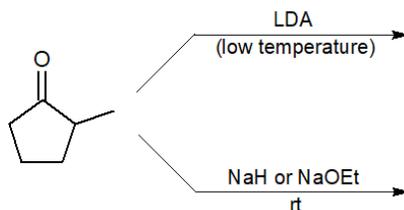


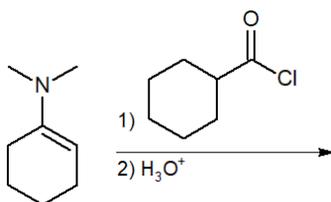
## 23.12: ADDITIONAL EXERCISES

### General Review

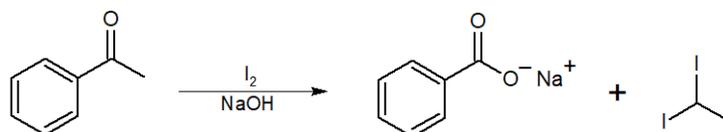
23-1 For each of the following reactions, predict the product. Then identify which one gives the kinetic product and which one gives the thermodynamic product. Explain your reasoning.



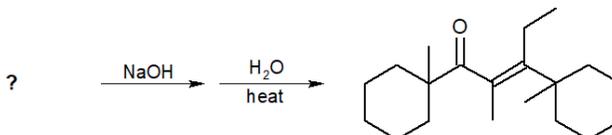
23-2 Predict the final product of the following reaction.



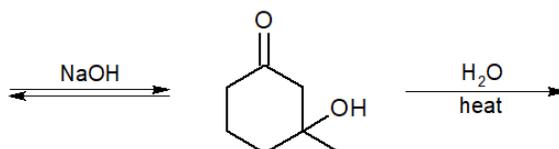
23-3 Explain why we obtain the products shown below as a result of the base catalyzed  $\alpha$ -halogenation reaction, instead of a single or double halogenated product.



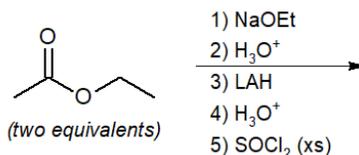
23-4 Identify the starting molecule of the aldol addition-condensation reaction that resulted in the final product below.



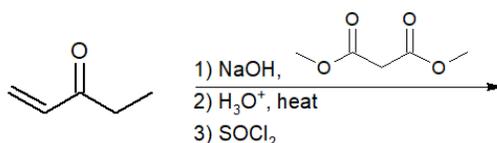
23-5 The following reaction is an example of an intramolecular aldol addition-condensation reaction. Given the aldol product, identify the starting molecule and the condensation product.



23-6 Provide the final product of the following reaction (for now, ignore any stereochemistry).

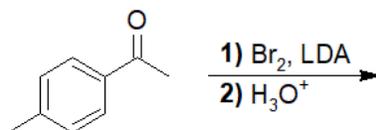


23-7 Predict the final product of the following reaction.



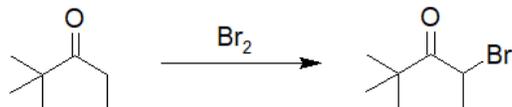
### Enols and Enolate Ions

23-8 Choose the correct IUPAC nomenclature of the product of the following reaction and provide its structure.

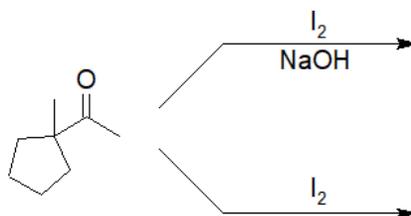


- a) dibromo(4-methylphenyl)methanol
- b) 4-methylbenzoic acid
- c) 4-methylbenzoyl bromide
- d) bromo(4-methylphenyl)methanol

23-9 Draw the mechanism for the following self-catalyzed halogenation reaction.

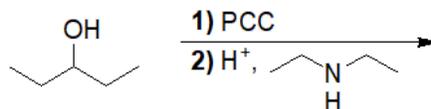


23-10 Predict the product of the following reaction.



### Formation and Alkylation of Enamines

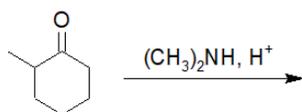
23-11 Choose the correct IUPAC nomenclature for the product of the following reaction.



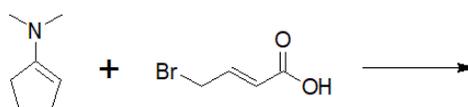
- a) (2Z)-N,N-diethylpent-2-en-3-amine
- b) N,N-diethylpentan-3-amine
- c) 3-(diethylamino)pentan-3-ol
- d) Tetraethylhydrazine

23-12 Predict the major products of the following reactions.

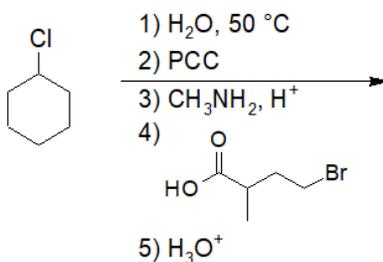
a)



b)

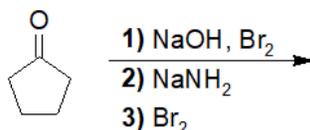


23-13 Predict the product of the following reaction.



