

Chemistry 310
Spring 2009
Prof. B. Hanson

Name: KEY

Exam #2

1. _____ 20 points

2. _____ 40 points

3. _____ 20 points

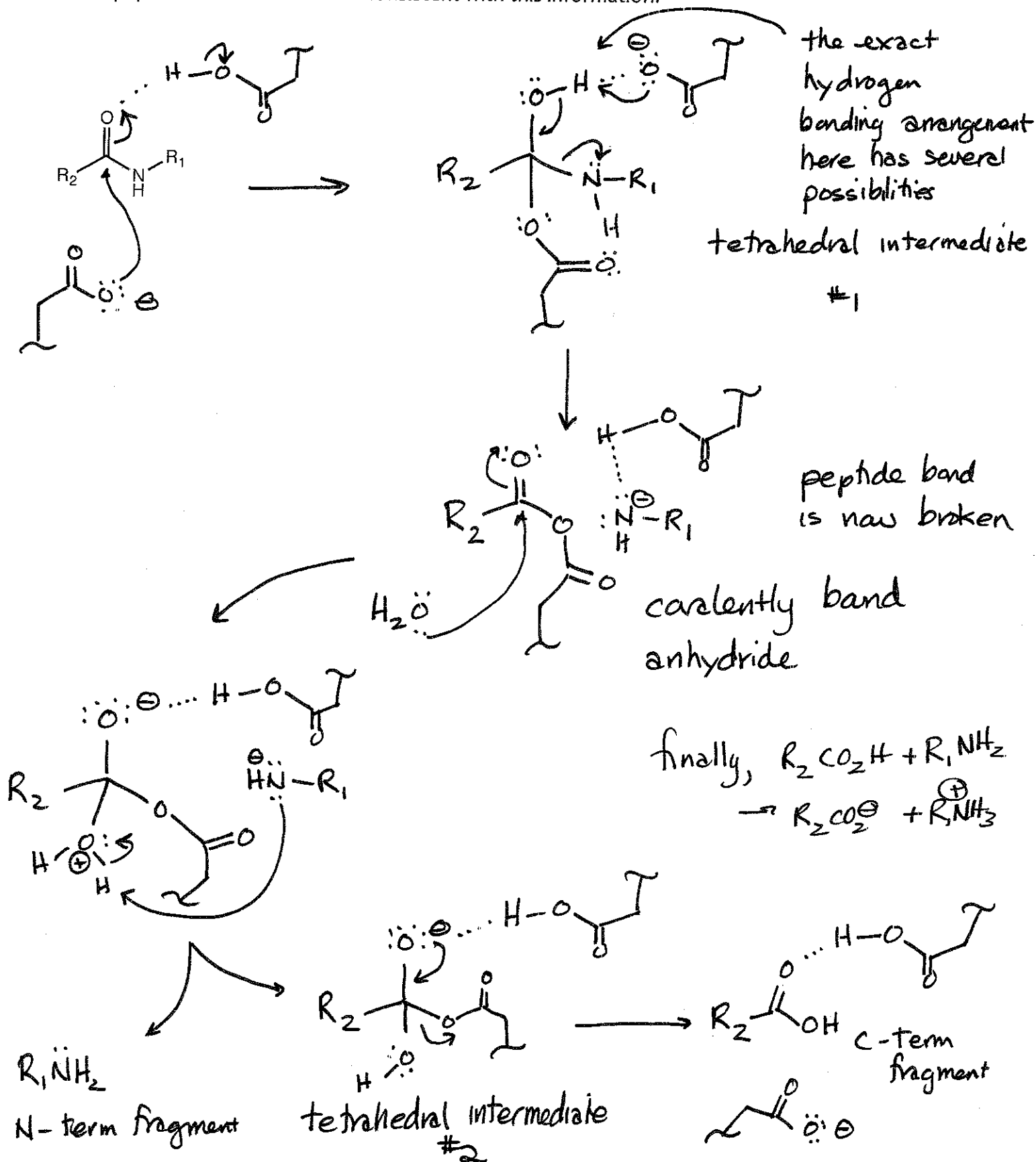
4. _____ 20 points

100 points

"There was a question on DNA structure that I was sure I blew, but I must have gotten all of the key words right. You know I have to tell you that when you told us that things like resonance and steric hinderance were really key words - it is true - they seem to be the answer to everything."

