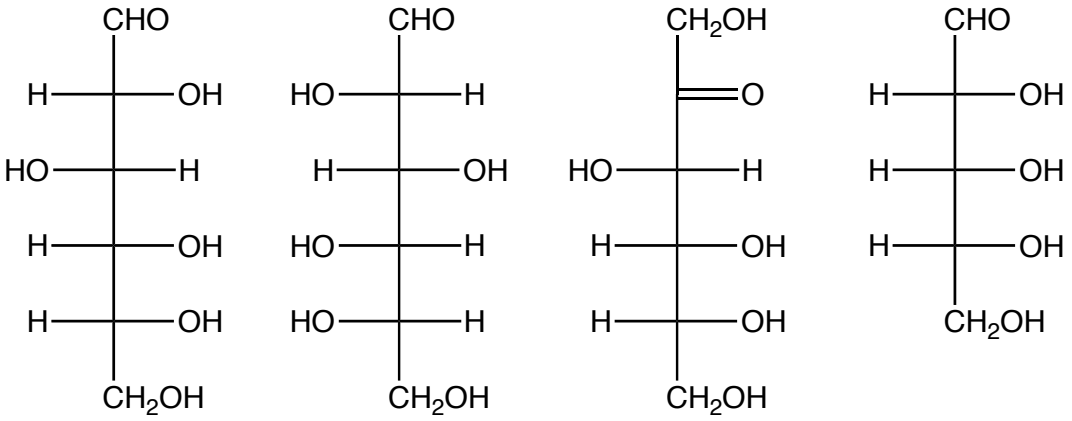
NAME (Print): _____

SIGNATURE: _____

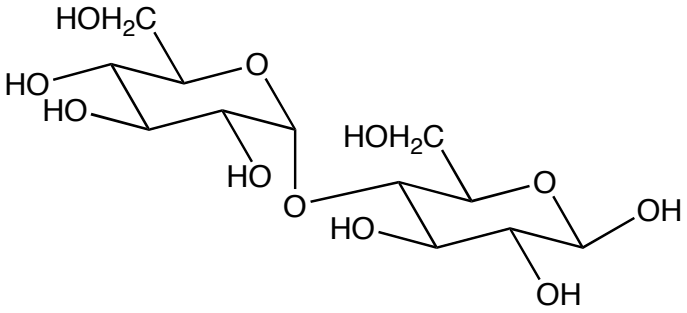
Chemistry 320N
Dr. Brent Iverson
Final Practice
April 20, 2026

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

1. For the following carbohydrates, draw a circle around all of the D-carbohydrate(s), and draw a rectangle around all of the L-carbohydrate(s). On the two first two lines below the four structures, indicate whether each is an aldose or ketose, and whether each is a pentose or hexose, respectively. On the third line below each structure, construct a compound name from all of these elements. For example, answers might be L-ketopentose or L-aldohexose. Finally, on the fourth line under each structure write the specific name (i.e. D-glucose) for each structure. You should use table 25.1 or other structures named in the book to identify these exact sugar names. (You will NOT need to know them for the test).



_____	_____	_____	_____	(aldose or ketose?)
_____	_____	_____	_____	(pentose or hexose?)
_____	_____	_____	_____	(compound name)
_____	_____	_____	_____	(exact name) (look up but don't memorize)

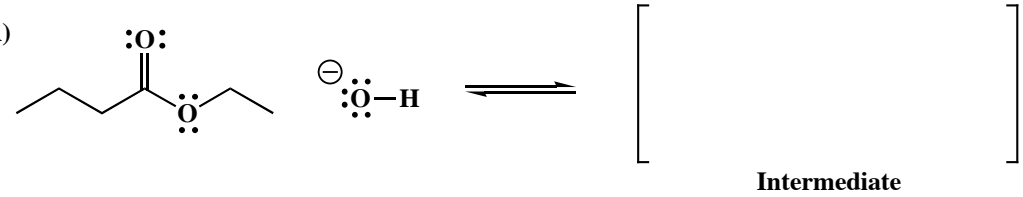


For the disaccharide of glucose on the left, draw a circle around any glucose residue that is/are α. Draw a box around any glucose residue that is/are β. Next, draw a box around the glyocosidic bond linkage. Finally, circle all anomeric carbon atoms.

Describe the above linkage using the terminology presented in class: _____

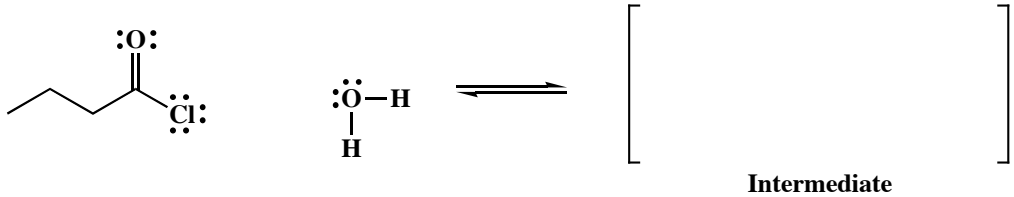
2. Many of the reactions we have learned this semester involve steps with nuclephiles reacting with electrophiles. For the following examples of steps in mechanisms we have seen this semester, 1) Draw the intermediate that will be formed when the two molecules react. 2) Draw all formal charges and lone pairs on the intermediates. 3) Draw arrows on the starting materials to indicate the flow of electrons that leads to the intermediate. 4) Finally, draw a box around the nucleophile and a circle around the electrophile in each case. There is no need to draw products or any further steps of the mechanisms. You might want to read these directions again so you know what we want.

A)



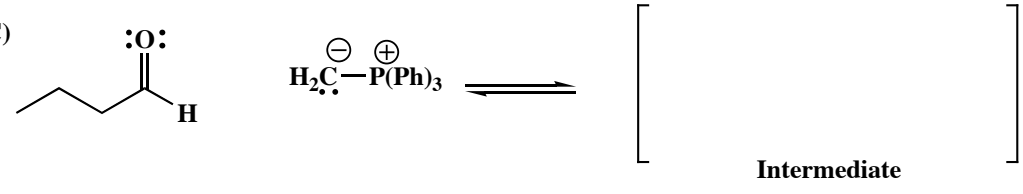
Intermediate

B)



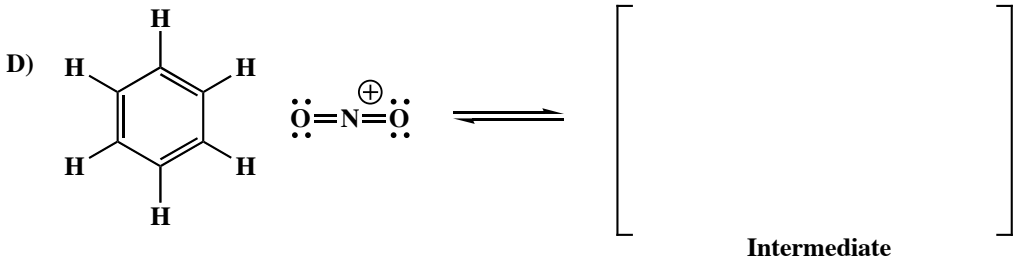
Intermediate

C)



