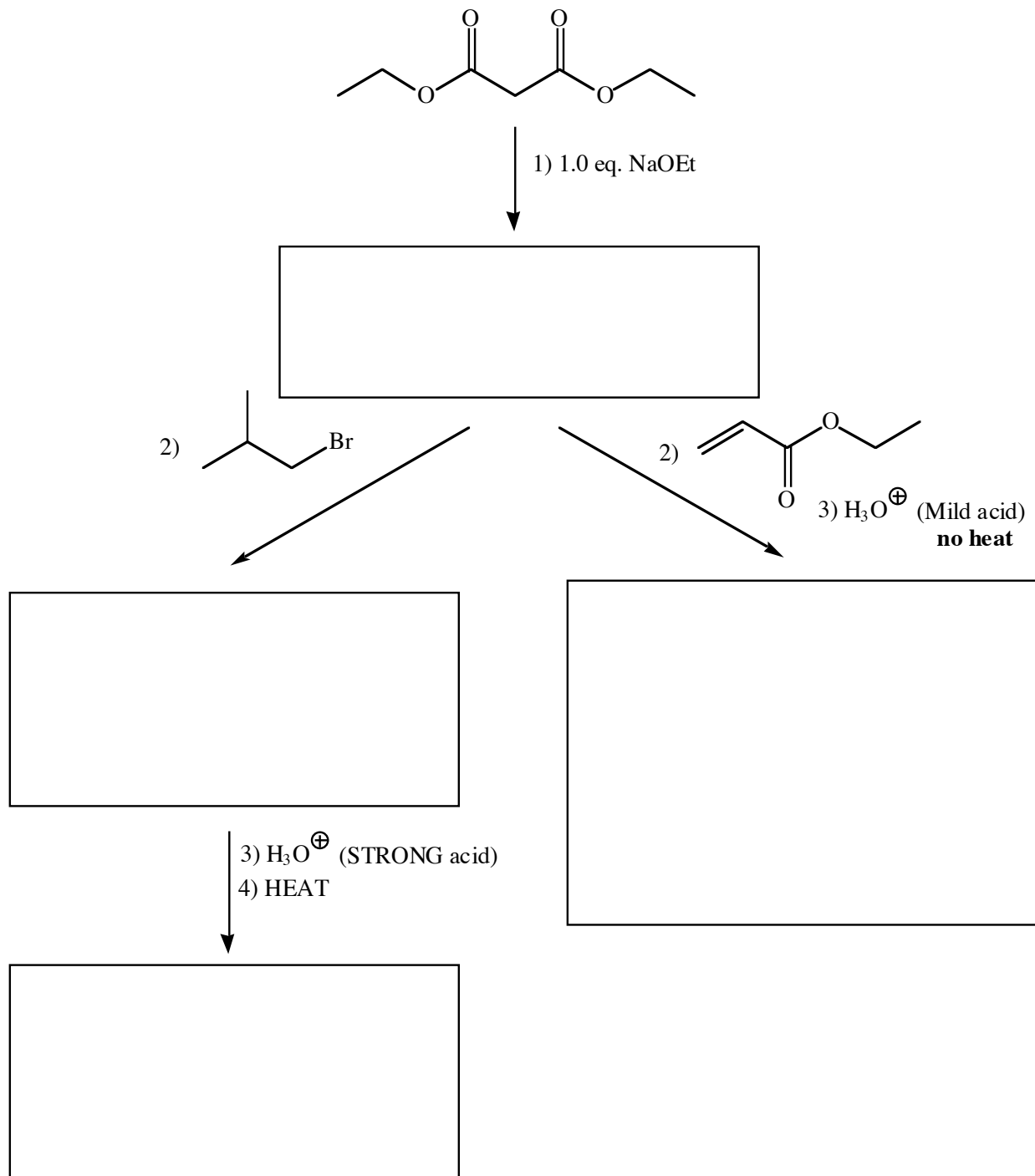
8. (3 or 5 pts each) For the following reactions, draw the predominant product or products. **When a new chiral center is created, mark it with an asterisk (*) and if a racemic mixture is produced, you must write "racemic" under your structure. If an E,Z mixture is produced as the result of a dehydration 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.



