Chem 112 B: Midterm 2, Thursday April 5, 2012

Name: Answer Key

*UID:*_____ *GSI:*_____

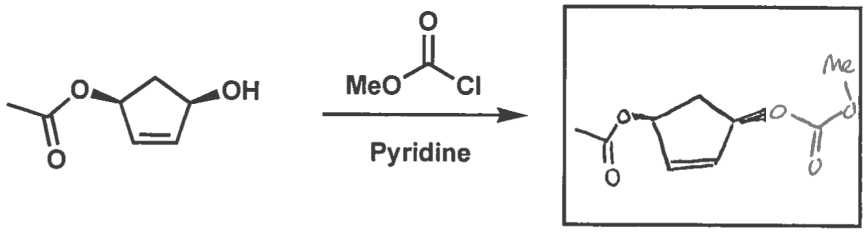
*There are a total of **10 pages** on this exam including this one.*

Question 1	_____(20 pts)
Question 2	_____(20 pts)
Question 3	_____(20 pts)
Question 4	_____(15 pts)
Question 5	_____(15 pts)
Question 6	_____(25 pts)
Question 7	_____(30 pts)
Question 8	_____(30 pts)
Total	_____**(175 points)**

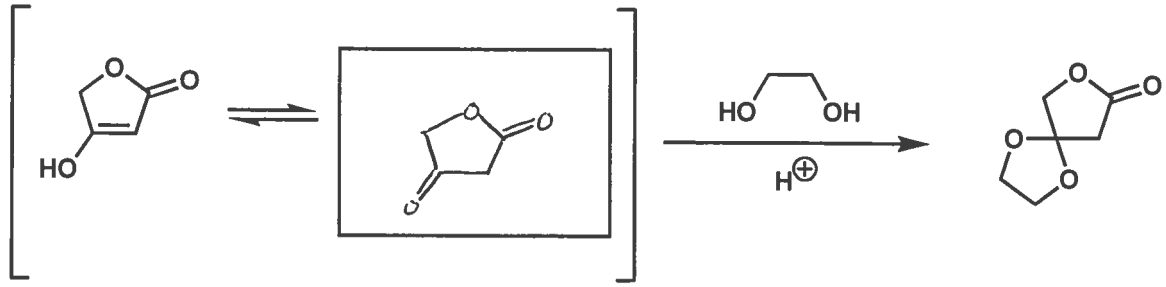
Question 1

Fill in the reagents or products in the boxes. You must use the exact number of steps. (5 points each)

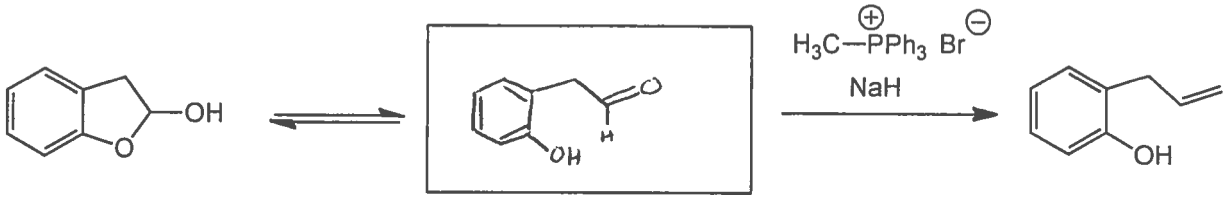
(a)



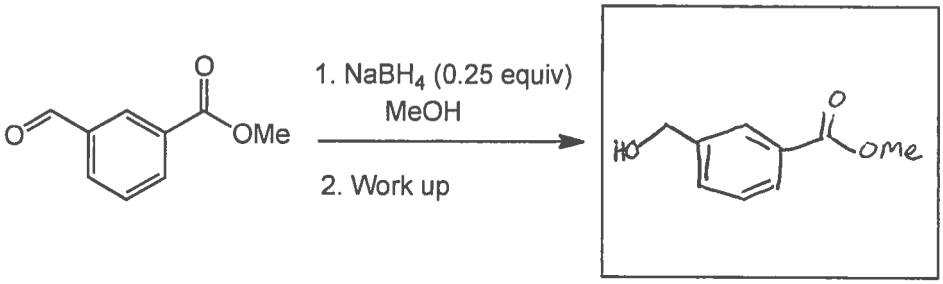
(b)



(c)