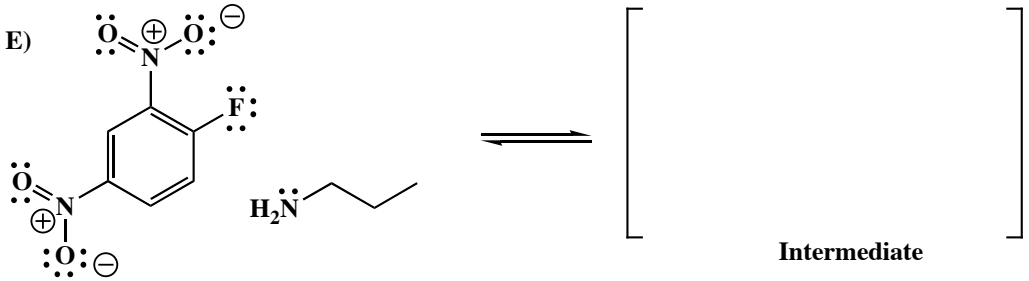
Intermediate

D)



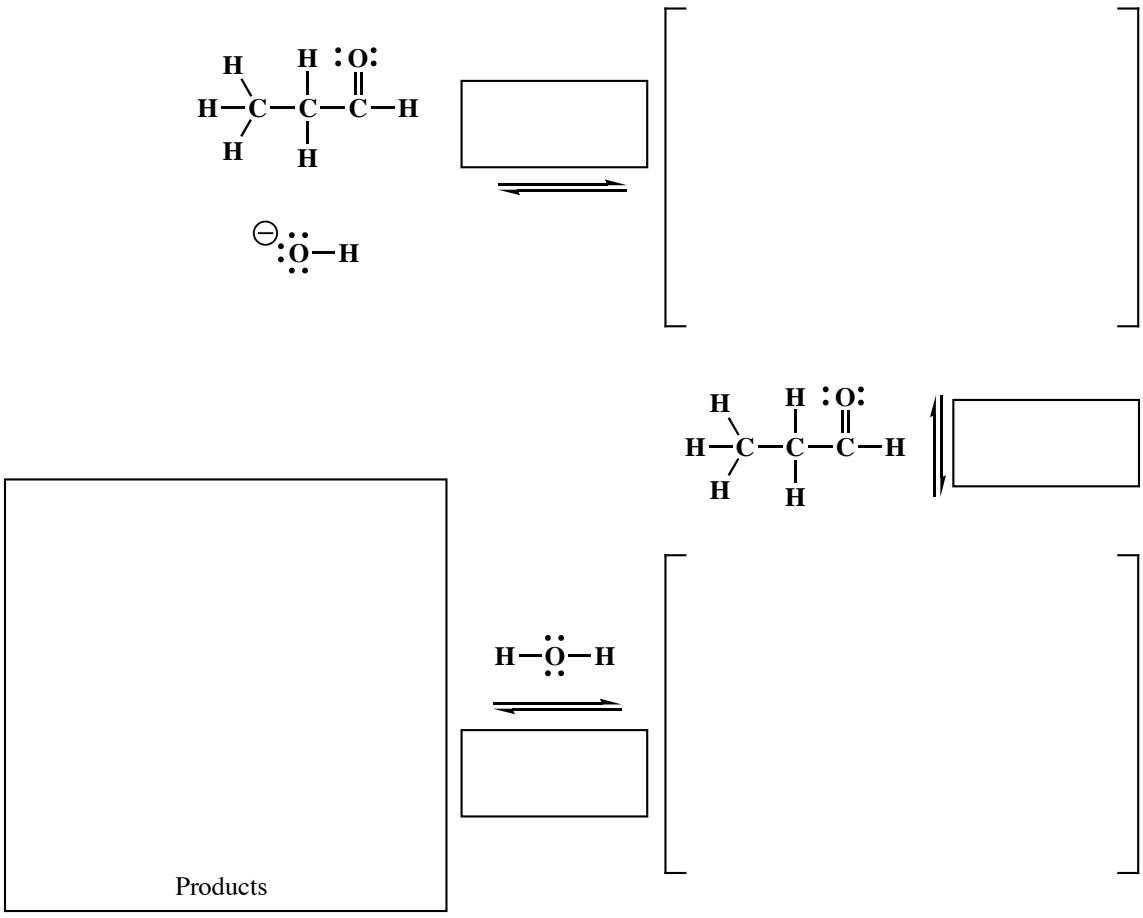
Intermediate

E)