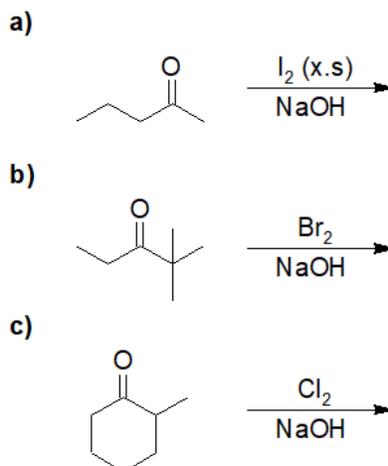
### Alpha Halogenation of Ketones

23-14 Predict the product of the following reaction.



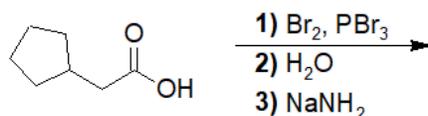
23-15 Draw the mechanism for the  $\alpha$ -halogenation step of the ketone in problem 23-14.

23-16 Provide the structures of the products of the following reactions.

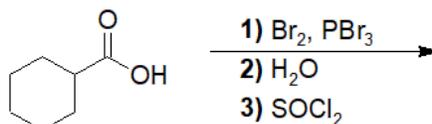


### Alpha Bromination of Acids: The HVZ Reaction

23-17 Give the product of the following reaction.

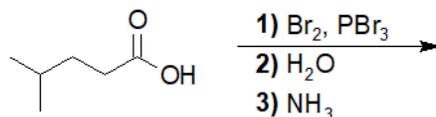


23-18 Choose the correct IUPAC nomenclature of the product of the following reaction.



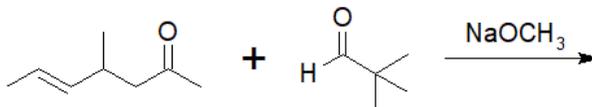
- 1-chlorocyclohexane-1-carboxylic acid
- 1-bromocyclohexane-1-carbonyl chloride
- 1-chlorocyclohexane-1-carbonyl chloride
- 1-hydroxycyclohexane-1-carbonyl bromide

23-19 Provide the structure and IUPAC nomenclature of the product of the following reaction.

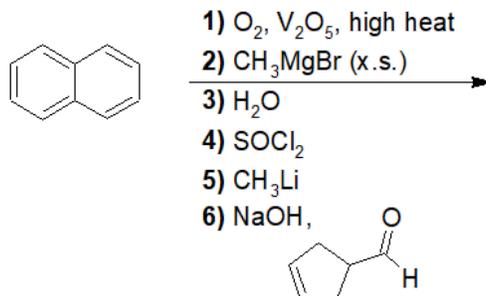


### The Aldol Condensation of Ketones and Aldehydes

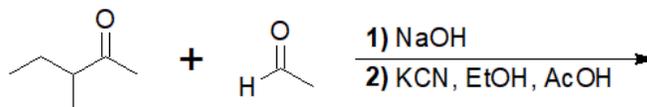
23-20 Give the structure of the product of the following aldol condensation reaction.



23-21 Predict the structure of the product of the following reaction.

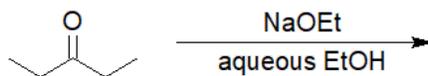


23-22 Provide the structure of the product of the following reaction.



### Dehydration of Aldol Products

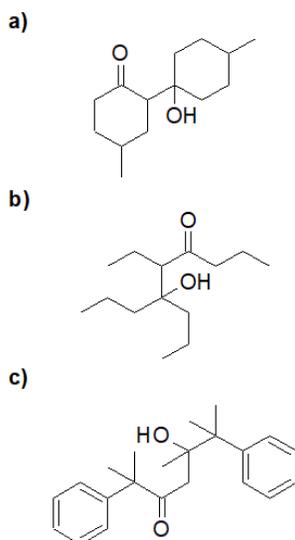
23-23 Choose the correct IUPAC nomenclature for the product of the following aldol condensation reaction.



- a) 5-ethyl-4-methylheptan-3-one
- b) 5-ethyl-4-methylhept-4-en-3-one
- c) 5-ethyl-5-hydroxy-4-methylheptan-3-one
- d) (5Z)-5-ethyl-4-methylhept-5-en-3-one

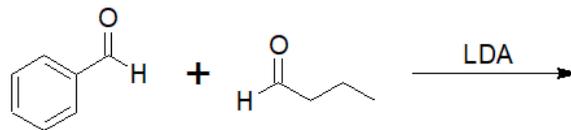
23-24 Provide the mechanism for the reaction to the answer for the previous question.

23-25 For the following compounds, draw a possible product of the condensation step.

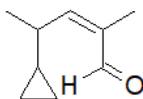


### Crossed Aldol Condensations

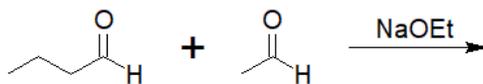
23-26 Provide the structure of the product of the following reaction.