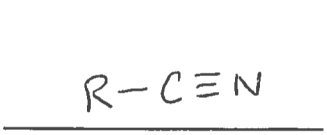


(d)



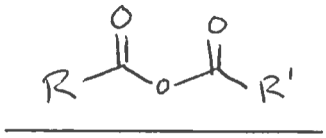
Question 2

In the spaces below, show examples of the indicated functional groups. Use 1, 2, 3 etc. to rank the functional groups from most reactive (labeled 1) to least reactive in a hydrolysis reaction. *Points for the ranking of the reactivity of the functional groups is all or nothing.*(20 points)



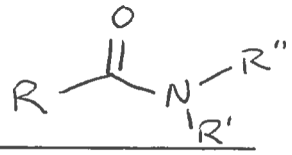
Nitrile

5



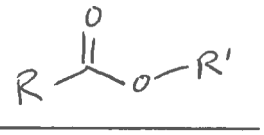
Acid anhydride

2



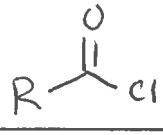
Tertiary amide

4



Ester

3



Acid Chloride

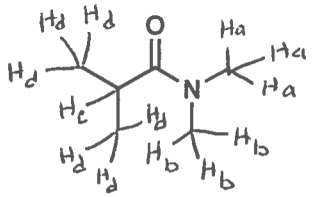
1

3 points per functional group x5 = 15

5 points for ranking

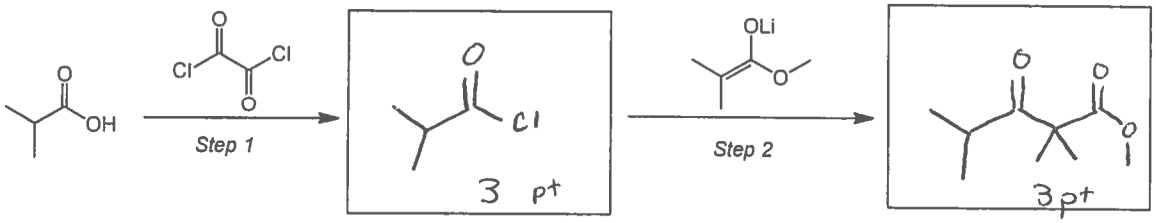
Question 3

(a) How many different resonances would you expect in the *proton* NMR spectrum of the compound shown below? Draw in all of the hydrogen atoms and label them with **a**, **b**, **c**, etc. below, using different letters for non-equivalent resonances. (8 points)

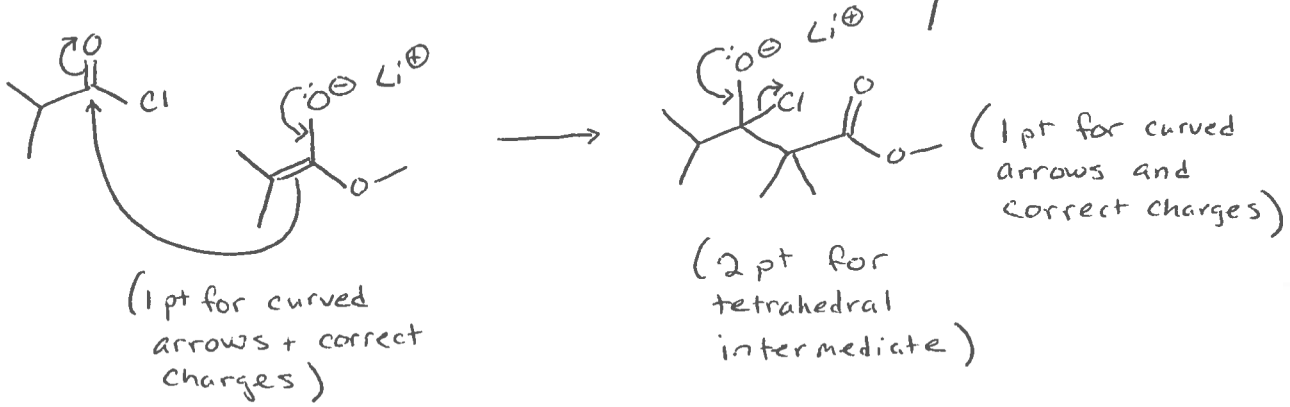


(5 pt for a is different from b)
(3 pt for everything else is correctly labeled)

(b) Draw the products of the following two-step reaction in the boxes and provide a mechanism for step 2 below. What type of named reaction (two words) category does this fall into? (10 points)



