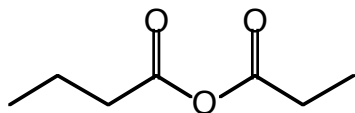
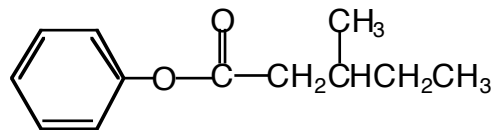


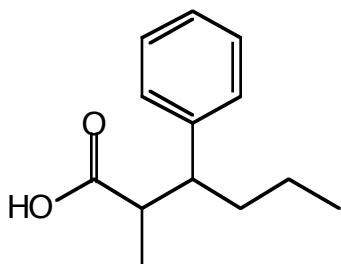
1. Provide an unambiguous name (IUPAC or common) for each of the following molecules. (16 points)



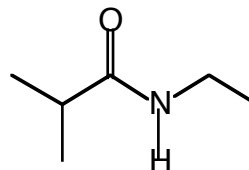
butanoic propanoic anhydride



Phenyl 3-methylpentanoate

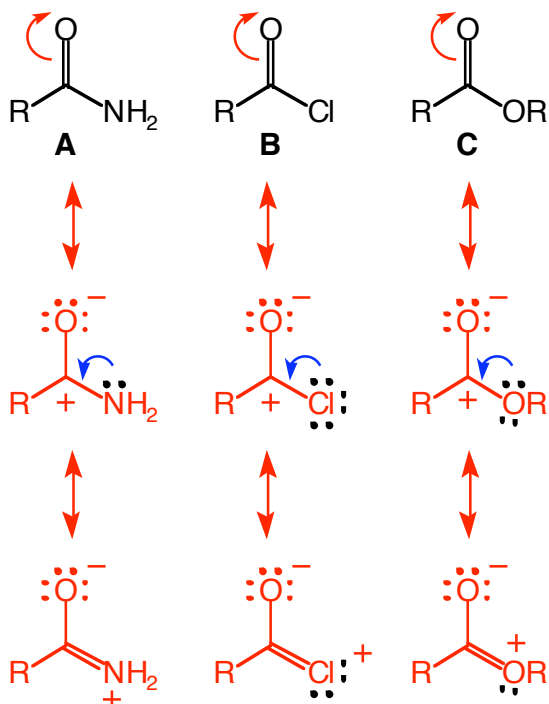


2-Methyl-3-phenylhexanoic acid



N-Ethyl isobutyramide
 or
N-Ethyl 2-methylpropanamide

2. Recall that carbonyls absorb IR irradiation between $1700 - 1800 \text{ cm}^{-1}$ and that the exact position is dependent on the strength of the $\text{C}=\text{O}$ bond. Match the following carboxylic acid derivatives with their predicted IR absorption frequency *and* provide an explanation for your decision. You must use pictures *and* words for full credit. (10 points)



