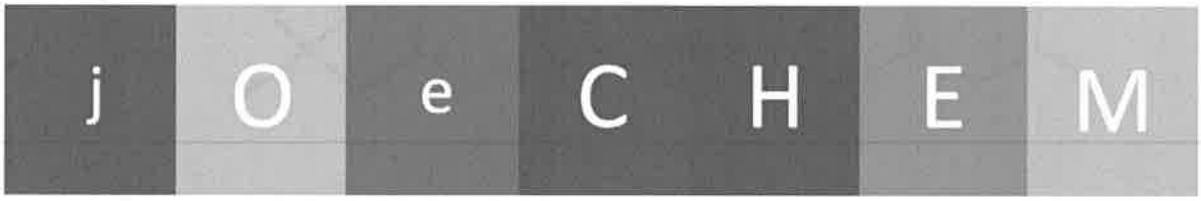
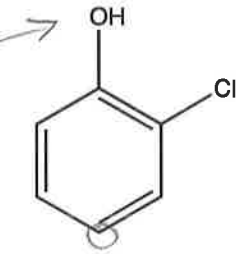
Organic Chemistry II

Final Exam

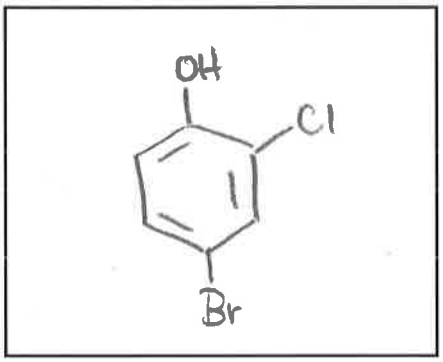


1.) The many reactions below are shown missing their **final product**. For each problem below, correctly predict the final product. If you believe no product is formed/no reaction occurs, write "**NR**".

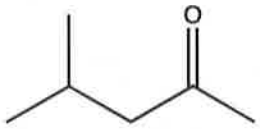
Stronger director



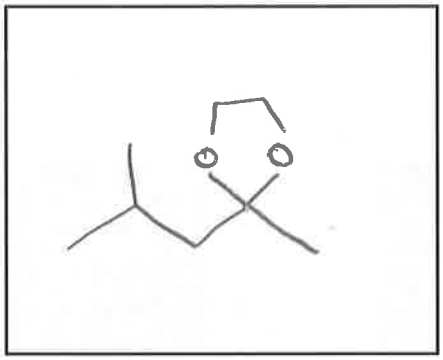
Br_2 , $FeBr_3$

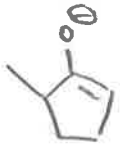


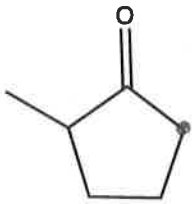
acetal



H^+, $-H_2O$



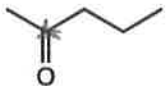


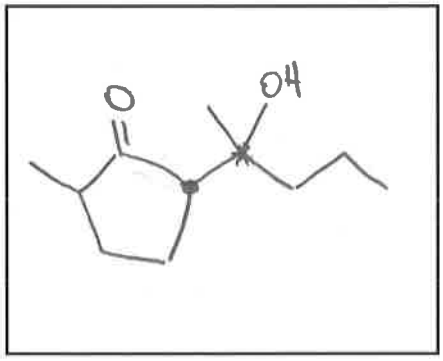


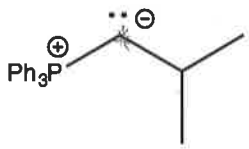
aldol rxn

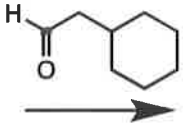
1.) LDA, -78 °C, THF

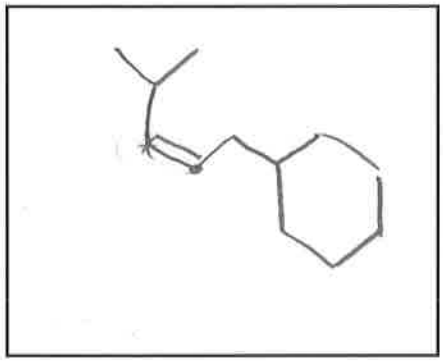
2.)







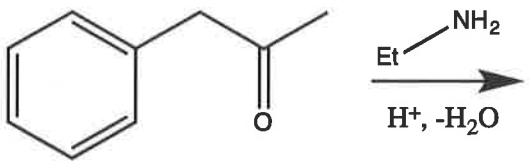


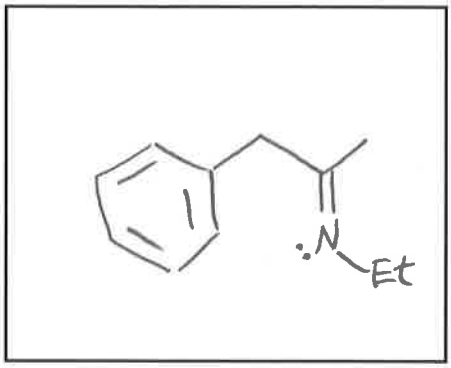


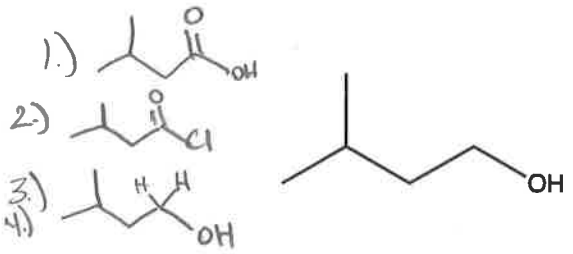
Wittig; remember cis double bond!

