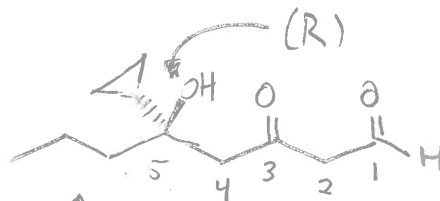
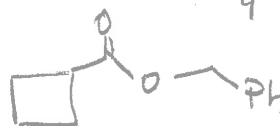


1. Draw the structure of the following compounds (don't forget stereochemistry). (30 points)

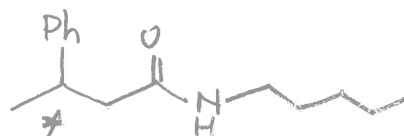
a. (R)-5-cyclopropyl-5-hydroxy-3-oxooctanal



b. benzyl cyclobutanecarboxylate



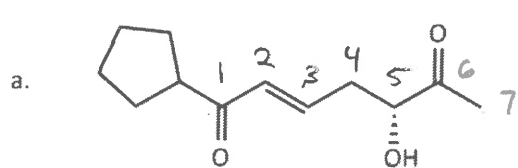
c. N-pentyl-3-phenylbutanamide



no stereochem indicated

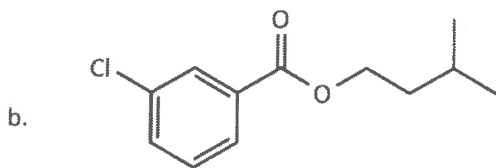
2. Provide IUPAC names for the following compounds (don't forget stereochemistry where appropriate).

(30 points)

