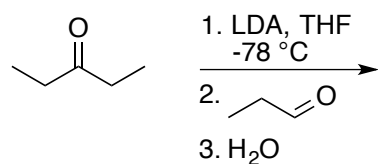
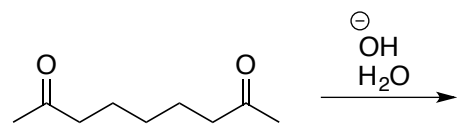
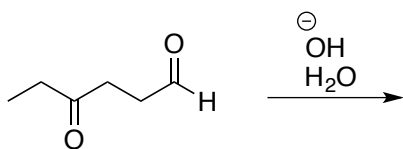
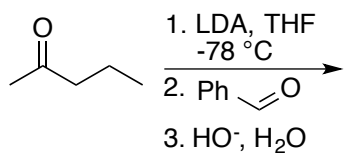
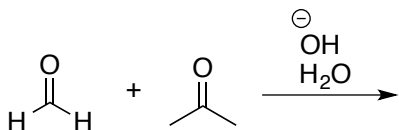
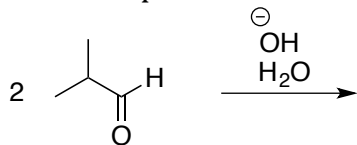


**Chemistry 234**  
**Chapter 23 Problem Set**

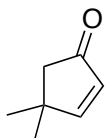
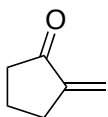
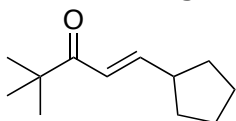
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**Carbonyl Condensation Chemistry**

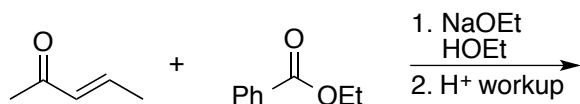
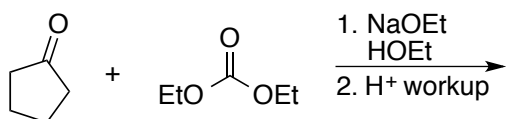
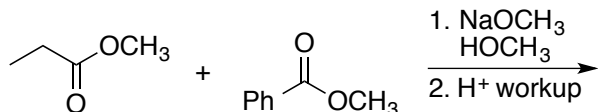
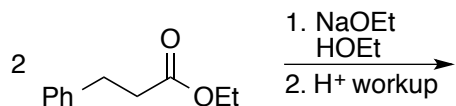
1) Draw the product formed from each of the aldol reactions/condensations below.



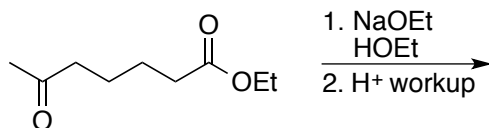
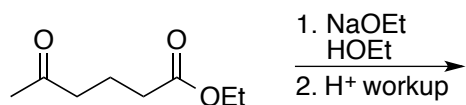
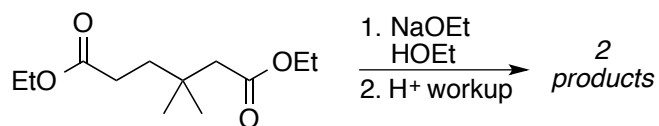
2) What starting material(s) is/are needed to prepare each compound below via an aldol reaction?



3) Predict the major organic product formed from each of the Claisen Condensation Reactions.

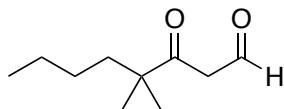
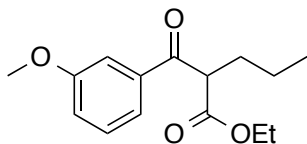


4) Each compound below undergoes a Dieckmann Condensation (Intramolecular Claisen). Predict the major products for each.



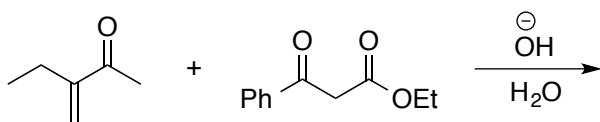
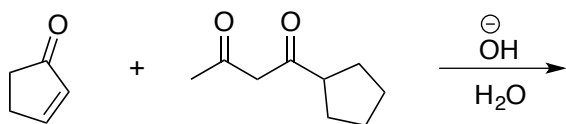
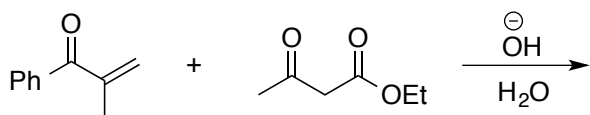
5) Draw the complete electron pushing mechanism for the second reaction in question 4.