Mechanism for step 2: (4 pt)



(1 pt for curved arrows + correct charges)

(2 pt for tetrahedral intermediate)

(1 pt for curved arrows and correct charges)

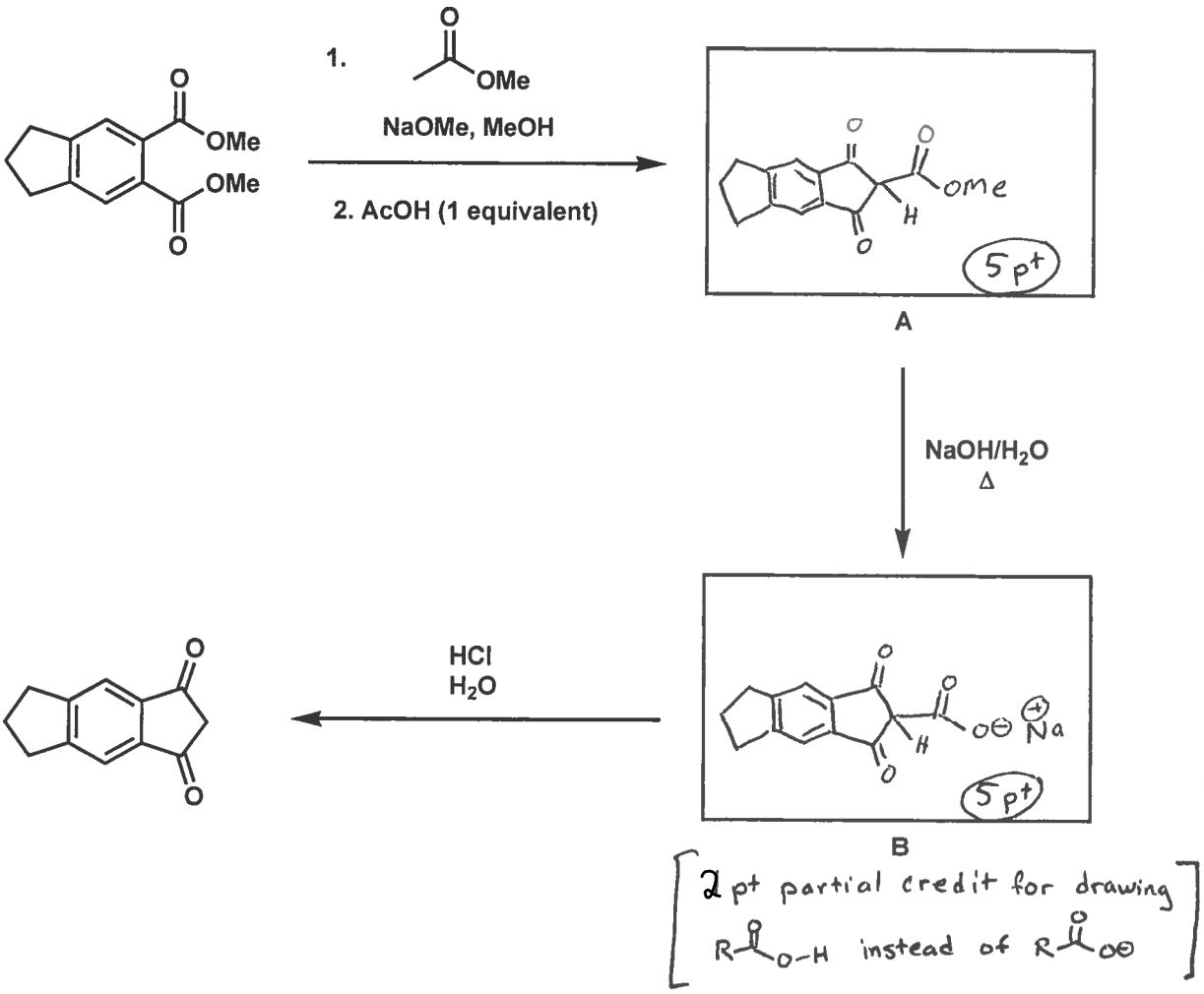
Type of named reaction: Claisen Condensation (2 points)

Question 4

(a) The Claisen condensation is an important reaction for the formation of carbon-carbon bonds using carboxylic acid derivatives. What is the intramolecular version of this reaction called? (4 points)

Dieckmann condensation (4pt)

(b) For the reaction sequence below, identify **A** and **B**. (10 points)