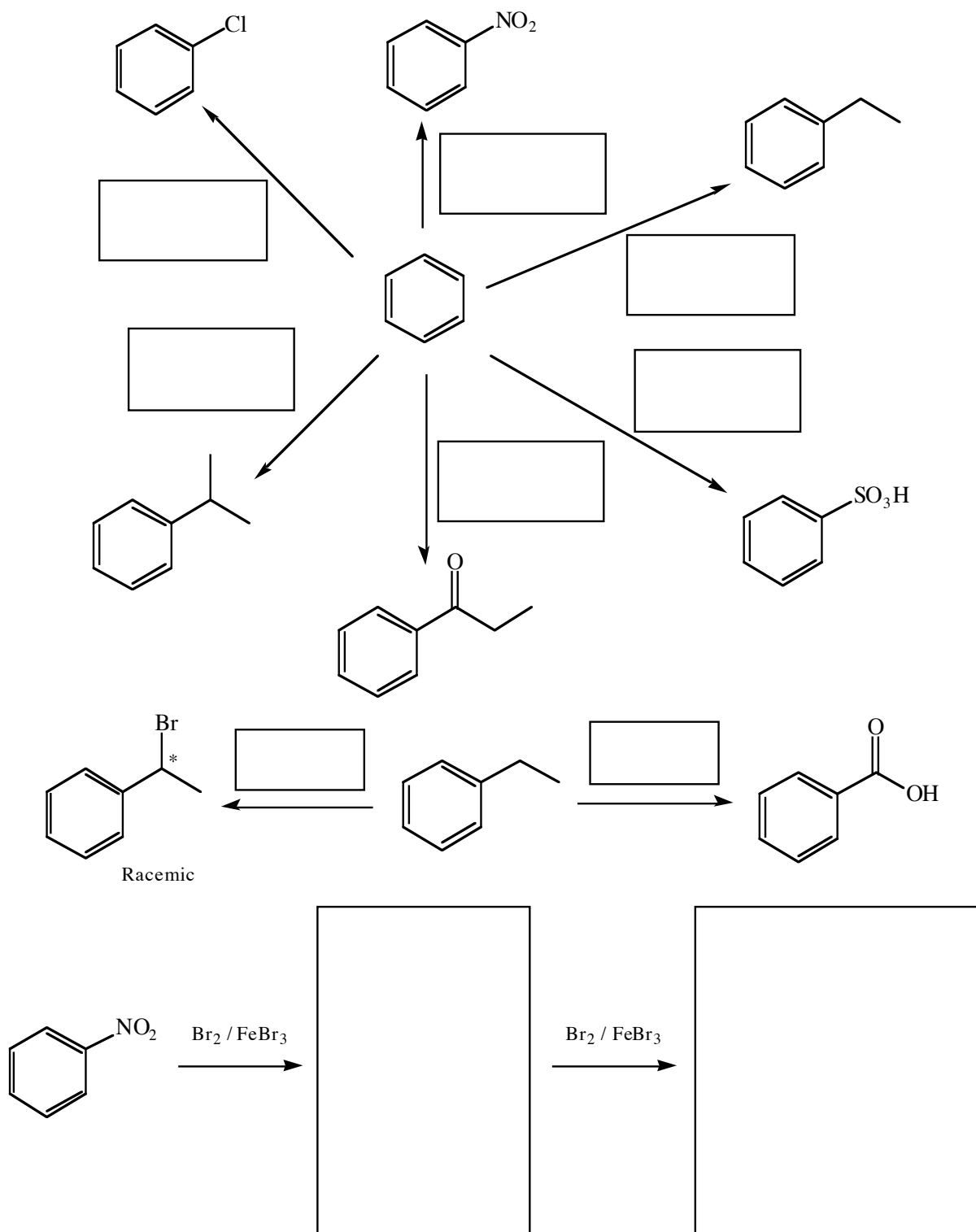
9. (3 or 5 pts each) For the following reactions, draw the predominant product or products. **When a new chiral center is created, mark it with an asterisk (*) and if a racemic mixture is produced, you must write "racemic" under your structure. If an E,Z mixture is produced as the result of a dehydration 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.