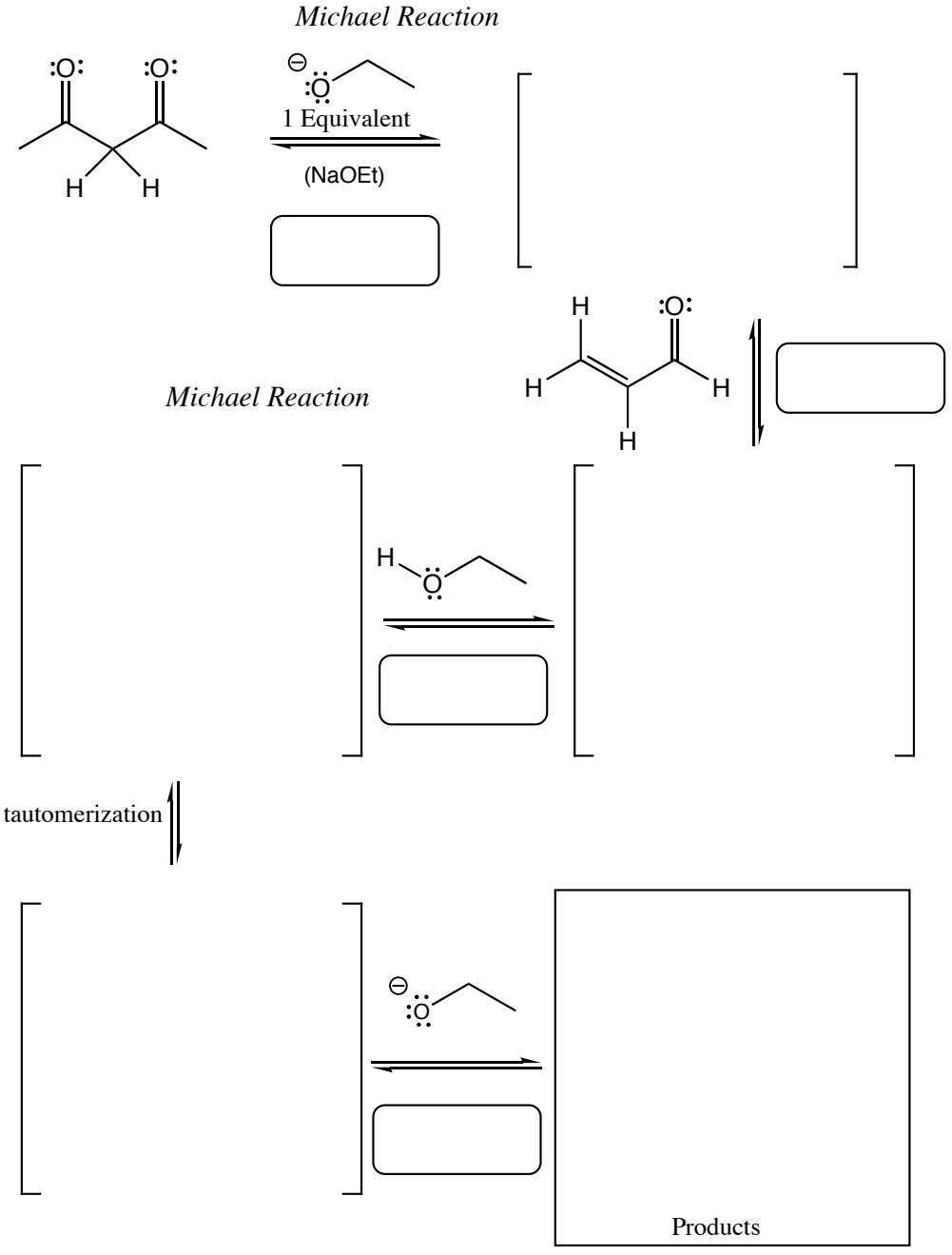


Intermediate

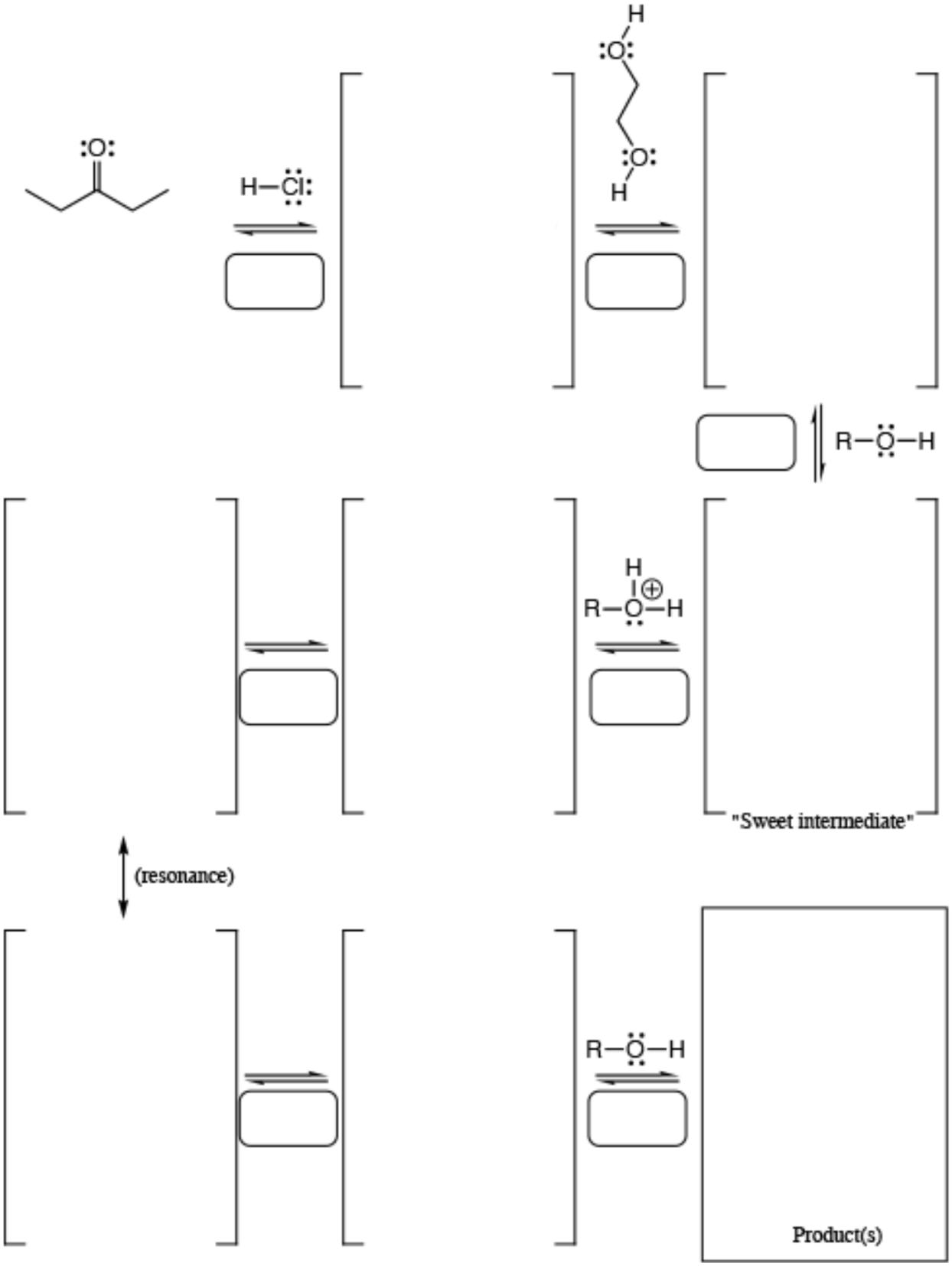
3. Complete the mechanism for the following aldol reaction. Be sure to show arrows to indicate movement of all electrons, write all lone pairs, all formal charges, and all the products for each step. Remember, I said all the products for each step. IF A NEW CHIRAL CENTER IS CREATED IN AN INTERMEDIATE OR THE PRODUCTS, MARK IT WITH AN ASTERISK and WRITE RACEMIC IF RELEVANT. **In the boxes provided adjacent to the first two sets of arrows, write which of the four basic mechanistic elements are involved (i.e. "Make a bond", "Add a proton", etc.)**



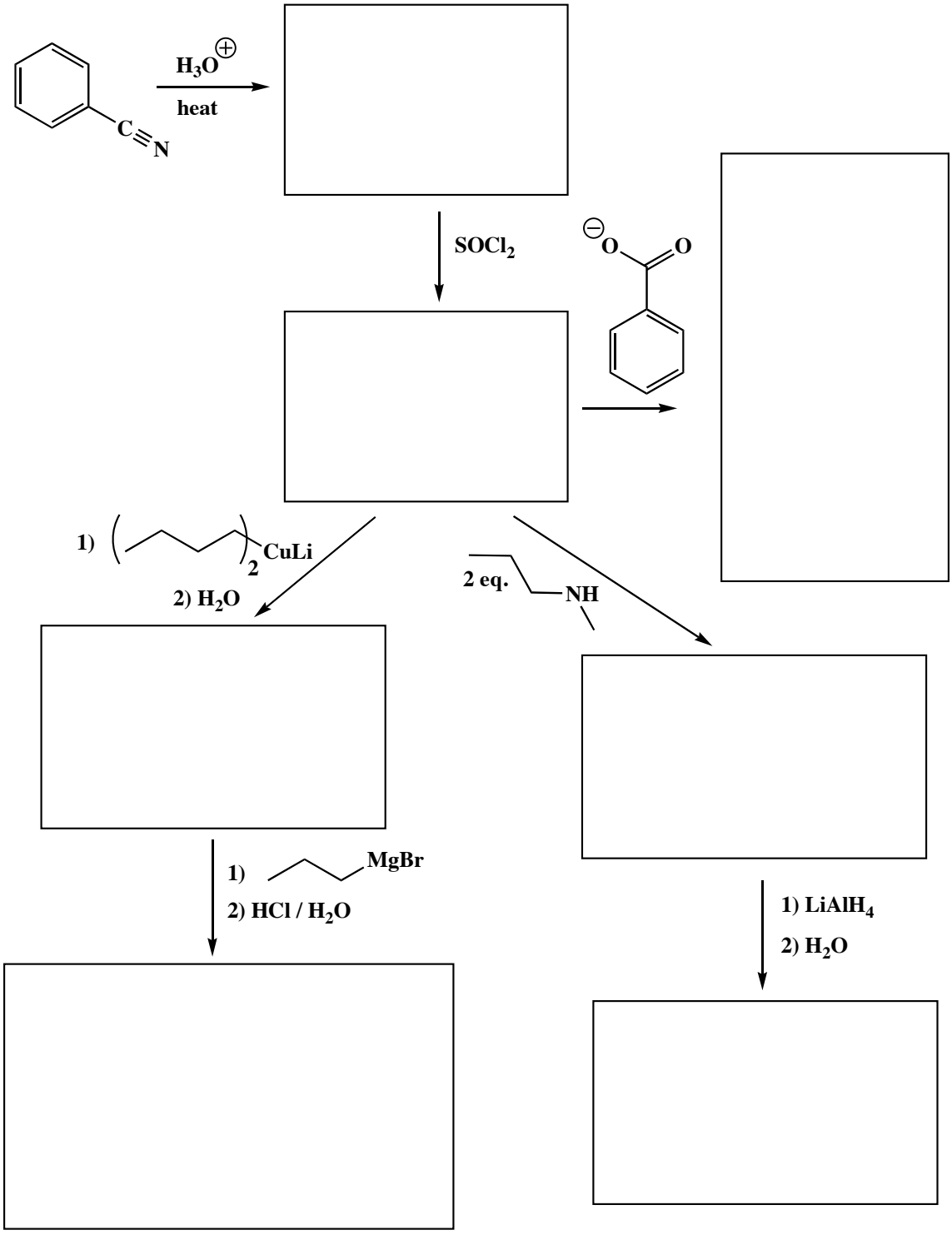
4. Complete the following mechanism for the Michael reaction. Make sure to show all lone pairs, all formal charges and use arrows to indicate the flow of all electrons. You must draw all products that are made in each step. This should look familiar, as it is identical to the mechanism sheet handed out in class. **In the boxes provided adjacent to the arrows, write which of the four basic mechanistic elements are involved (i.e. "Make a bond", "Add a proton", etc.)**