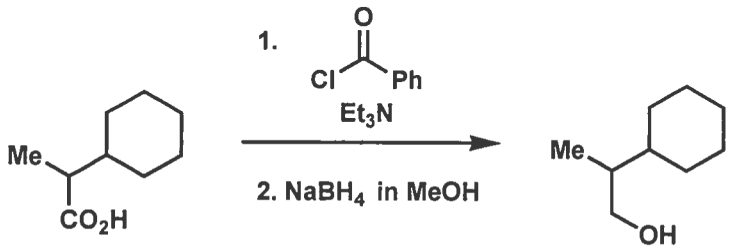
[2 pt partial credit for drawing R–O–H instead of R–O⊖]

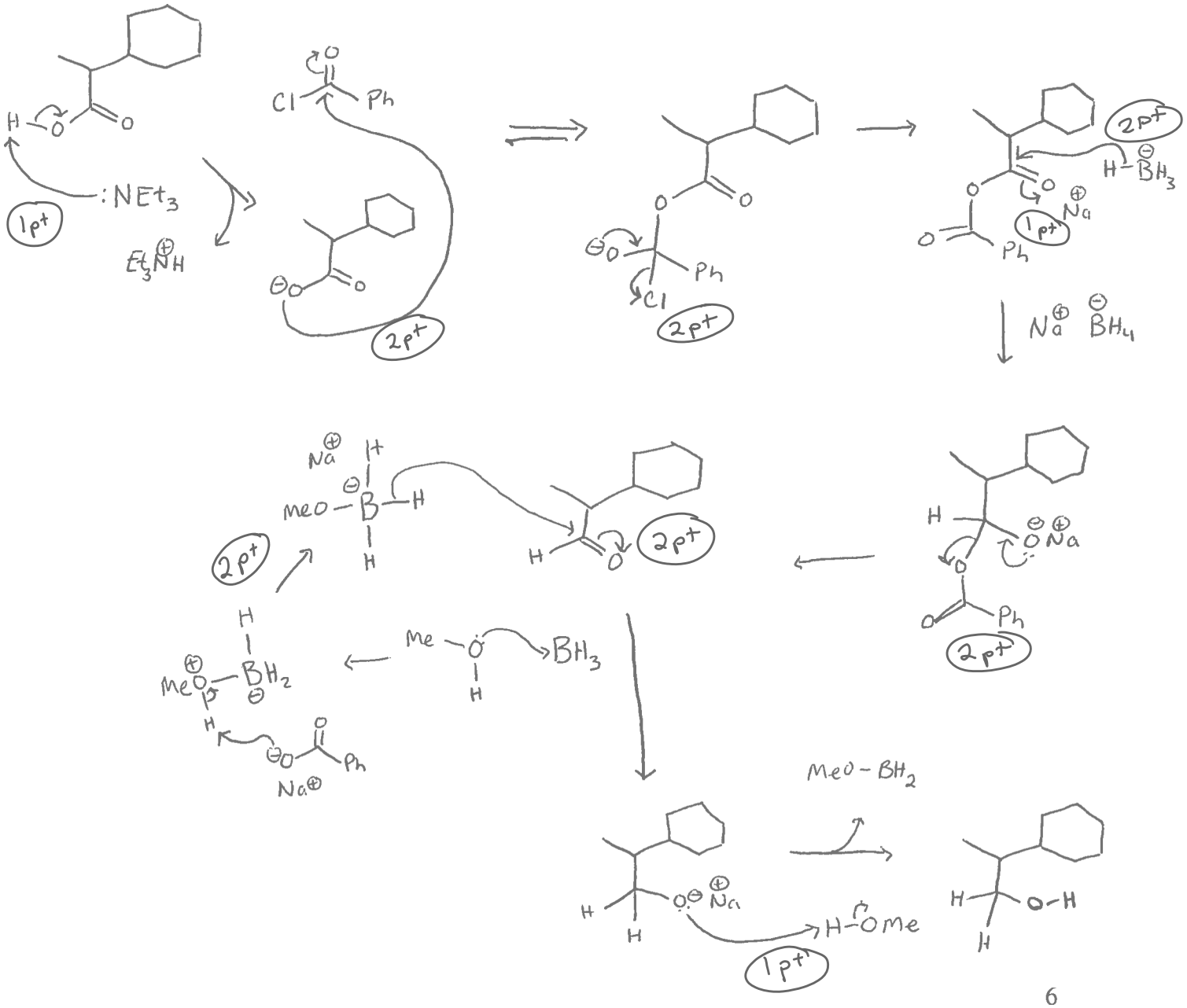
(b) The conversion of **A** to **B** has a name often associated with this type of process. What is this name? (**Hint**: it is a named reaction that I wish was named after me). (1 point)