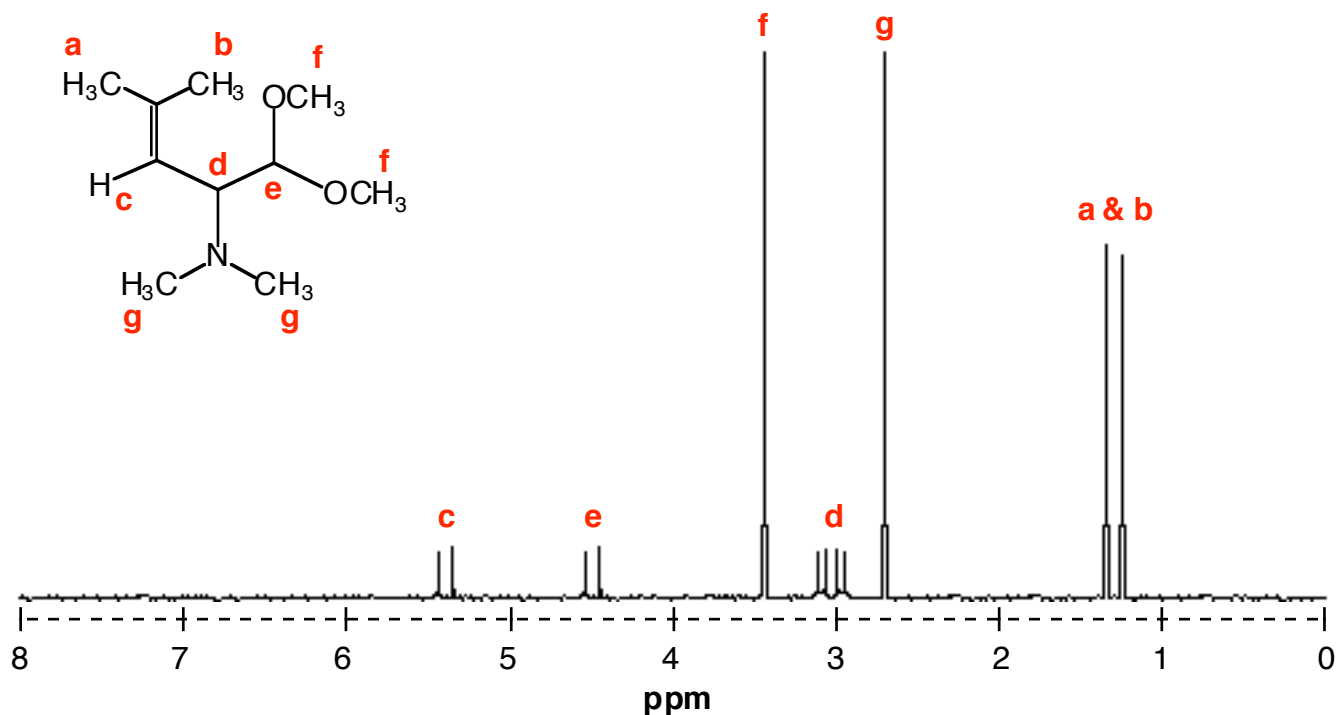
B	1800 cm^{-1}
C	1750 cm^{-1}
A	1695 cm^{-1}

All the compounds possess similar resonance structures. The strength & length of the $\text{C}=\text{O}$ bond is dependent on the last row of resonance structures and the ability of the leaving group to donate electrons to the carbonyl carbon.

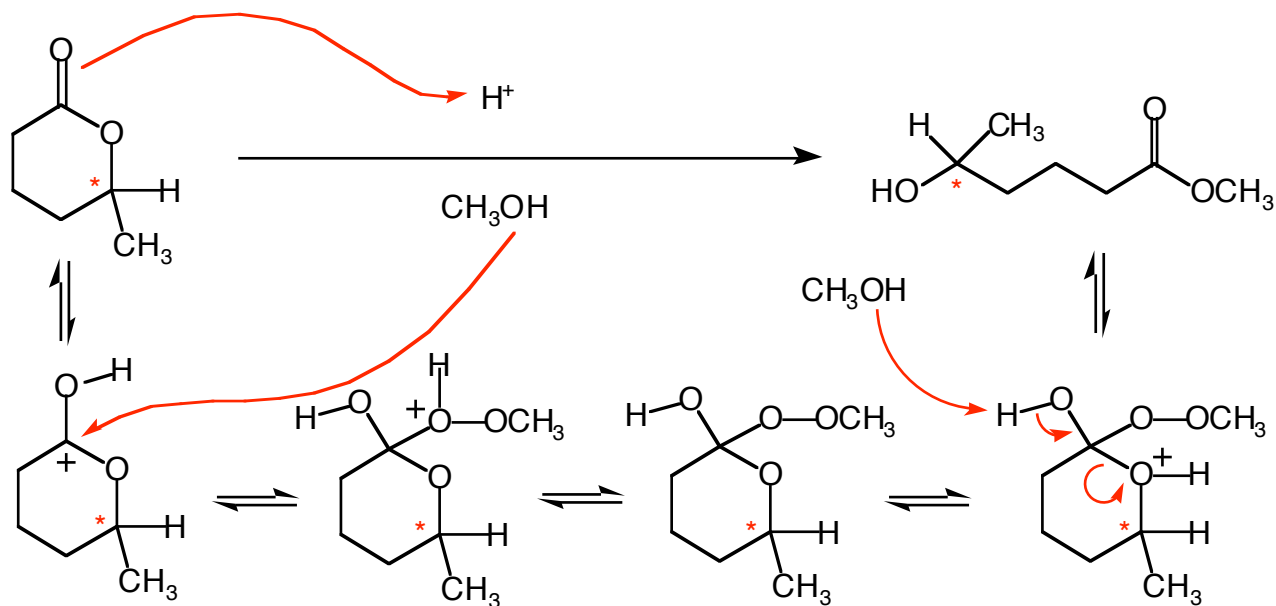
Since Cl is the least capable of possessing a positive charge, it will not want to share its electrons as much. This will result in the resonance structure shown in the 3rd row being a very minor contributor. Thus, the carbonyl of the acyl chloride will have more double bond character and be stronger than the others. It will thus require more energy to stretch.