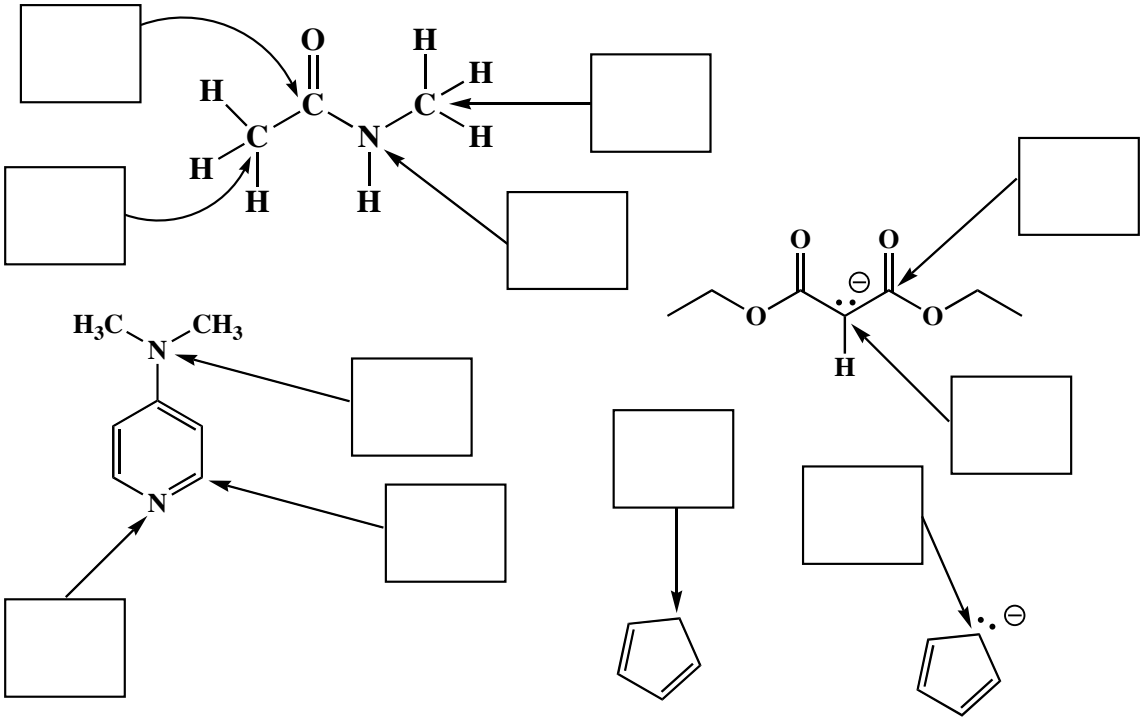
5. Complete the mechanism for the following cyclic acetal formation reaction. Be sure to show arrows to indicate movement of all electrons, write all lone pairs, all formal charges, and all the products for each step. **In the boxes provided adjacent to the arrows, write which of the four basic mechanistic elements are involved (i.e. "Make a bond", "Add a proton", etc.)**



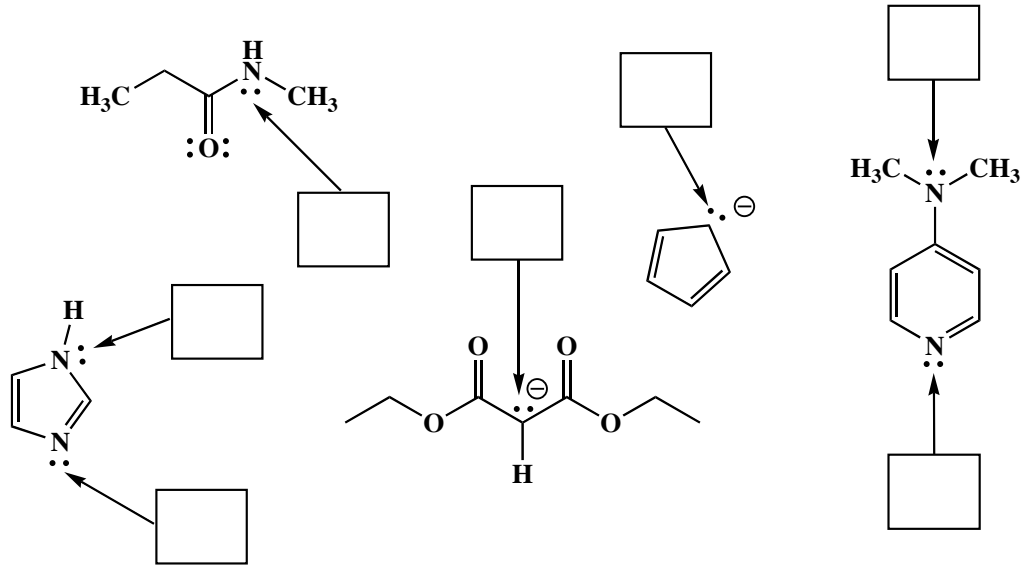
6. Fill in the box with the product or products that are missing from the following chemical reaction equations. When a racemic mixture is formed, you must write "racemic" under both structures EVEN THOUGH YOU DREW BOTH STRUCTURES.