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.

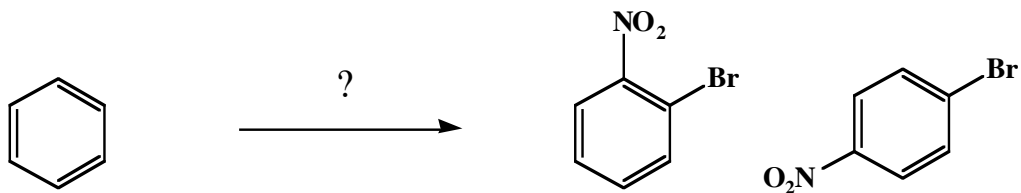


11. (2, 3, or 5 pts each) Fill in the boxes with reagents that will produce the products drawn. For the last one, fill in the products (draw both ortho and para products if that is appropriate).

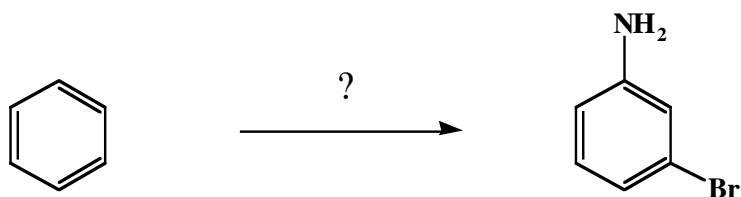


12. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When in doubt, draw the molecule!

A) (4 pts)

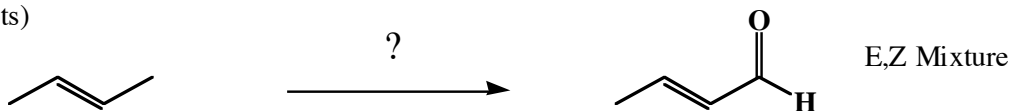


B) (7 pts)

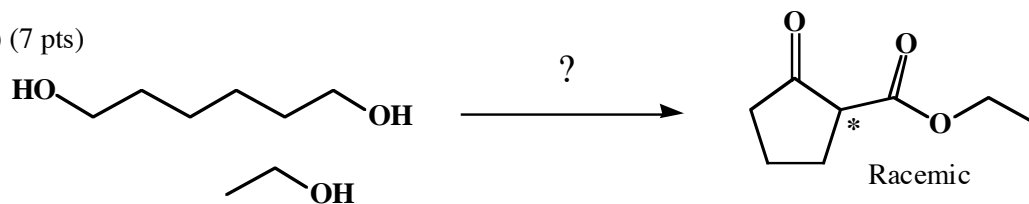


12. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When in doubt, draw the molecule!

C) (7 pts)

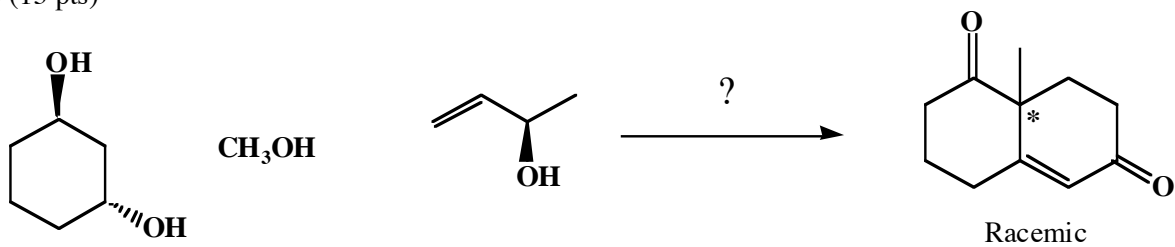


D) (7 pts)



12. Using any reagents turn the starting materials 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 in doubt, draw the molecule!

E) (13 pts)



12. 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 in doubt, draw the molecule!

F) (19 pts)