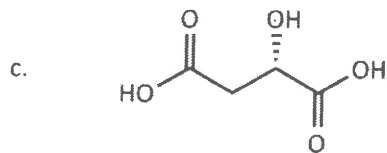


(2E,5R)-1-cyclopentyl-5-hydroxy-

hept-2-ene-1,6-dione



3-methylbutyl 3-chlorobenzoate



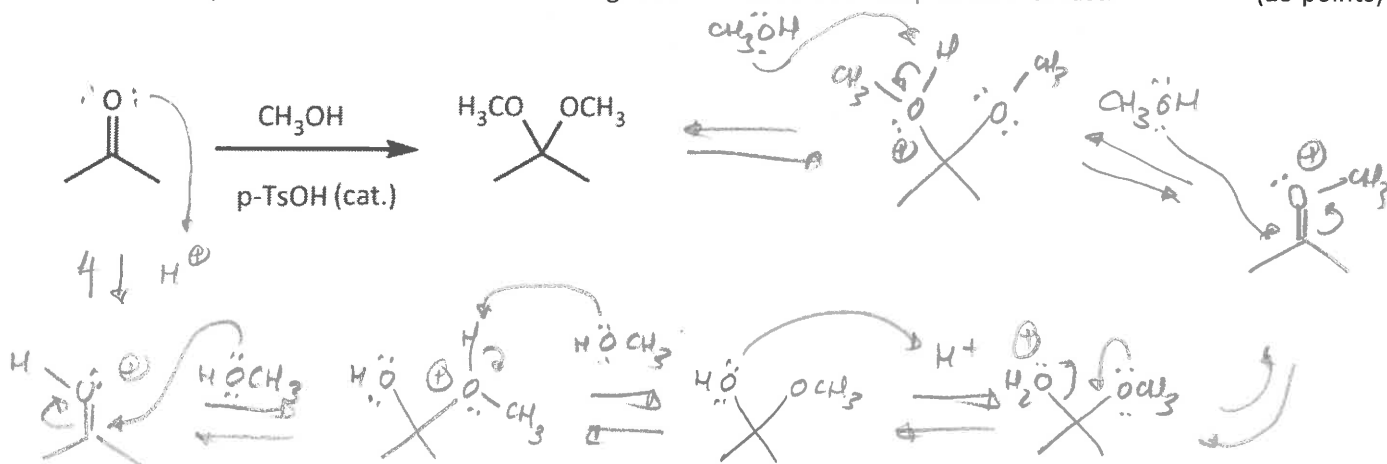
(S)-2-hydroxybutanedioic acid

3. Which carbonyl group is more reactive toward nucleophilic attack, aldehydes or ketones? Explain. (10 points)

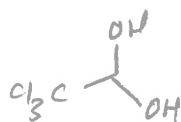
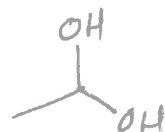
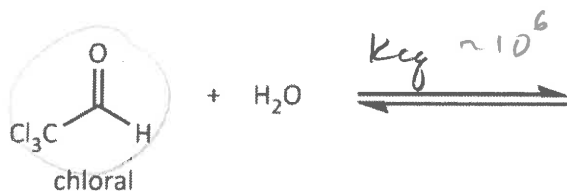
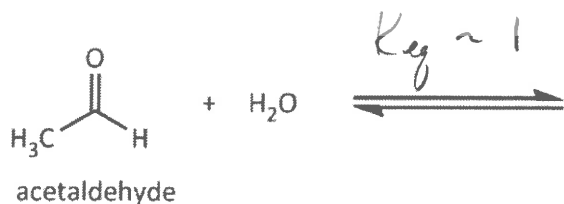


1. Aldehydes are less sterically hindered to Nu attack
2. Ketone carbonyl carbon is more stabilized by R groups

4. Show the complete mechanism for the following reaction. Label each step as slow or fast. (15 points)

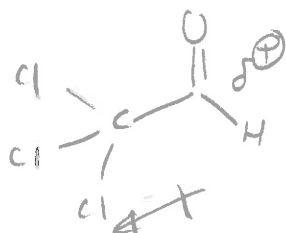


5. Show the hydrates from each aldehyde. Which equilibrium reaction is expected to favor the product more. Explain. (10 points)



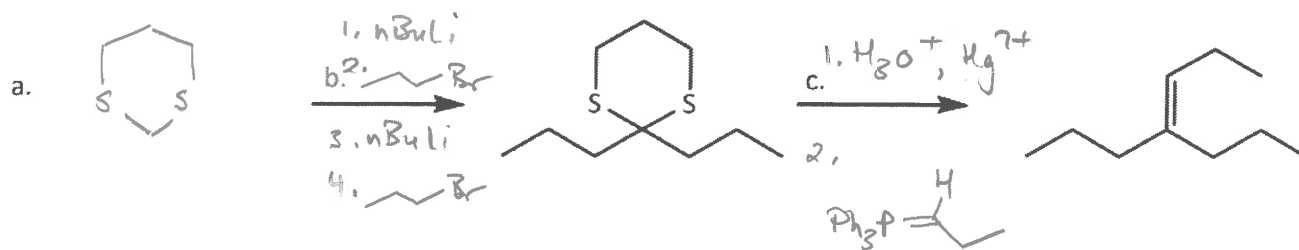
favoured more

"chloral hydrate"
- sedative

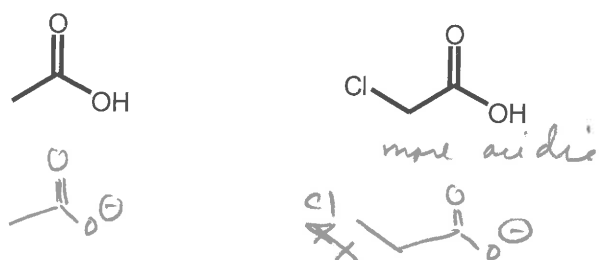


trichloromethyl destabilizes the carbonyl group
- more reactive than acetaldehyde