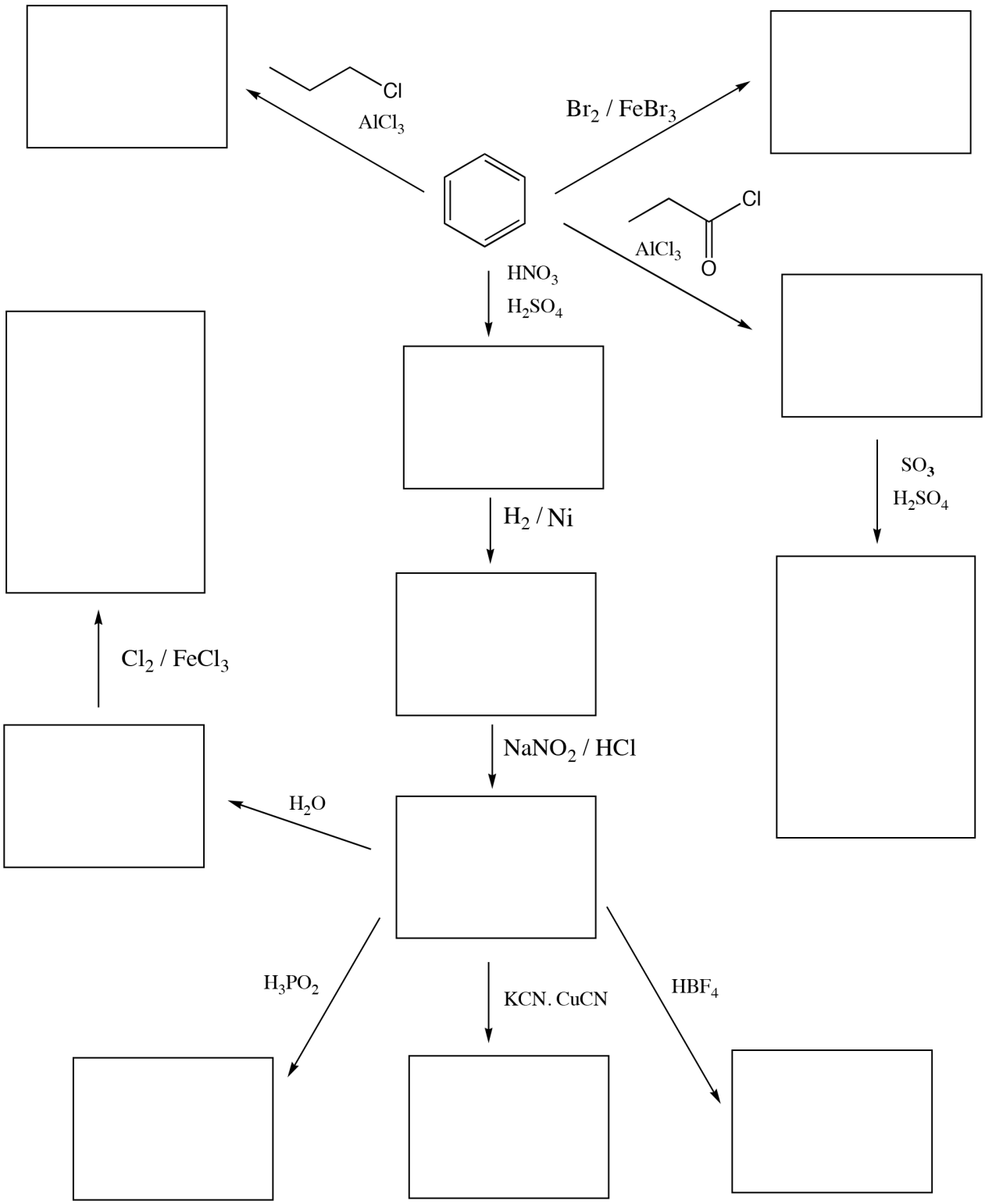
7. In the boxes provided, write the hybridization state of the given atoms.



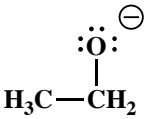
8. In the boxes provided, according to the valence bond approach, write the type of atomic orbital that contains the indicated lone pair of electrons..

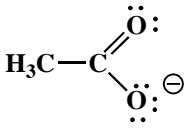


9. Write the predominant product or products that will occur for each transformation. Assume each reagent only adds once to the ring. If predominantly ortho/para products are predicted, you must draw both.



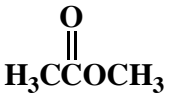
10. A) On the upper lines, rank the following with respect to relative anion stability, with a **1 under the least stable anion** (i.e. most reactive with a proton) and a **4 under the most stable anion** (*i.e.* least reactive with an proton). On the lower lines, rank the following with respect to leaving group ability, with a **1 under the worst leaving group**, and a **4 under the best leaving group**.

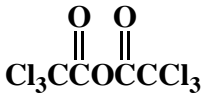


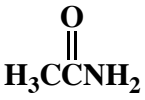


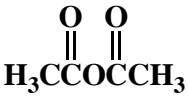
Anion Stability	_____	_____	_____	_____
Leaving Group Ability	_____	_____	_____	_____

B) Rank the following in terms of **relative reactivity with a nucleophile without acid catalysis**. **Place a 1 under the least reactive** and a **4 under the most reactive species**.





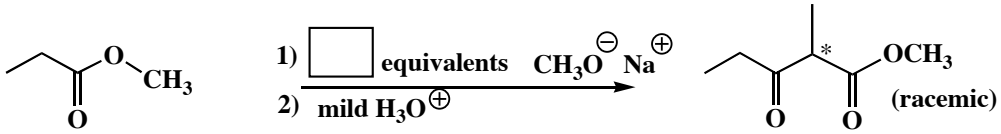




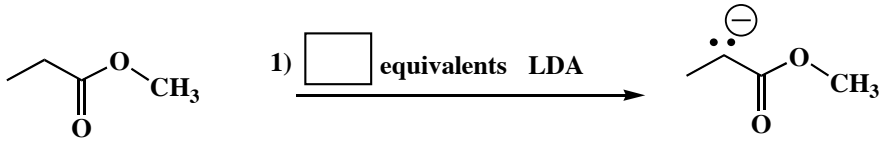
_____ _____ _____ _____

11. 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.**

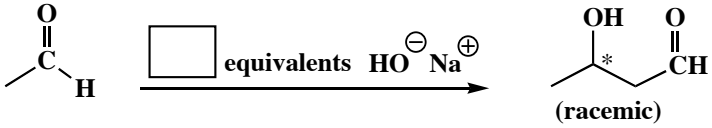
A)



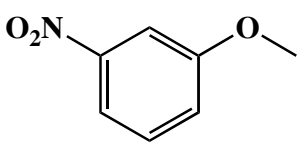
B)



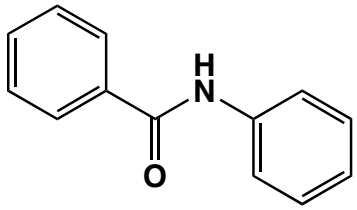
C)



12. You might find these are harder so take your time. Write the predominant product or products that will occur for each transformation. **If a new chrial center is created and a racemic mixture is formed, mark the chiral center with an asterisk "*" and write "racemic" under the structure. If ortho/para products are made, you must draw both. Note, for this problem, aldols can dehydrate if heated in dilute acid.**

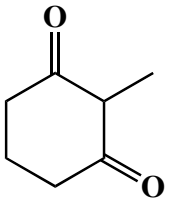


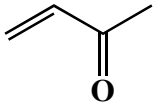
Br_2 / $FeBr_3$ →



Br_2 / $FeBr_3$ →

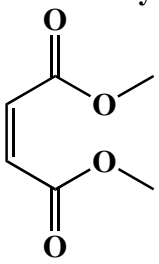
Assume only one Br atom adds



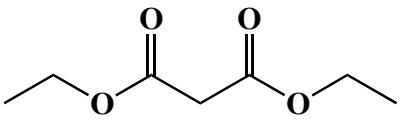


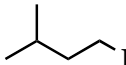
cat. NaOH
heat →

Be sure to indicate stereochemistry of the products on this next one.