23-27 Suggest the structures of the starting compounds that were reacted to create this final crossed aldol condensation product.



23-28 Provide the structures of all possible products of the following crossed aldol condensation reaction.

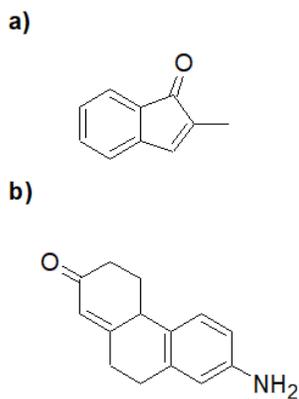


### Aldol Cyclizations

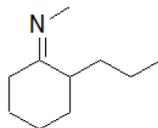
23-29 Provide the IUPAC name for the product of the following intramolecular aldol condensation reaction.



23-30 Identify the starting material used to create the following products of aldol cyclization.



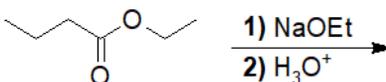
23-31 Starting with a single diketone molecule, propose a method of synthesis for the following compound that includes an aldol cyclization step.



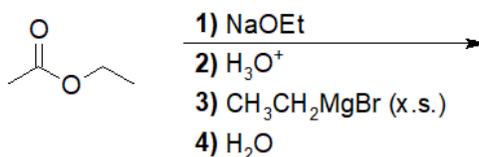
**(1Z)-N-methyl-2-propylcyclohexan-1-imine**

**Claisen Condensations**

23-32 Predict the product of the following Claisen condensation reaction.

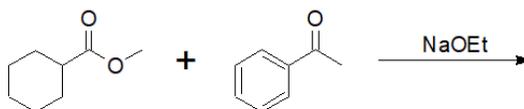


23-33 Predict the final product of the following reaction.

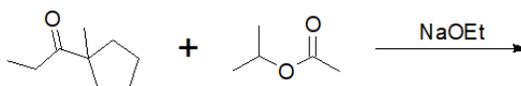


23-34 Provide the structure of the products of the following crossed Claisen condensation reactions.

a)

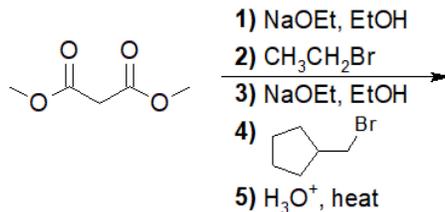


b)

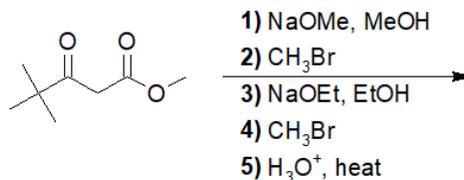


**Syntheses Using  $\beta$ -Dicarbonyl Compounds**

23-35 Give the structure and IUPAC nomenclature of the product of the following reaction.



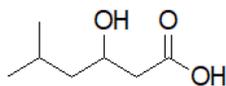
23-36 Choose the correct IUPAC nomenclature of the product of the following reaction.



- a) 2,2,4,4-tetramethylpentan-3-one
- b) 2,2,4-trimethylpentan-3-one
- c) 2,4,4-trimethylpent-1-en-3-one

d) 2,4,4-trimethyl-3-oxopentanoic acid

23-37 Suggest a way to make (5-methylhexyl)benzene from 3-hydroxy-5-methylhexanoic acid.



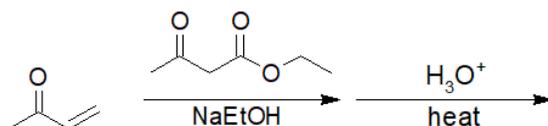
**3-hydroxy-5-methylhexanoic acid**

### Conjugate Additions: The Michael Reaction

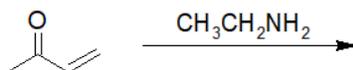
23-38 For the following pairs of compounds, identify the Michael acceptor and the Michael donor.



23-39 Predict the product of the following reaction chain.



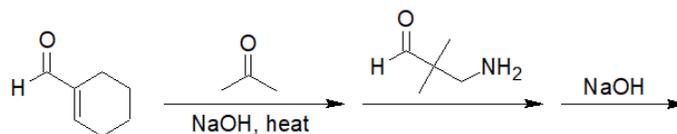
23-40 Pick the answer that correctly names the product of the following Michael addition reaction.



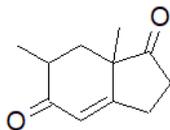
- a) 3-(ethylamino)butan-2-one
- b) 2-(ethylamino)butan-2-ol
- c) 4-(ethylamino)butan-2-one
- d) 4-(methylamino)butan-2-one

### The Robinson Annulation

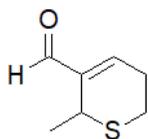
23-41 Predict a possible product of the following reactions.



23-42 Given the following compound, predict the Michael acceptor and donor that initially reacted to allow for the aldol condensation to occur.



23-43 Given the following Robinson annulation product, identify the intermediate compound that results from the Michael addition and exists before the aldol condensation.



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