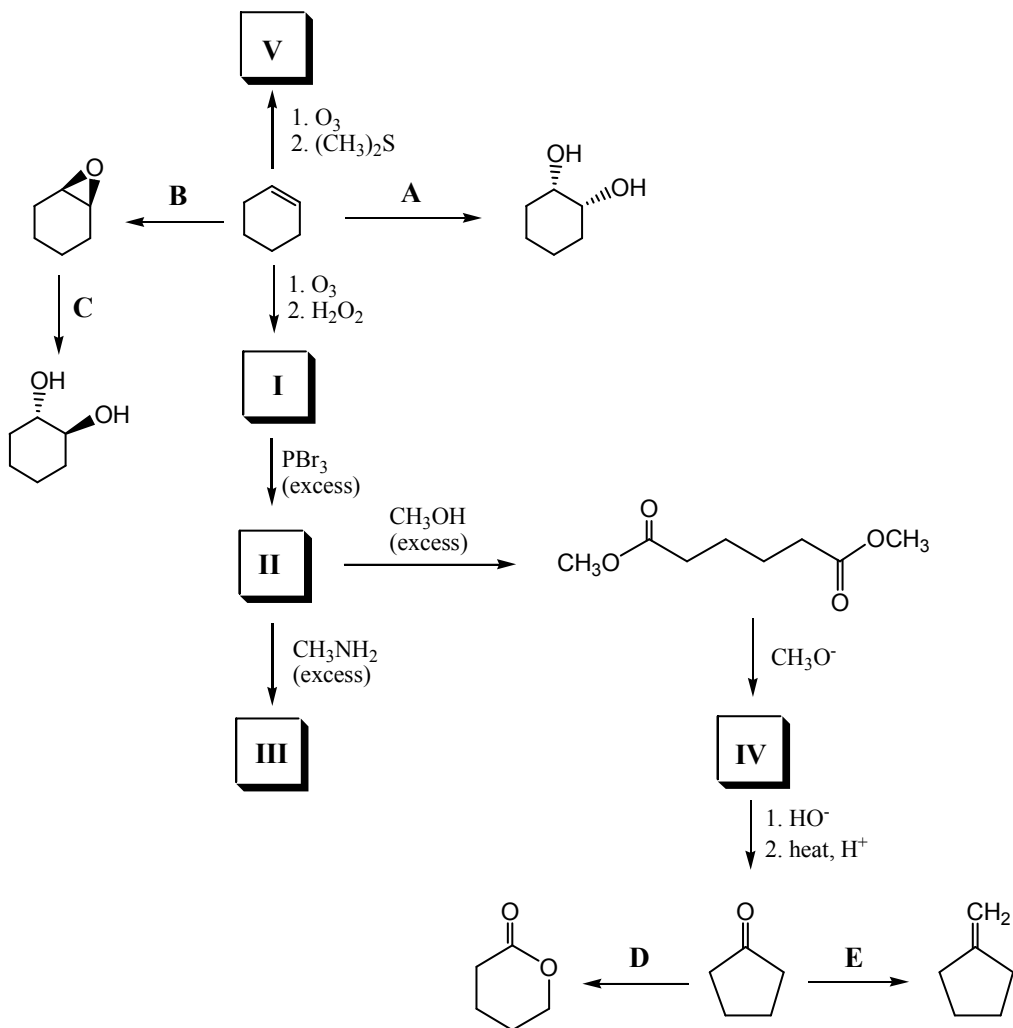
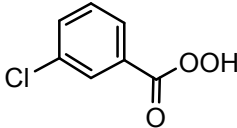
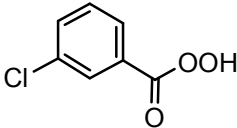
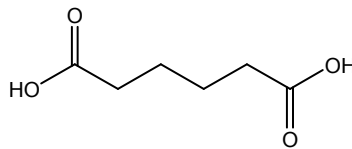
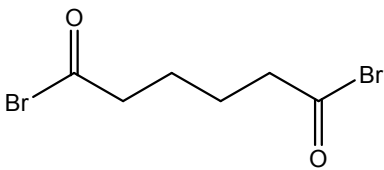
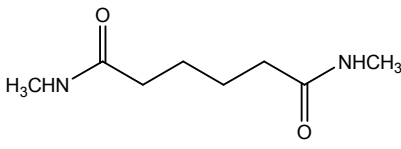
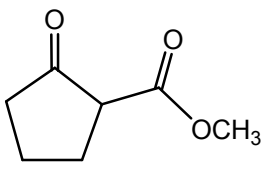
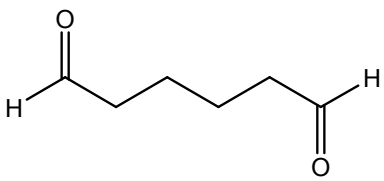