Unsolicited Testimonial from Haley Perlick, '94,
reflecting on a graduate school biochemistry exam

1. (20 points). HIV protease is an enzyme critical to the virus life cycle. However, it is not a serine protease, but rather an aspartyl protease. It has two aspartic acid residues, both of which are crucial to its action. One of these aspartate residues plays a role analogous to the serine of a serine protease, the other acts in a more general "helper" manner. Draw a mechanism for the hydrolysis of the peptide bond shown below consistent with this information.



2. (40 points) A reaction scheme is shown on the next page.

a. (10 points) Fill in all the boxes on the scheme. Where the box has a # below it, fill in the number of the associated reactants or products. The other boxes require a structure or standard abbreviation of the name of a reactant.

b. (10 points) For each numbered step in the scheme, give the name of the reaction occurring, or if there is not a name per se, give a descriptive category. Give your answers here:

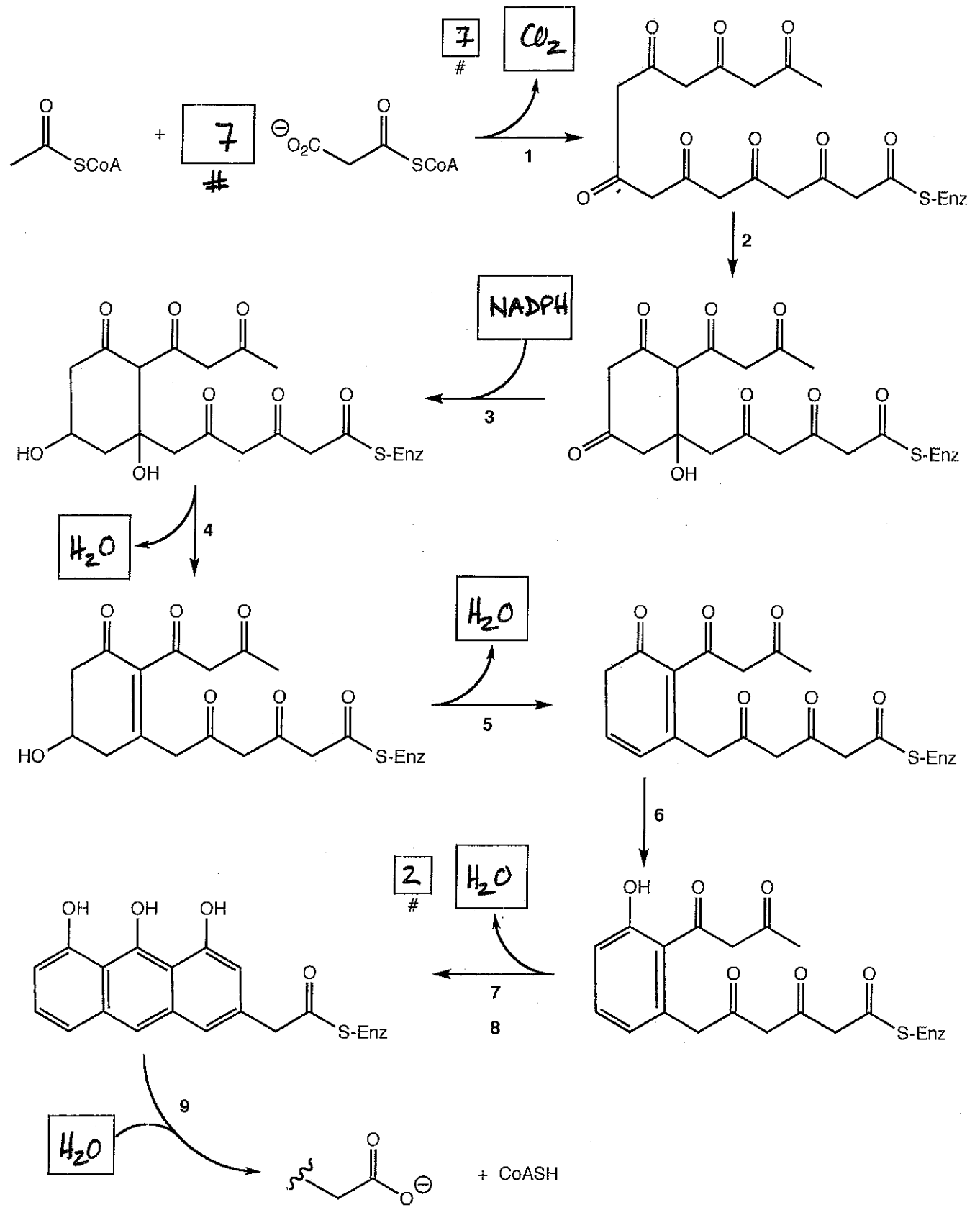
- | | |
|------------------------------------|---------------------------------------|
| 1. <u>Claisen condensation</u> | 2. <u>aldol condensation</u> |
| 3. <u>reduction</u> | 4. <u>dehydration/elimination</u> |
| 5. <u>dehydration/elimination</u> | 6. <u>enolization/tautomerization</u> |
| 7. <u>aldol condensation</u> | 8. <u>enolization/tautomerization</u> |
| 9. <u>hydrolysis (of an ester)</u> | |