The nitrogen in the amide is the most capable of sustaining a positive charge. Therefore, the resonance structure shown in row 3 will be a strong contributor to the hybrid structure of the amide. The $\text{C}=\text{O}$ bond will thus possess a lot of single bond character, making it longer, weaker, and requiring less IR irradiation to stretch.

3. Predict the proton NMR of the following molecule. For full credit, you must assign your peaks *and* consider the relative heights in all peaks that show splitting. (12 points)

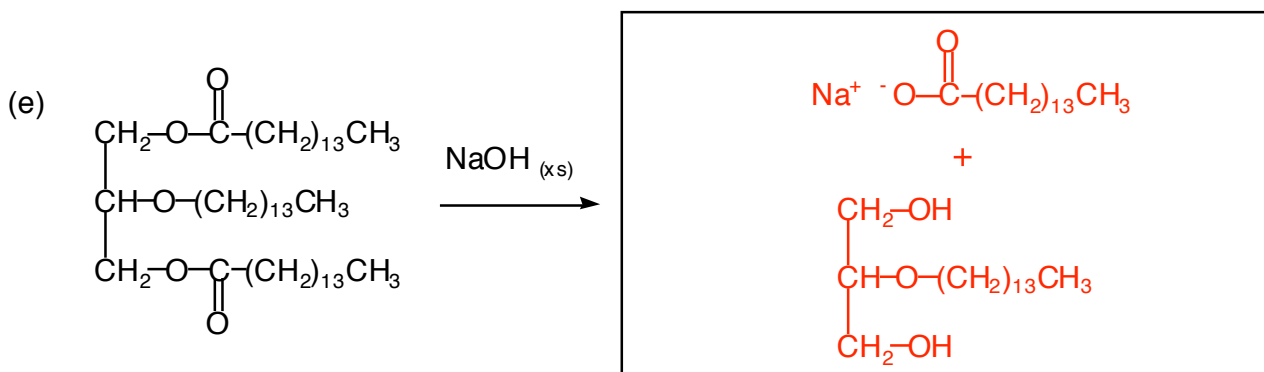
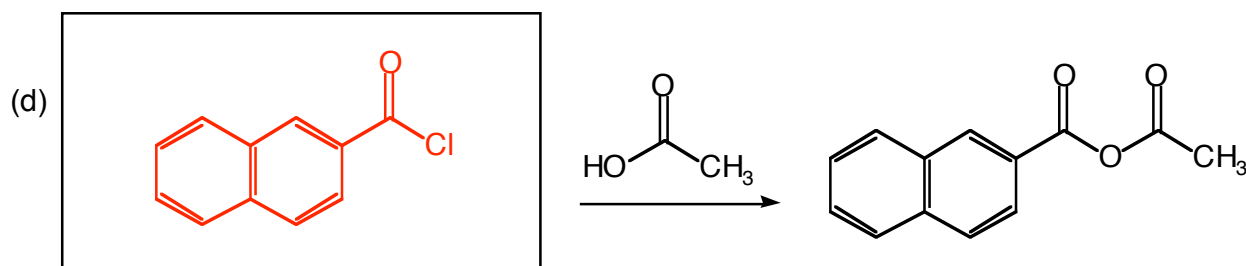
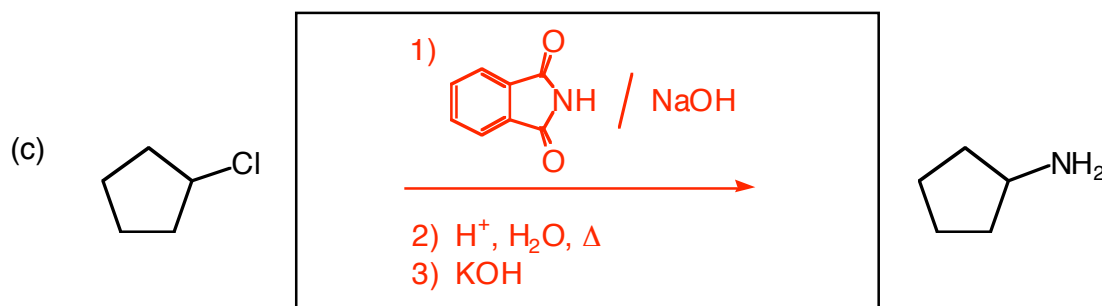
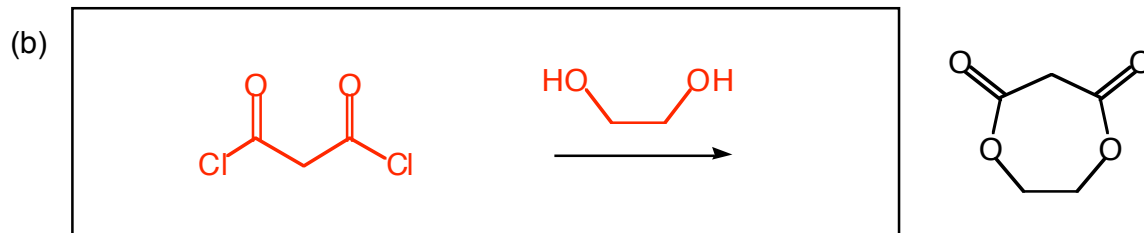
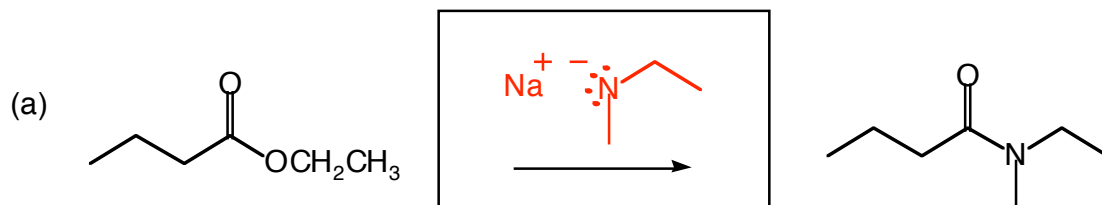