II. Use the provided table (next page) and fill in compound structures and reagents for the following synthesis. Make sure your answer is correctly put in the designated box of the given table. **No partial point will be given for the misplaced answer.** (20 points)

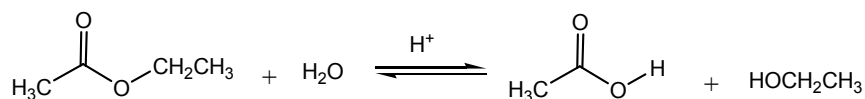


<b>A:</b>  $\text{OsO}_4$	<b>B:</b> mCPBA 	<b>C:</b>  $\text{H}^+, \text{H}_2\text{O}$
<b>D:</b>  mCPBA 	<b>E:</b>  $\text{Ph}_3\text{P}^{\oplus}-\text{CH}_2^{\ominus}$	<b>I:</b>  
<b>II:</b>  	<b>III:</b>  	<b>IV:</b>  
<b>V:</b>  		

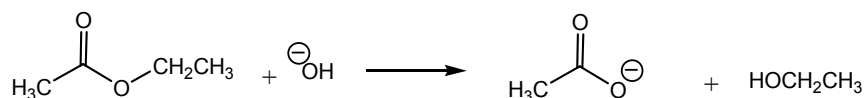
Continue to the next page

III. Propose an electron-pushing mechanism for each of the following reactions. Briefly explain why the hydrolysis of ester in acidic condition is reversible (reaction a) while in basic condition (reaction b) is irreversible. (10 points)

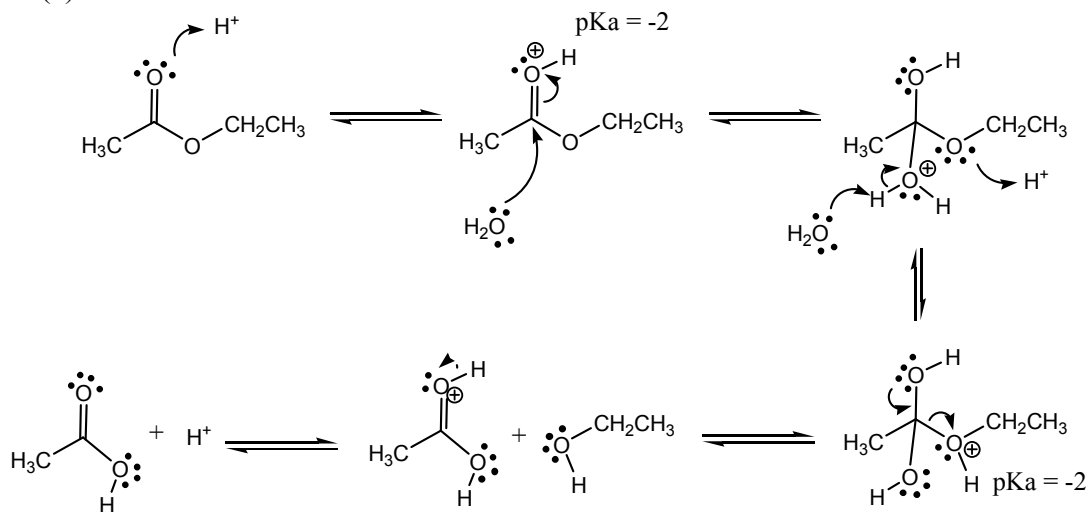
(a)



(b)

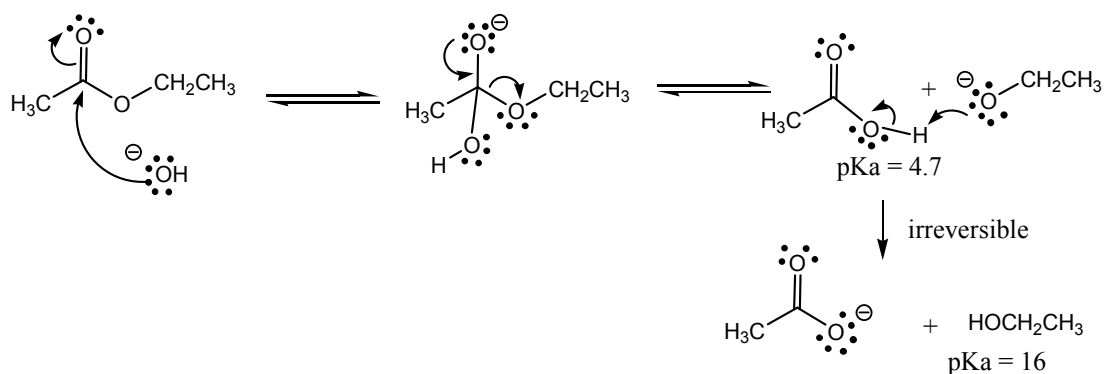


For reaction (a)



Every step is reversible due to the similar  $\text{pK}_a$  of the acidic protons of intermediates and acid catalyst.