c. (20 points) Pick any one of the 9 steps in this scheme and draw a mechanism for it. If the step is actually several rounds of the same reaction, you only need to draw the mechanism for one round. You may carefully abbreviate the structure to eliminate parts that are not changing.

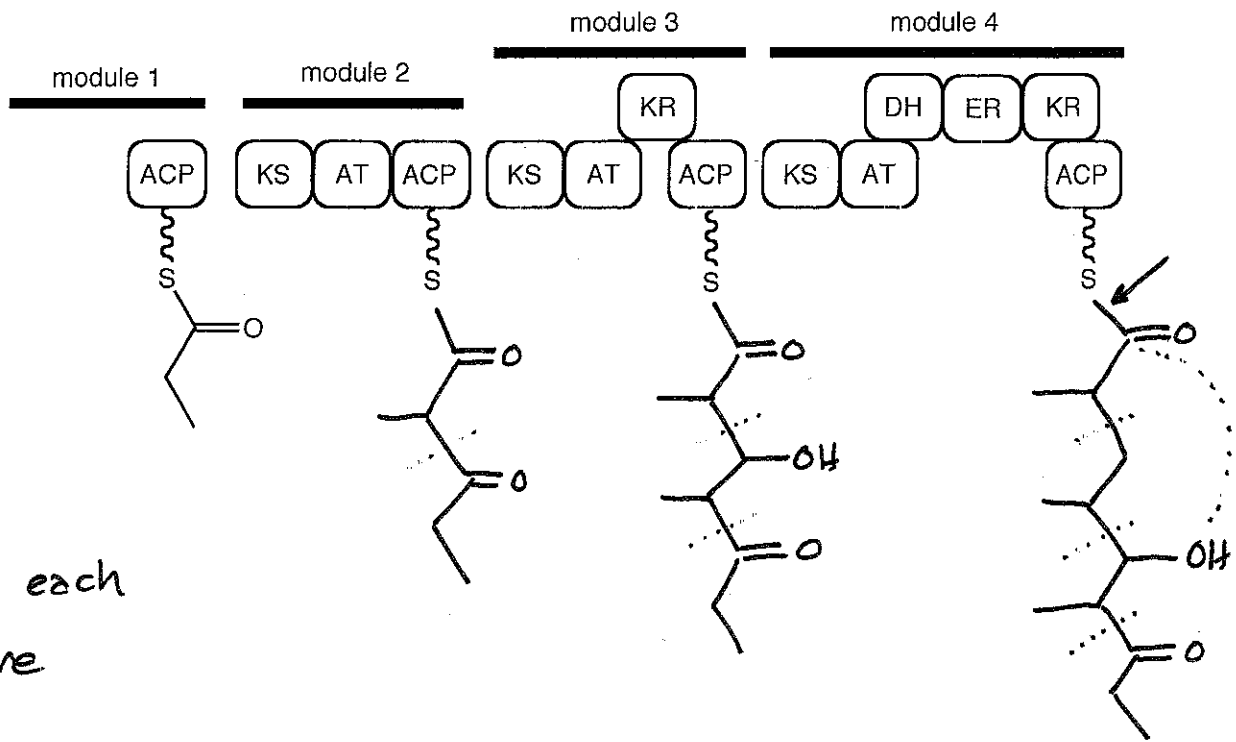
I am writing the mechanism of step _____.

Many answers

Reaction Scheme for Question 2.