Saponification (1pt)

Question 5

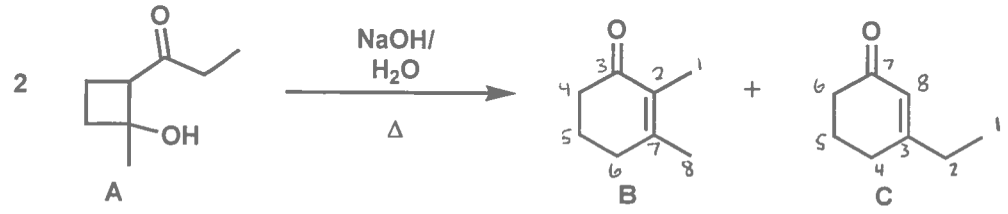
Sodium borohydride is known to reduce aldehydes. But, it cannot reduce acids or esters. It can however, reduce 'activated esters'. With this in mind, provide a mechanism for the transformation below. (15 points)

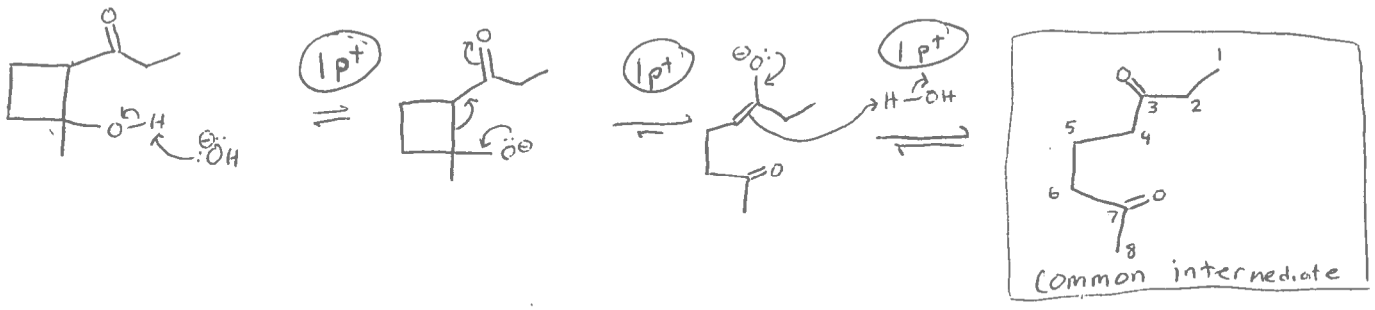


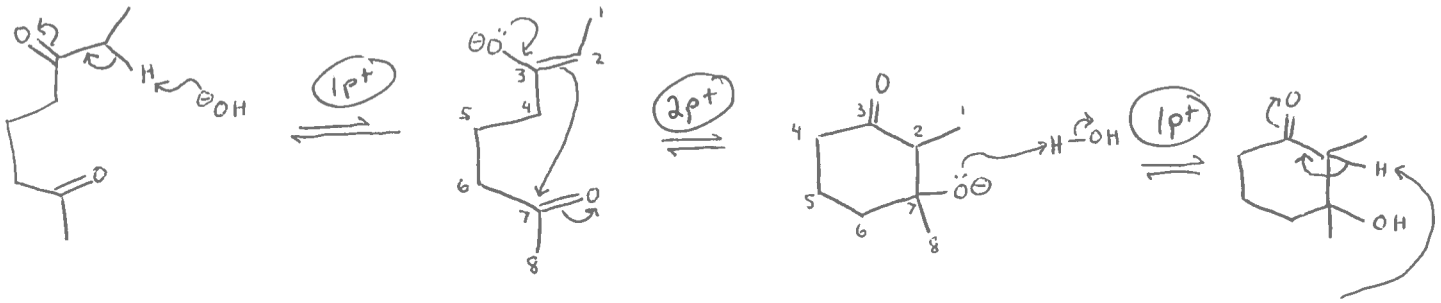


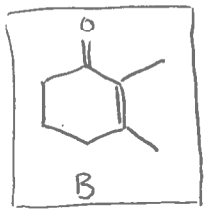
Question 6

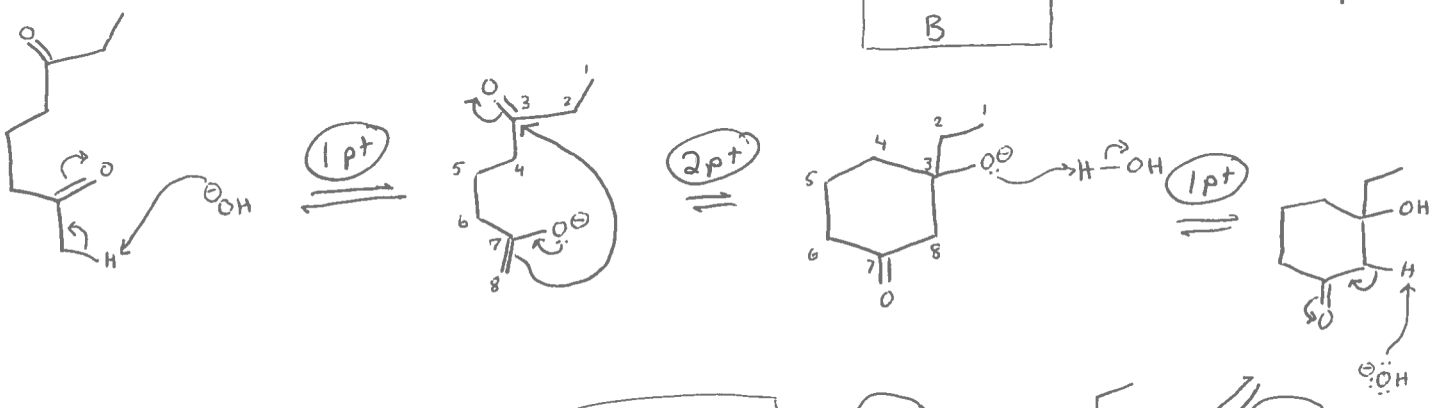