- 6) What starting materials are needed to synthesize each compound below by a Crossed Claisen Reaction?

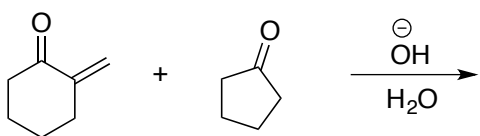
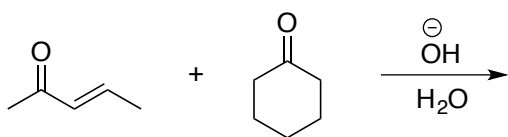
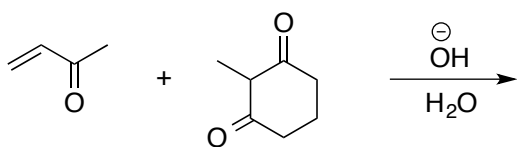


### Conjugate Addition

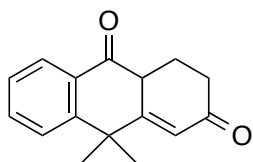
- 7) Predict the product for each Michael reaction below.



- 8) Draw the product from the Robinson Annulation of each.

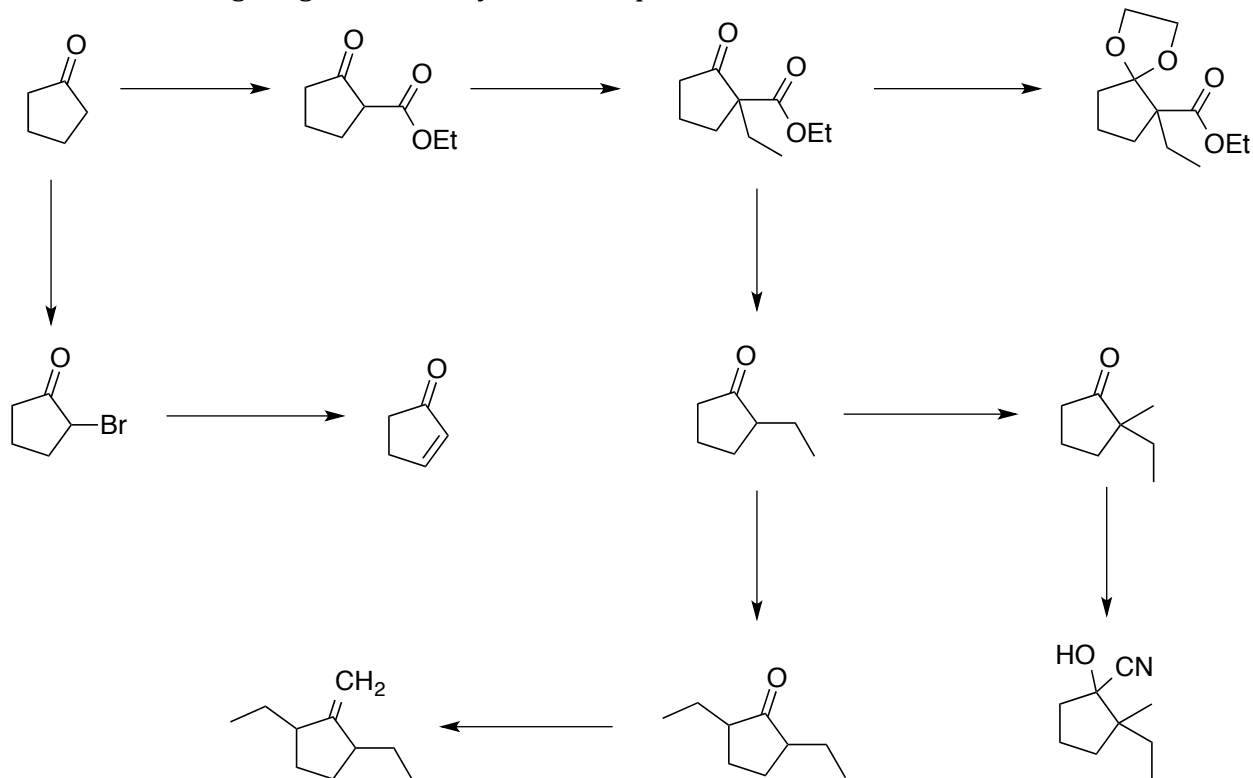


- 9) Identify what reagents you would use to prepare the compound below using a Robinson Annulation reaction?