6. Suggest starting materials in a. and reagents and conditions for b. and c. (15 points)

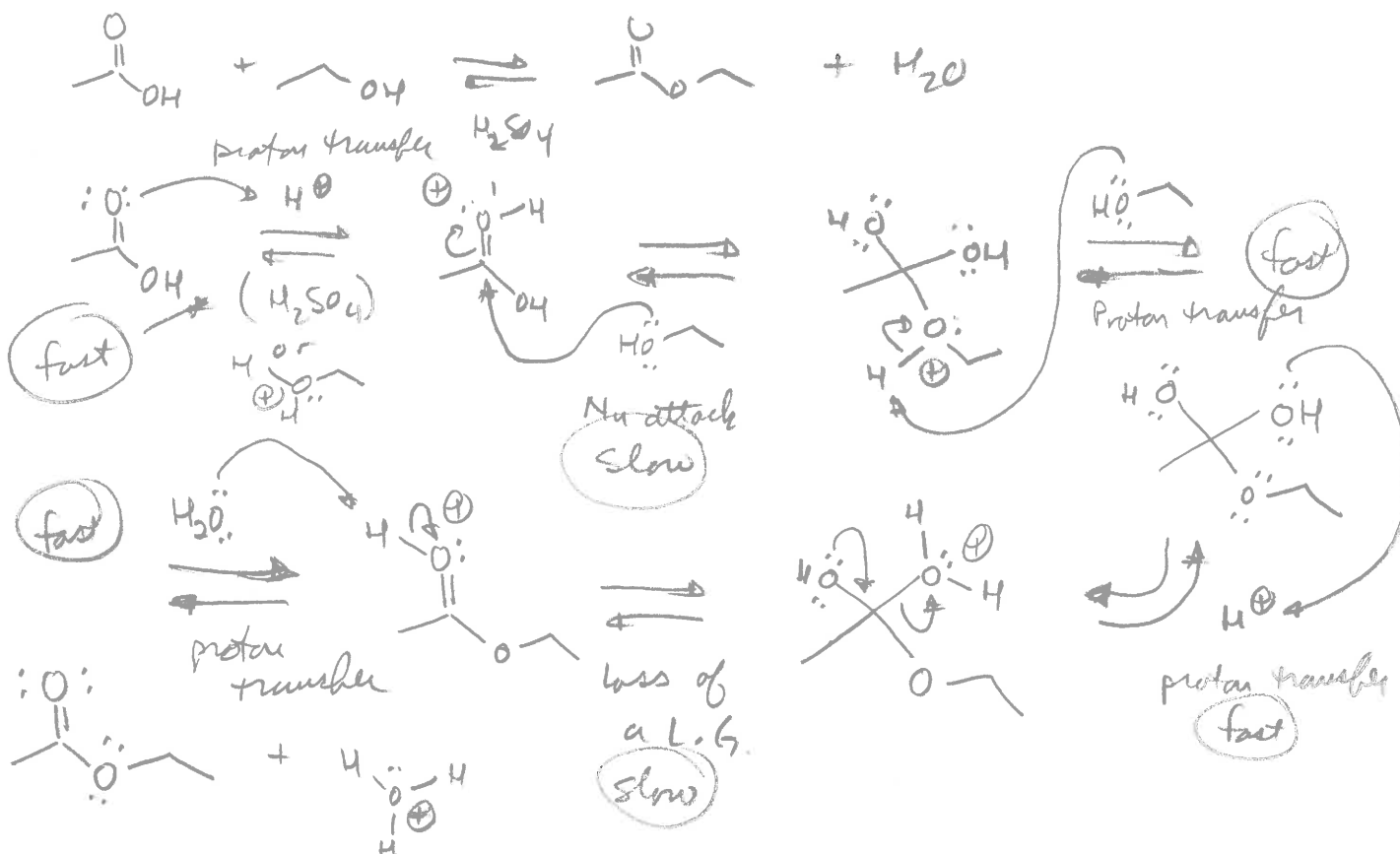


7. Which carboxylic acid shown below is more acidic? Clearly explain why. (10 points)

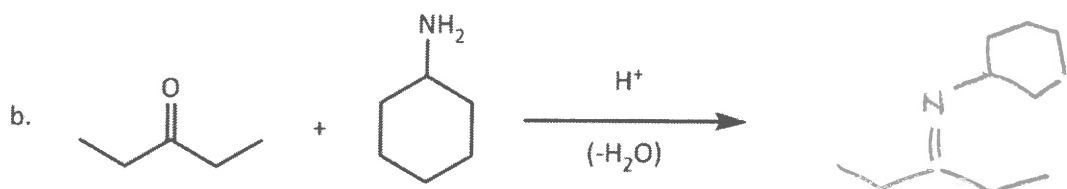
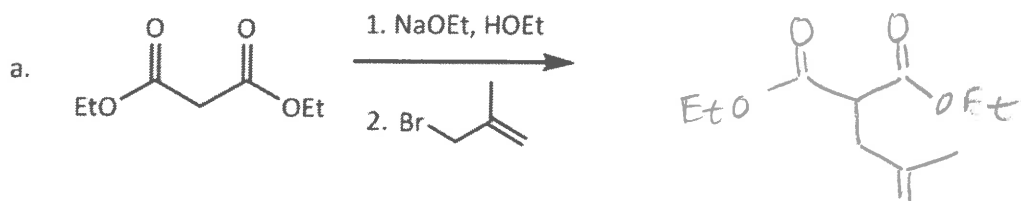


The α -chloro substituent stabilizes the conjugate base through inductive withdrawal of electron density.