(a) Provide a mechanism that rationalizes the formation of **B** and **C** in the following reaction. (15 points)

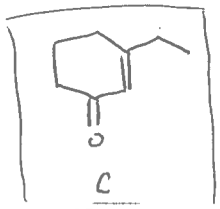


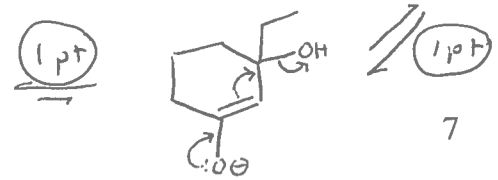




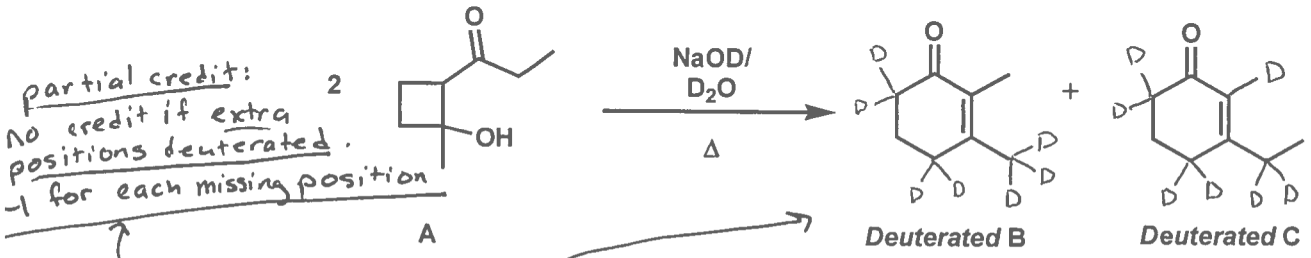






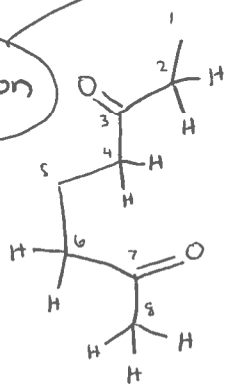


(b) On the basis of your answer in part (a), draw in deuterium atoms bonded to the carbons in both **B** and **C** below at **all possible locations** where deuterium is expected to be incorporated in the product. Why is deuterium incorporated? (10 points)