→

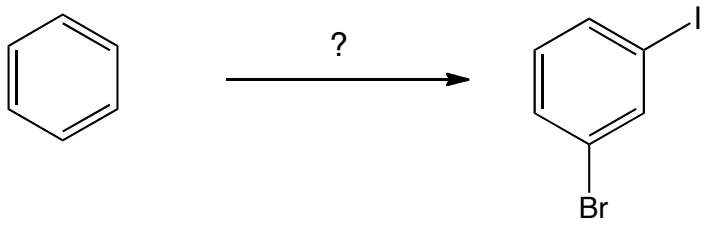


1) 1.0 Eq. NaOEt
2) 

→
3) $H_3O^{\oplus}$ / heat

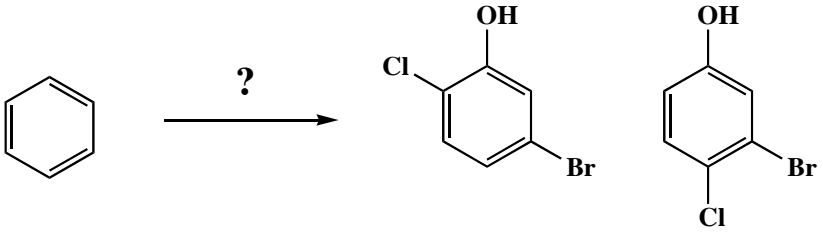
13. Show reagents and intermediates synthesized along the way that allow you to produce the product from the given starting material. Assume you can isolate either the ortho or para product in pure form, even though both are usually produced together.

(13 pts)



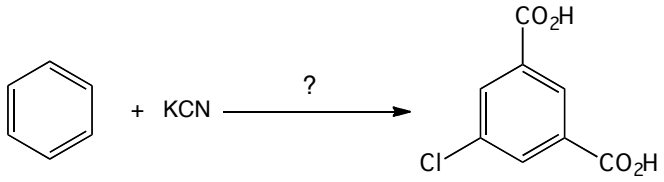
14. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule! **NOTE: For this one, you are not allowed to separate complex mixtures along the way and pull out just the isomers you want. In other words, the product isomers shown must be the only predominant isomers you make during your synthesis.**

(16 pts)



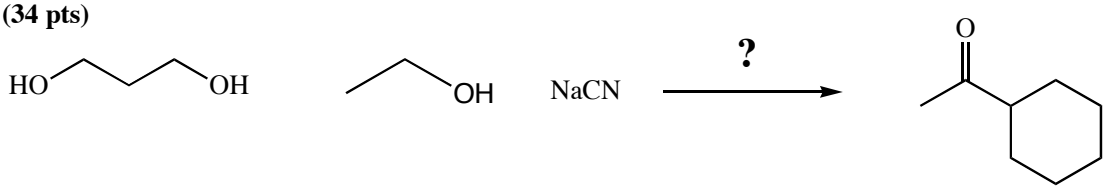
15. Show reagents and intermediates synthesized along the way that allow you to produce the product from the given starting material. Assume you can isolate either the ortho or para product in pure form, even though both are usually produced together.

(19 pts)



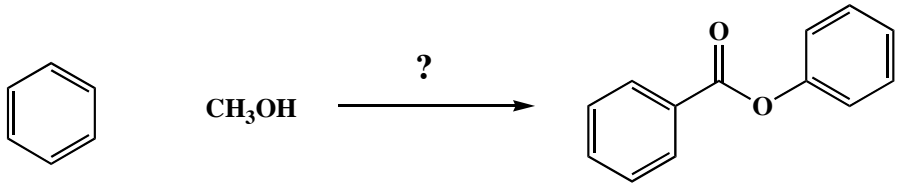
16. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule! Note, for these last two, you might not need to use all three starting materials

(34 pts)



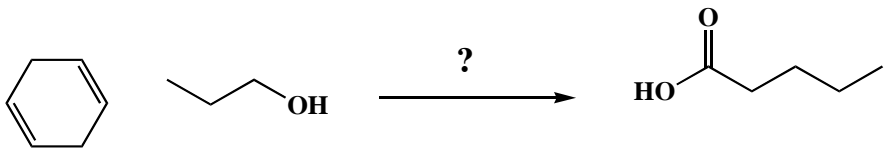
17. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

(23 pts)

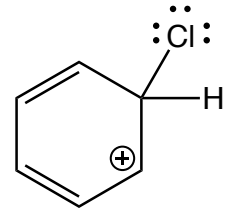


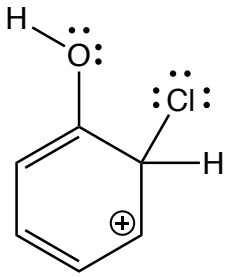
18. Using any reagents turn the starting material into the indicated product. All the carbons in the product must come from the given starting material or starting materials. Draw all molecules synthesized along the way. When it doubt, draw the molecule!

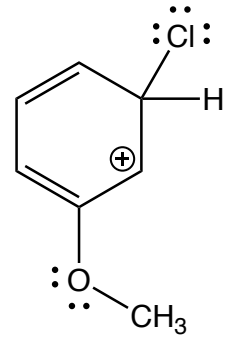
(21 pts)

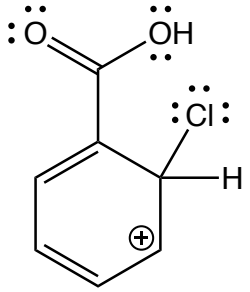


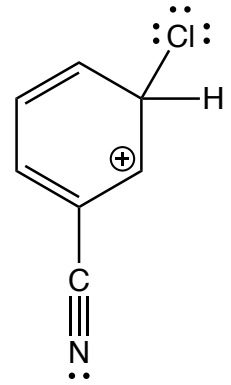
19. For each of the following arenium ion intermediates, draw all the significant resonance contributing structures.