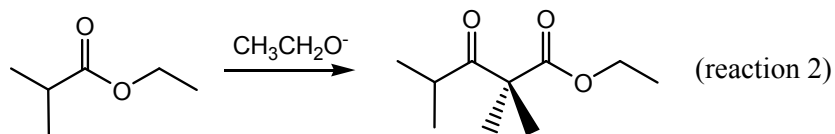
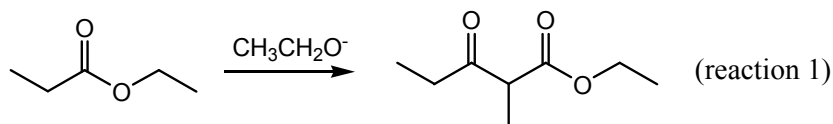
For reaction (b)



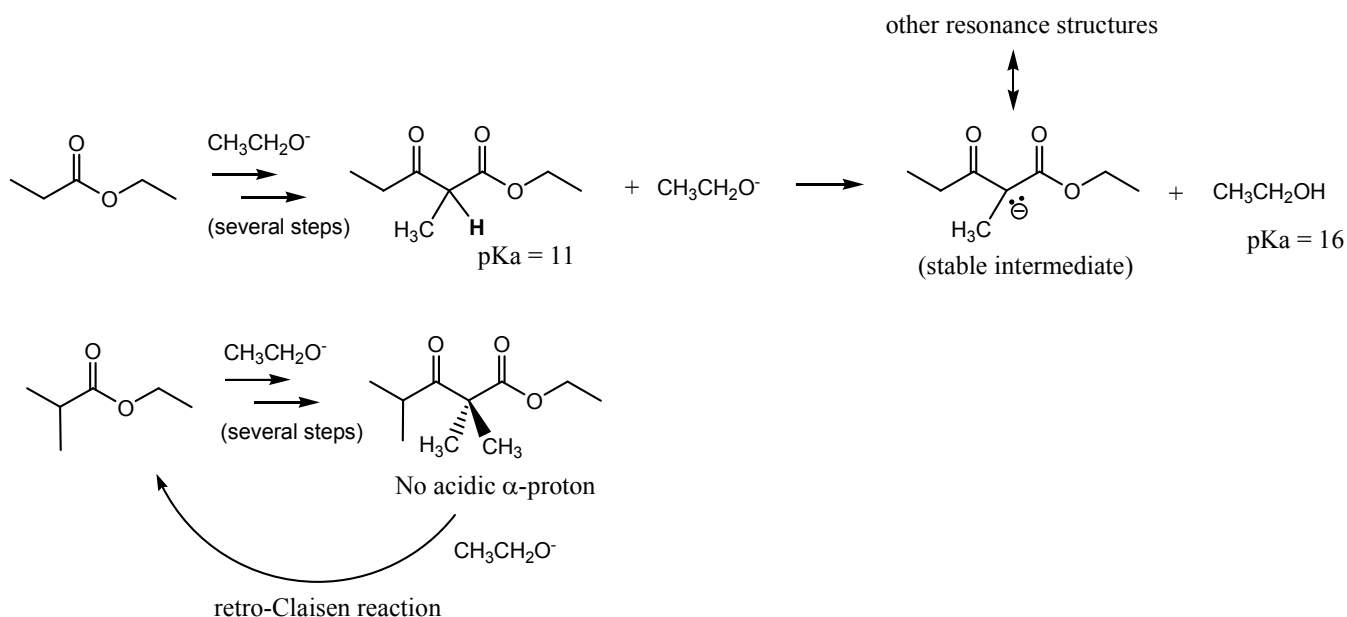
The last step is irreversible due to the large difference in the  $\text{pK}_a$  between carboxylic acid and ethanol.

**Continue to the next page**

IV. Propose an electron pushing mechanism for **reaction 1 only**. For the following two Claisen condensations, briefly explain why the yield for reaction 1 could be much better than that of reaction 2 (10 points)



Reaction 1 cannot be reversible while reaction 2 can.