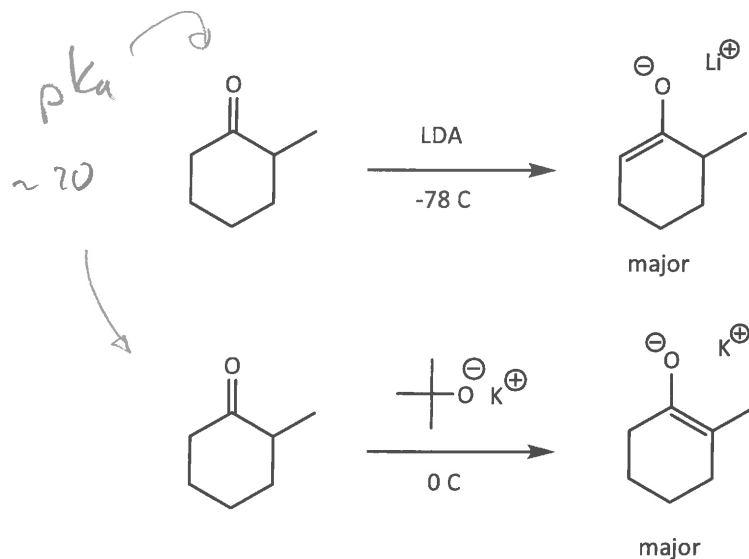
8. Show the complete mechanism of the Fischer esterification of acetic acid with ethanol (using a catalytic amount of H_2SO_4). For each step of the reaction, indicate whether the step is a proton transfer, nucleophilic attack, or loss of a leaving group. Also, show which steps are fast and which ones are slow. (20 points)



9. Show the product (or products) produced from the following synthetic transformations. (10 points)



10. Explain why the two different enolates are formed in terms of *kinetics* vs. *thermodynamics* control. Your answer should include the strength of the base used (i.e. the acidity of its conjugate acid). (10 points)



Kinetic enolate

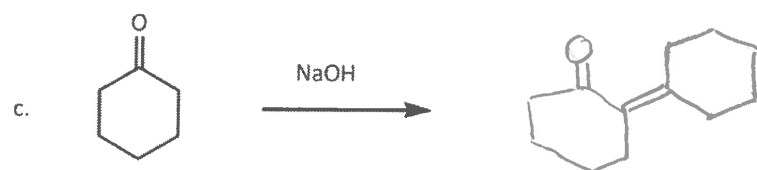
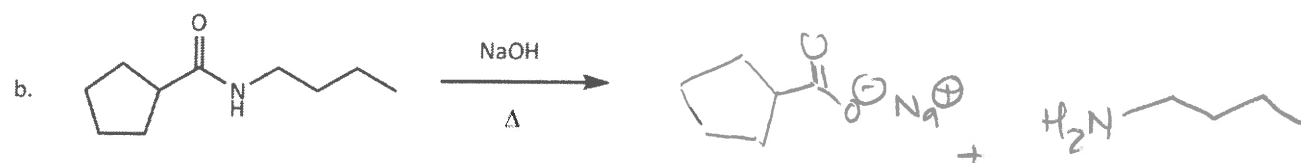
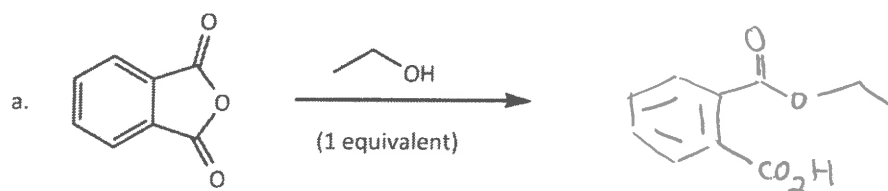
this enolate is formed faster and irreversibly, since the conjugate acid of LDA is diisopropylamine and has a $pK_a \sim 40$ $K \approx 10^{20}$