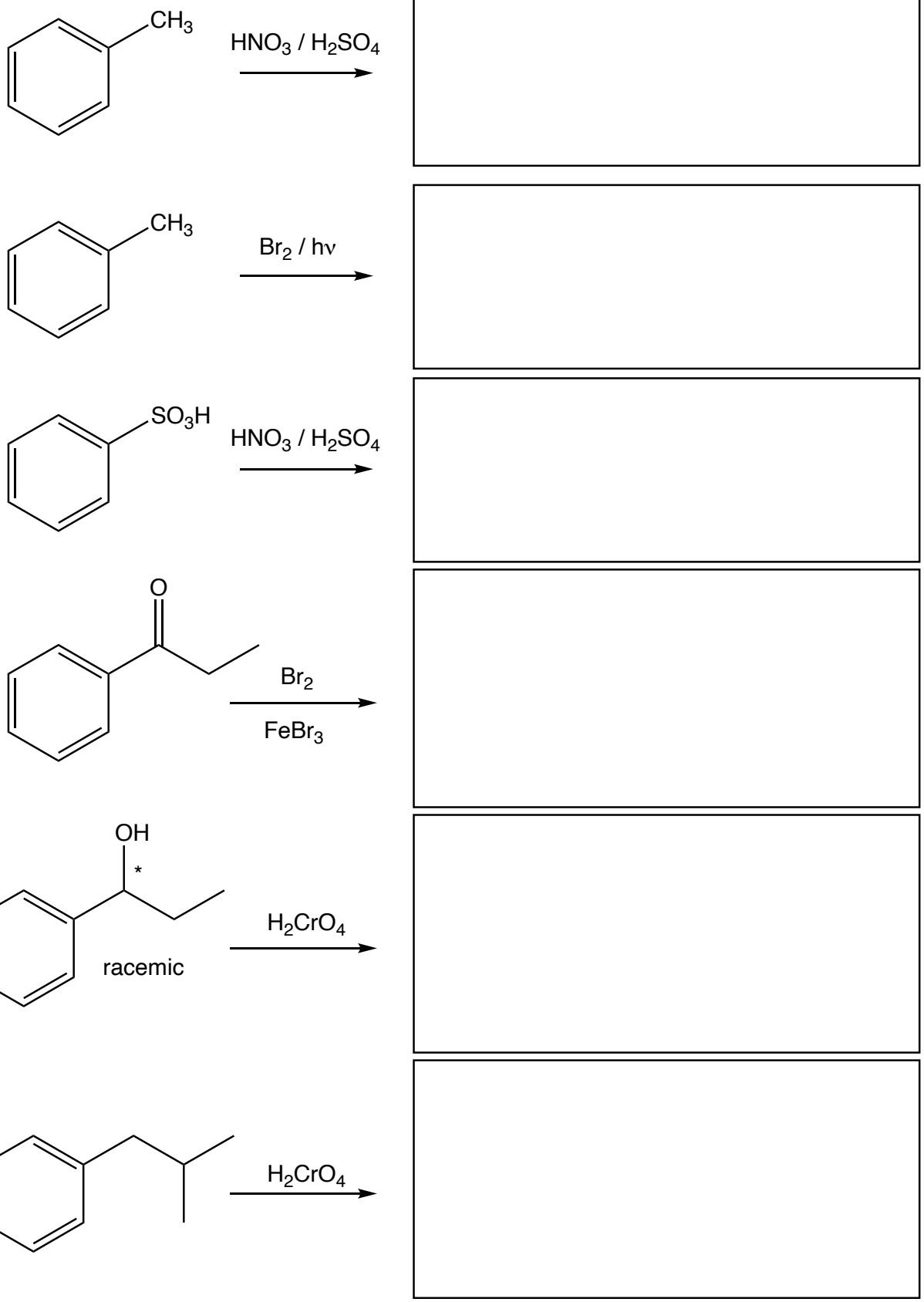




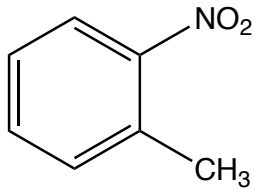




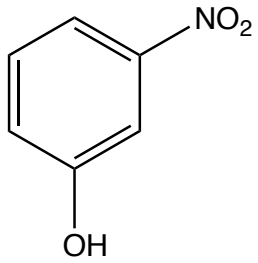
20. Fill in the boxes with the product or products of each reaction. You must draw both ortho and para products if that is appropriate.



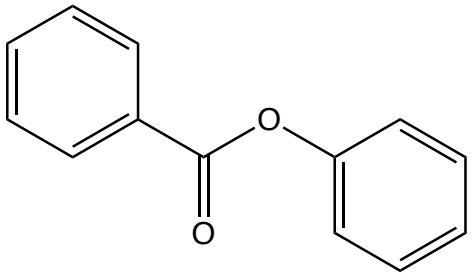
20. (cont.) Fill in the boxes with the product or products of each reaction. You must draw both ortho and para products if that is appropriate. These are a little bit harder than on the previous page.