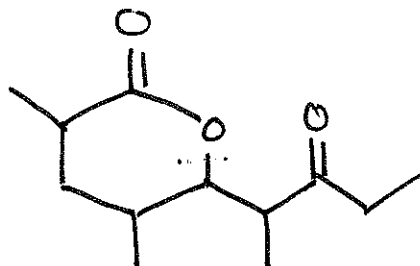


3. (20 points). Imagine a polyketide synthase (PKS) as shown below. Let's say that modules 2-4 each load the KS with methyl malonyl CoA and then do their thing. At the end of the process, the thioester is released from the ACP and a cyclic ester (lactone) forms. Draw the structure present on each ACP. Draw the structure of the final product. You need not show any stereochemistry.



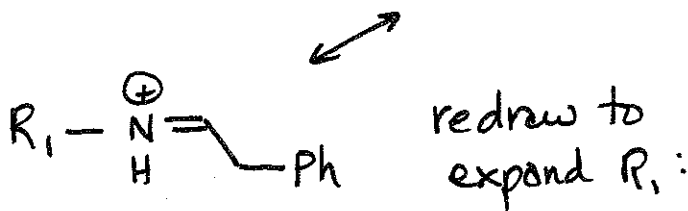
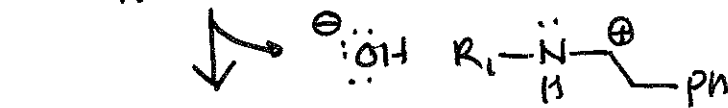
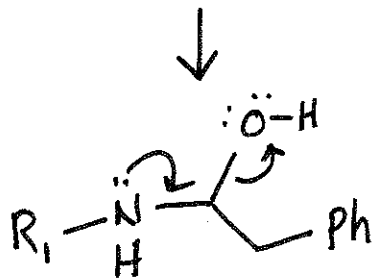
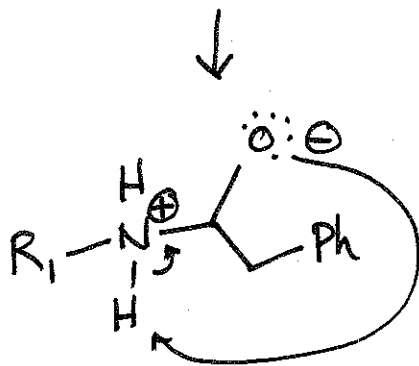
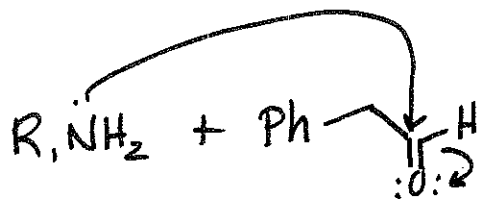
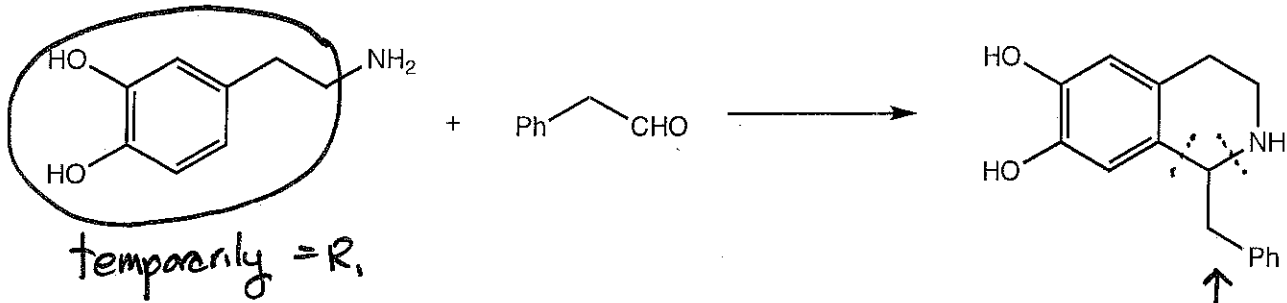
5 pts each
structure

last step cleaves where marked
w/ arrow to give a $-CO_2H$ which
the cyclizes w/ the OH to give a
lactone:



This is called the Pictet-Spengler rxn

4. (20 points). The biosynthesis of the benzylisoquinoline alkaloids, which includes such important molecules such as morphine, begins with the reaction shown below. Draw a mechanism for this reaction assuming it happens at near-neutral pH values (which means you can use proton or hydroxide but shouldn't generate anything more acidic or basic than these).



iminium ion

up to here, nucleophilic addn to $C=O$

overall, this piece is the old $RCHO$

product