4. Suppose an *optically pure* sample of the lactone below were placed in acidic methanol as shown. Would the product be optically pure? Suggest a mechanism for this reaction that supports your conclusion. Be sure to show all intermediates & charges for full and partial credit. (12 points)

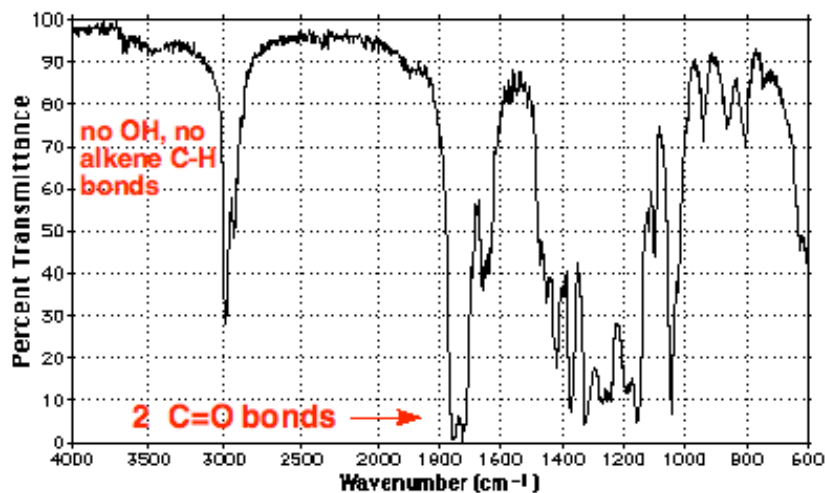


* Since the reaction never occurs at the stereocenter, it will remain intact and form an optically pure product.

5. Fill in the boxes below. When the box is on the product side of the equation, provide the major product only (if two products are formed equally, draw both of them). (20 points)



6. A compound with the molecular formula $C_6H_{10}O_3$ gives the following spectra. Provide a structure for the compound. For full credit, you must assign peaks in each of the 3 spectra! *Circle your answer.* (16 points)



DU = 2

Based on the spectra, the 2 DUs must be...