Br_2 / $FeBr_3$

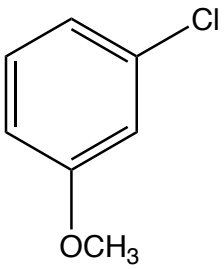


Br_2 / $FeBr_3$



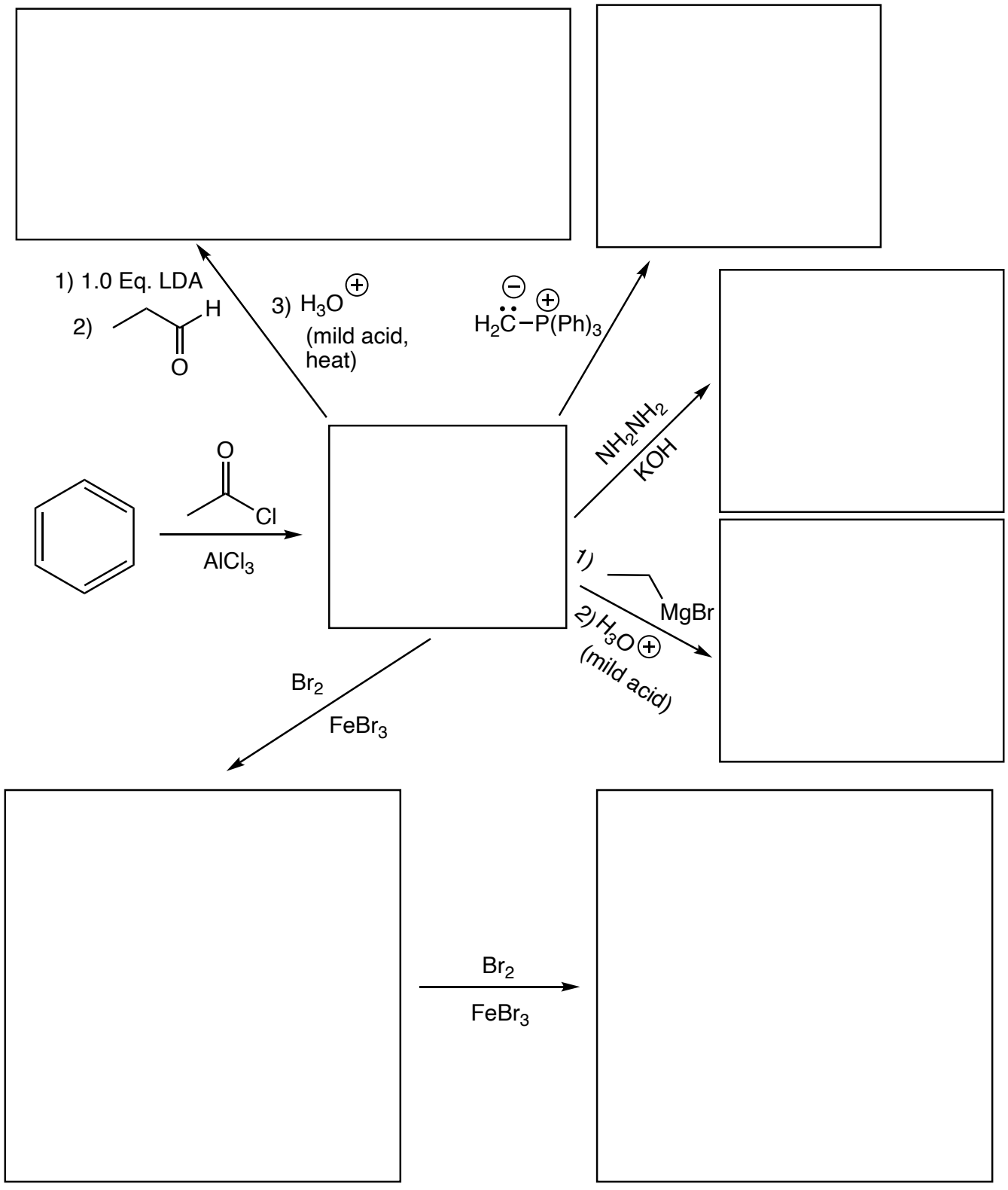
Br_2 / $FeBr_3$

Assume only one Br atom adds

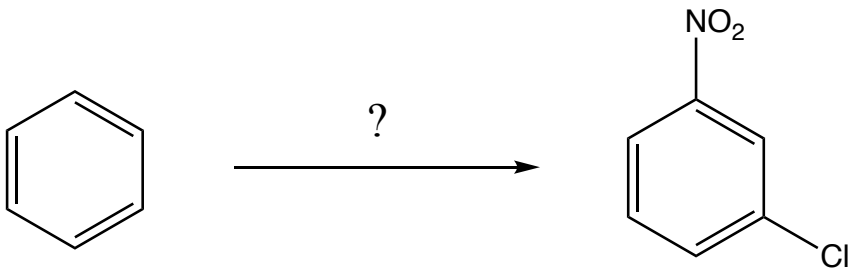


Br_2 / $FeBr_3$

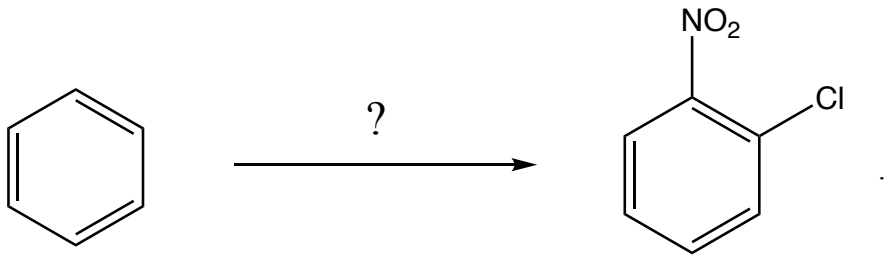
21. For the following reactions, fill in theboxes with the predominant product or products. When ortho/para products are both produced, you must draw both. When a new chiral center is produced, put an asterisk (*) next to it. If a racemic mixture is produced, you must write racemic. If an E/Z mixture is produced, draw both products. I know these are complicated directions, so you might want to read them again so you know what we want.



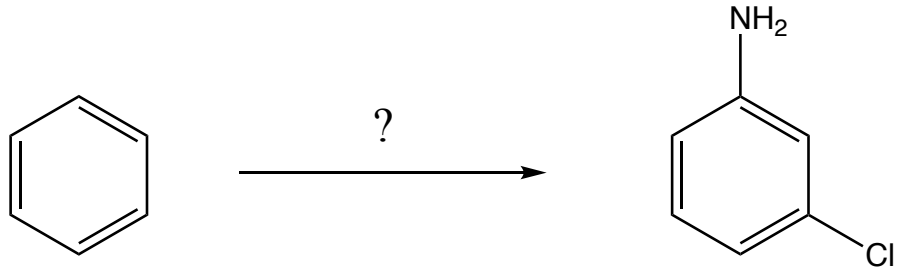
22. Show reagents and intermediates synthesized along the way that allow you to produce the product from the given starting material. Assume you can isolate either the ortho or para product in pure form, even though both are usually produced together.



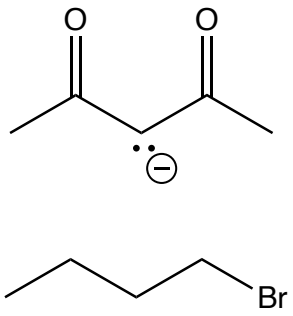
22. Show reagents and intermediates synthesized along the way that allow you to produce the product from the given starting material. Assume you can isolate either the ortho or para product in pure form, even though both are usually produced together.

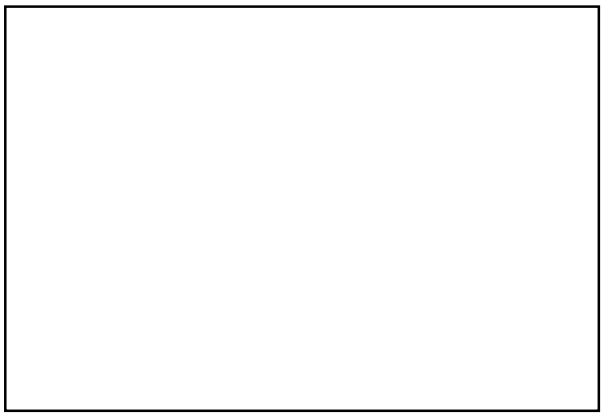


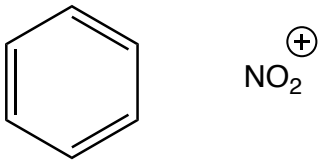
23. Show reagents and intermediates synthesized along the way that allow you to produce the product from the given starting material. Assume you can isolate either the ortho or para product in pure form, even though both are usually produced together.

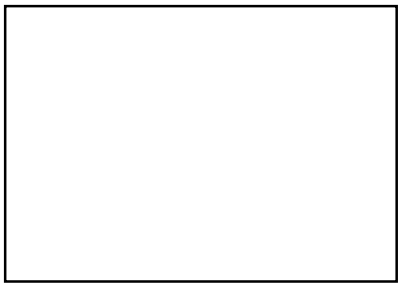


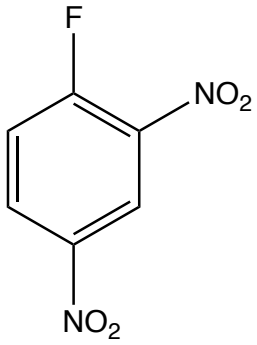
24. Here is a change of pace. For the following reactions, circle the nucleophile and draw a box around the electrophile. Draw the product(s) of the reactions, using the standard format for your answers.

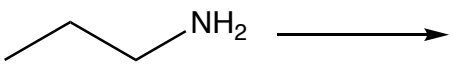


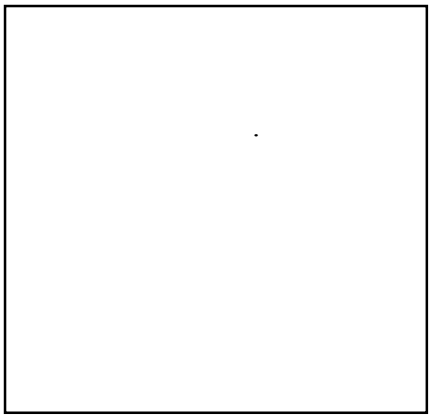


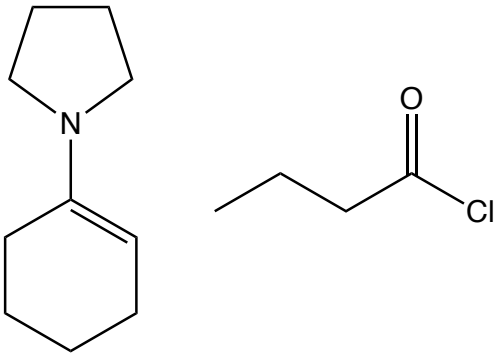


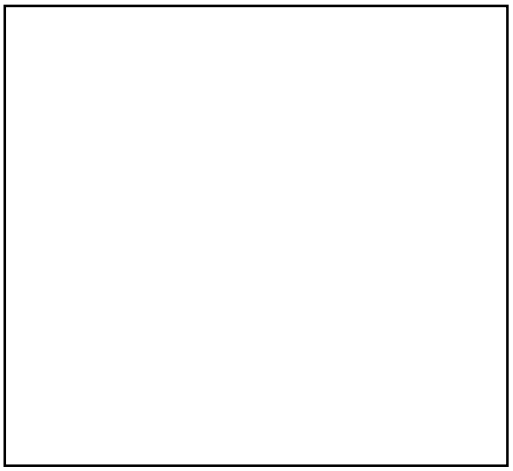












25. For each of the following, circle the derivatives that have a "bad" group on them, draw two boxes around the derivatives that have a "good" group on them, and draw nothing around the derivatives that have an "ugly" group on them.