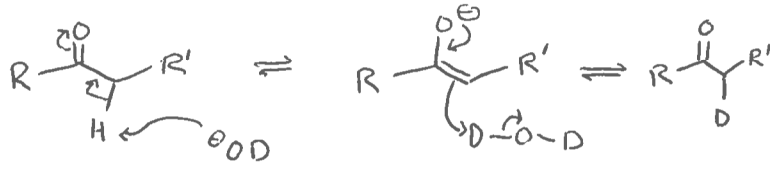
partial credit: 2
No credit if extra positions deuterated.
-1 for each missing position

5 pt for correct deuteration pattern



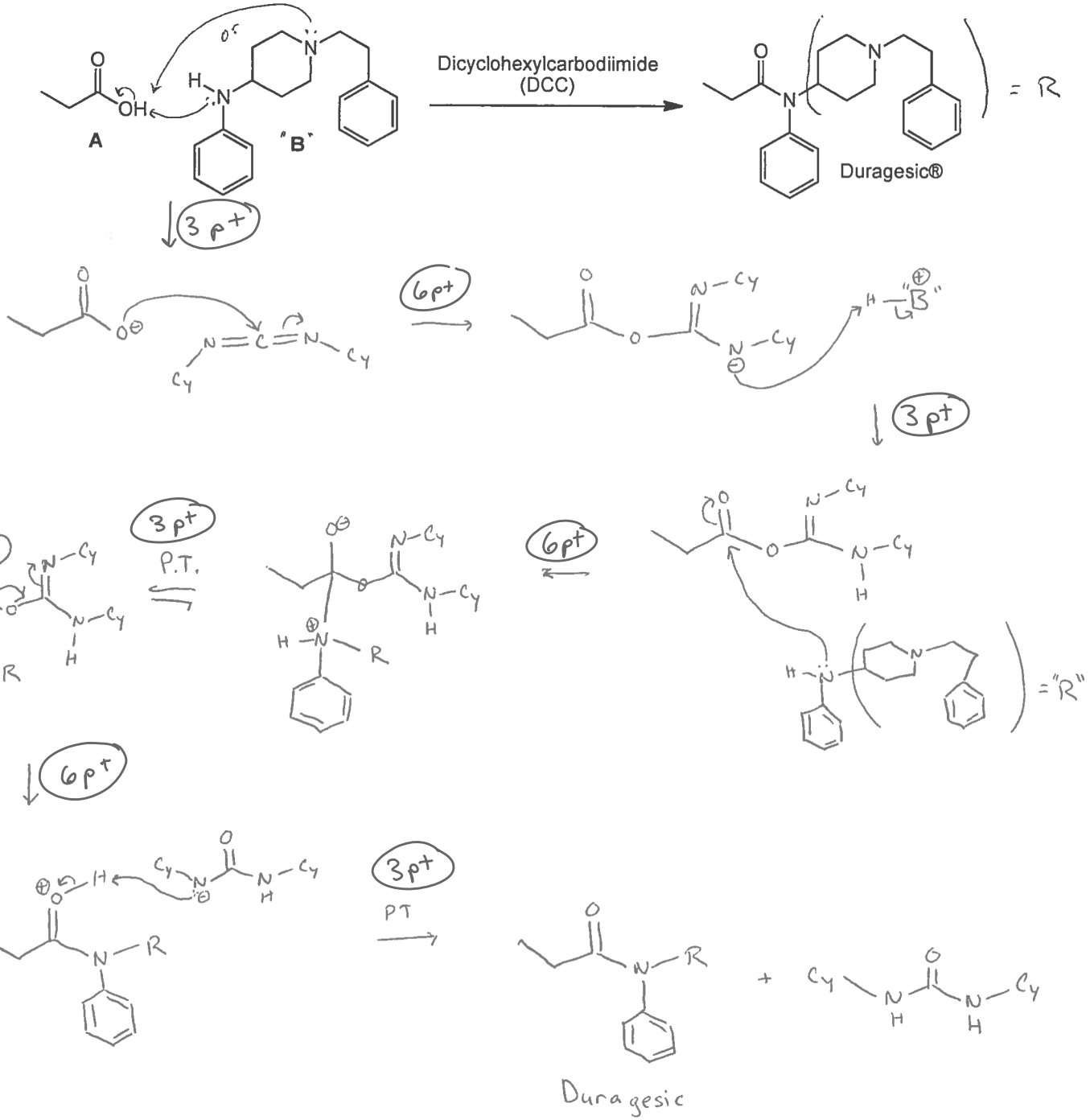
5 pt for explanation

In this common intermediate, there are 4 carbons with acidic hydrogens attached. All of these hydrogen atoms can be replaced with deuterium by base-catalyzed keto-enol tautomerization:



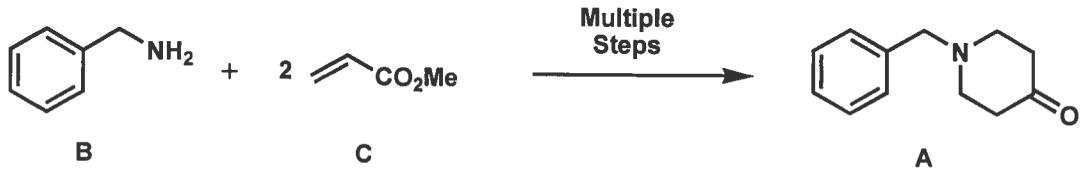
Question 7

Provide a mechanism for the formation of the drug Duragesic®, which is used to treat chronic pain, from **A** and **B** and DCC. (30 points)

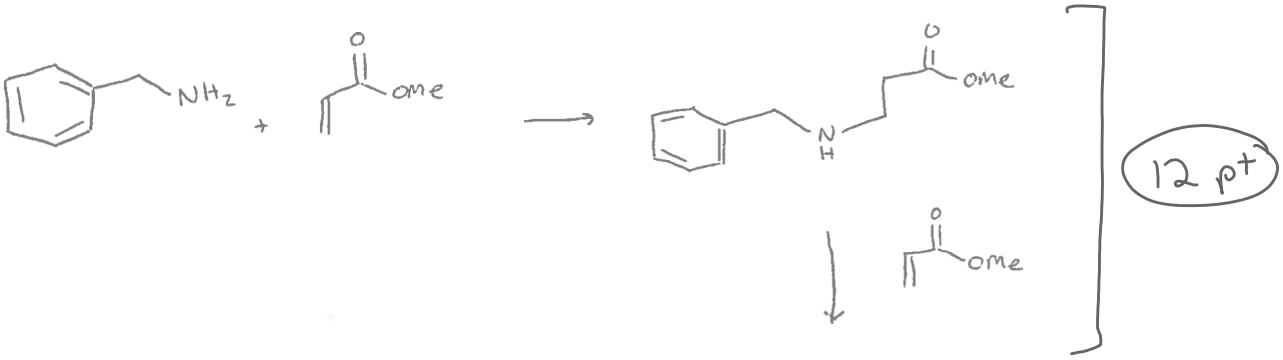


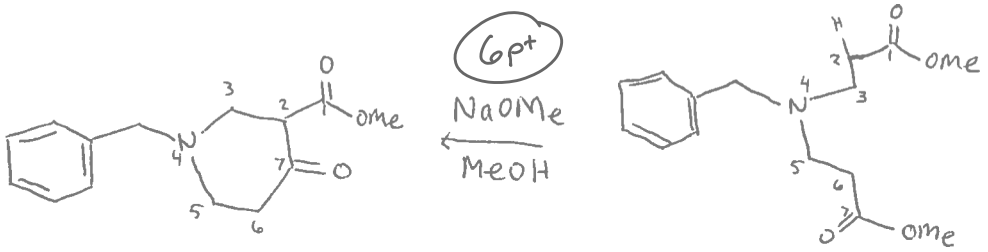
Question 8

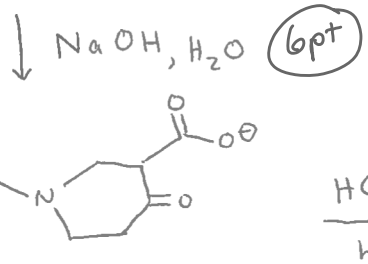
Provide a synthesis for **A** using benzyl amine (**B**), methyl acrylate (**C**) and any of the reactions we have learned so far. You must provide reagents for each step, but you do not need to include arrow-pushing mechanisms. (30 points)

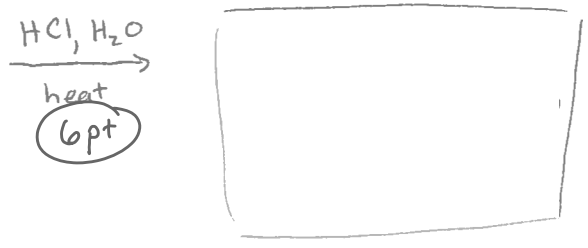


B C A









The End