#### Reaction 1

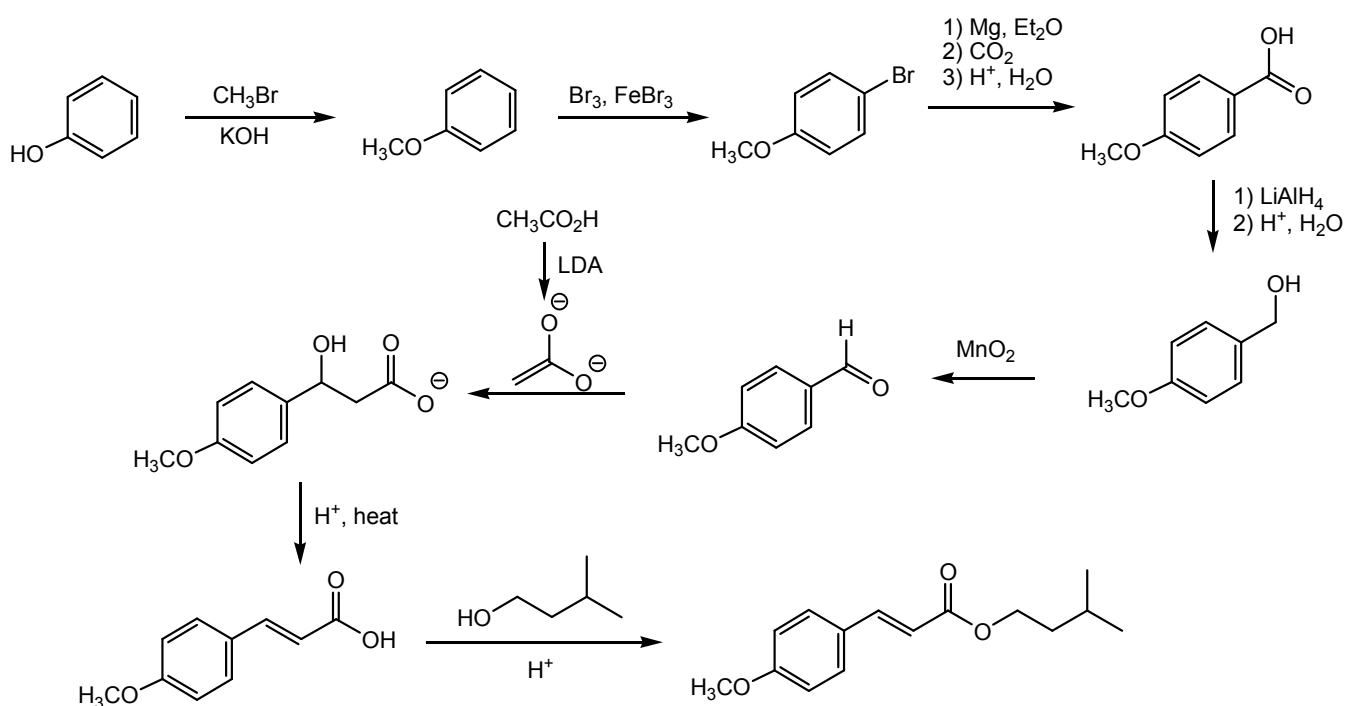
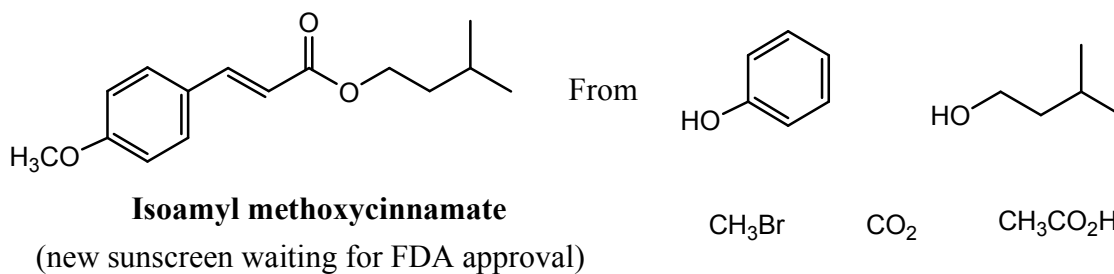
Due to the presence of a more acidic  $\alpha$ -proton ( $\text{pK}_a = 11$ ) in the product than in the starting material ( $\text{pK}_a = 25$ ), the product precursor can be stabilized by resonance in the form of anion till protonation. Retro-Claisen reaction is unlikely since the  $\text{EtO}^-$  cannot attack the carbonyl group of the anion of the product precursor.

#### Reaction 2

The product does not have the acidic  $\alpha$ -proton. Therefore, there is a greater chance for the  $\text{EtO}^-$  to attack the carbonyl group of ketone thus initiate the Retro-Claisen reaction.

**Continue to the next page**

V. Propose a synthesis for the following compound (Isoamyl methoxycinnamate) from the provided starting materials. You can use any reagents, acids, or bases you have learned but you can **only** use the provided starting materials. (10 points)



**Continue to the next page**

VI. **Bonus Points:** propose a correct structure based on the following spectroscopic information (next two pages). Put all your analysis and answer on this page (page 15). The grading will base only on your analysis and answer of this page. (10 points)