Thermodynamic enolate

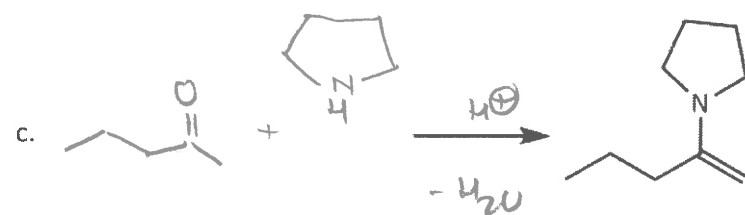
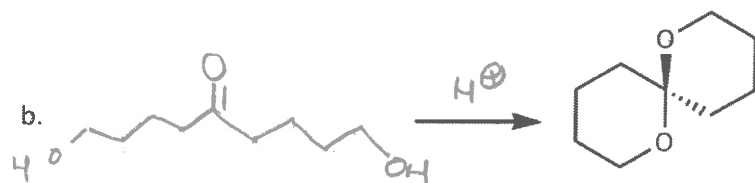
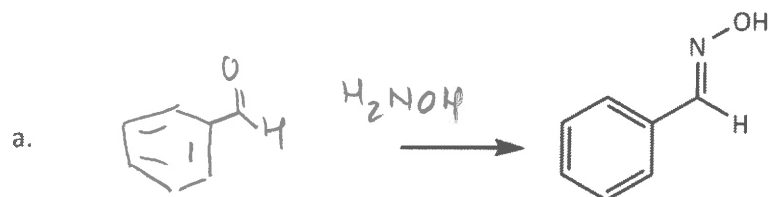
this enolate is more stable due to the double bond substitution (more substituted) and is in equilibrium with the kinetic enolate so is formed reversibly - the pK_a of the conjugate acid of tO^- is ~ 18 so $K_{eq} \approx 10^2$

11. Show the product (or products) from each reaction shown below.

(15 points)

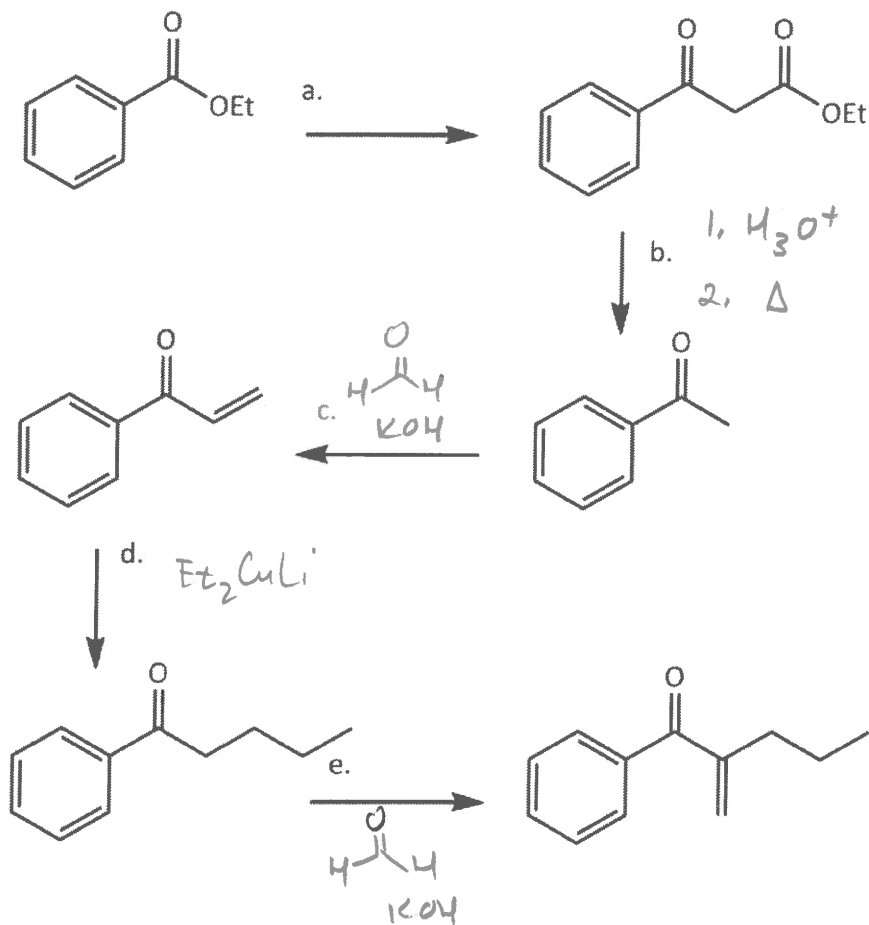


12. Each of the following products comes from a ketone or aldehyde. Show the starting ketone or aldehyde and any other compounds or reagents needed to complete the transformation. (30 points)



13. Fill in the reagents necessary to complete each step.

(25 points)



14. Suggest a mechanism for the following condensation reaction.

(20 points)