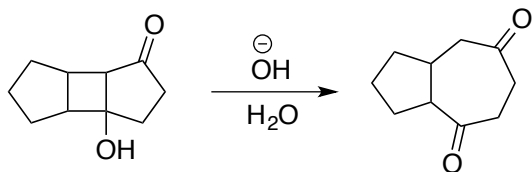


**Part 5: Application to Synthesis**

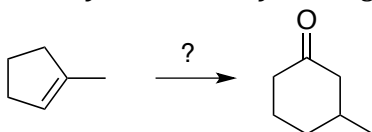
- 10) Fill in the missing reagents in the synthetic sequence below.



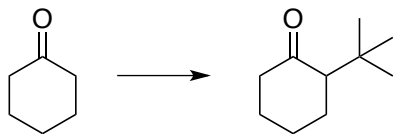
- 11) Provide a reasonable mechanism for the reaction below. What is the driving force for this reaction?



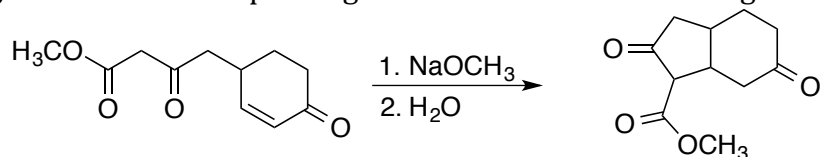
- 12) Propose an efficient synthesis for the following transformation. *Hint: You will need to use the ozonolysis reaction from organic I.*



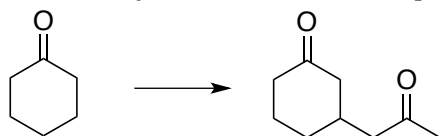
- 13) **Challenge:** The compound below cannot be prepared by direct alkylation of cyclohexanone. Explain why not and provide an alternative route to carry out the transformation. *Hint: at some stage, methyl cuprate might be useful.*



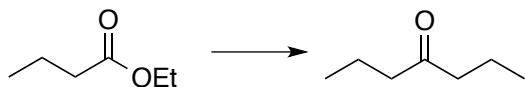
- 14) Draw an electron pushing mechanism for the following reaction.



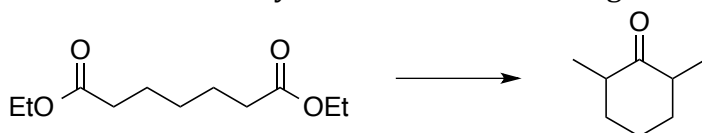
- 15) Devise a synthesis for the compound below starting with cyclohexanone.



16) Devise a synthesis of the ketone below using the ester starting material provided. Your synthesis must involve the use of a Claisen condensation.



17) Devise an efficient synthesis for the following transformation.



18) **Reaction Combo:** Draw the organic products formed when butanal is treated with each reagent.

- $\text{HO}^-$ ,  $\text{H}_2\text{C}=\text{O}$ ,  $\text{H}_2\text{O}$
1. LDA, THF,  $-78\text{ }^\circ\text{C}$ ; 2. PhCHO; 3.  $\text{H}_2\text{O}$
- diethyl malonate, NaOEt, HOEt
- $\text{CH}_3\text{-Li}$  then  $\text{H}^+$
- $\text{NaBH}_4$ ,  $\text{CH}_3\text{OH}$
- $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH}$ ,  $\text{H}^+$
- $\text{H}_3\text{C-NH}_2$ , trace acid
- $(\text{CH}_3)_2\text{NH}$ , trace acid
- $\text{H}_2\text{CrO}_4$
- $\text{Br}_2$ , AcOH
- $\text{Ph}_3\text{P=CH-CH}_3$
1. LDA, THF,  $-78\text{ }^\circ\text{C}$ ; 2.  $\text{H}_3\text{C-I}$
- $\text{HO}^-$ ,  $\text{H}_2\text{O}$  (rxn between two molecules of aldehyde)