(1° amine)

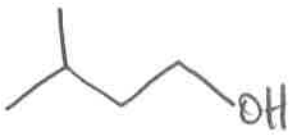
imine



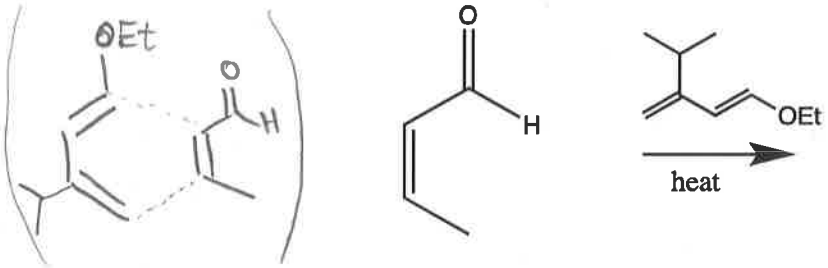


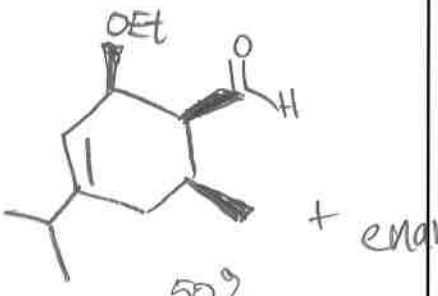


(goes back to original)



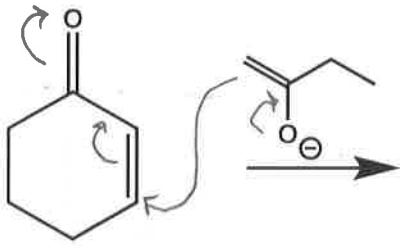
Diels alder

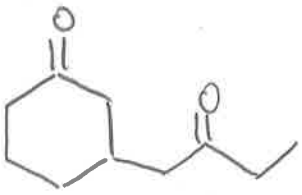




+ enantiomer 50%

Michael Addition
1,5-dicarbonyl

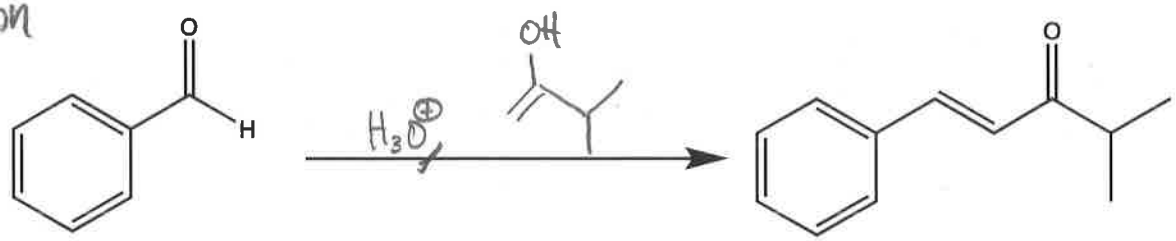


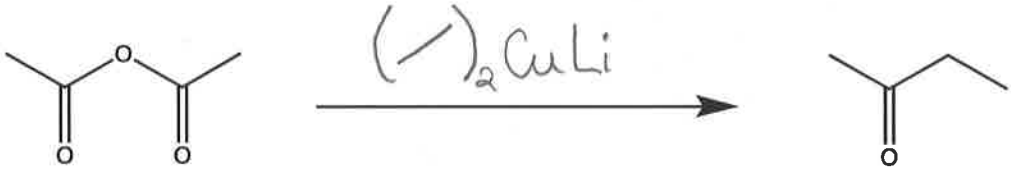


enolate:
soft nucleophile, attack once

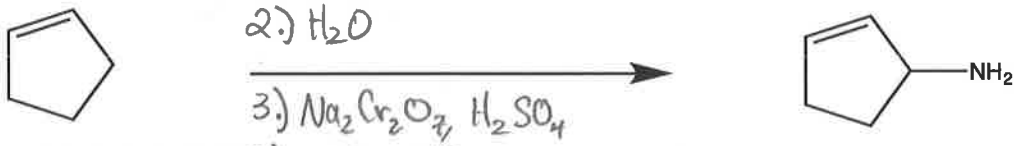
2.) Below various reactants and products are shown. In each reaction, provide the necessary reagents to make the given transformations occur. **Note:** The reactions can possibly require multi-step reagents.

aldol condensation

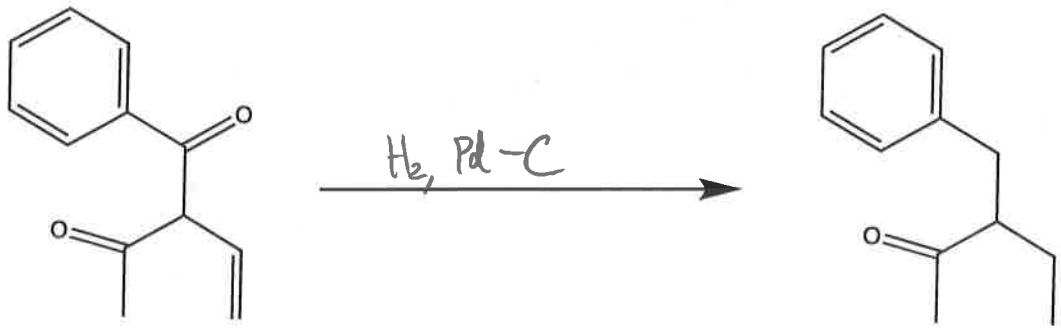




either OR

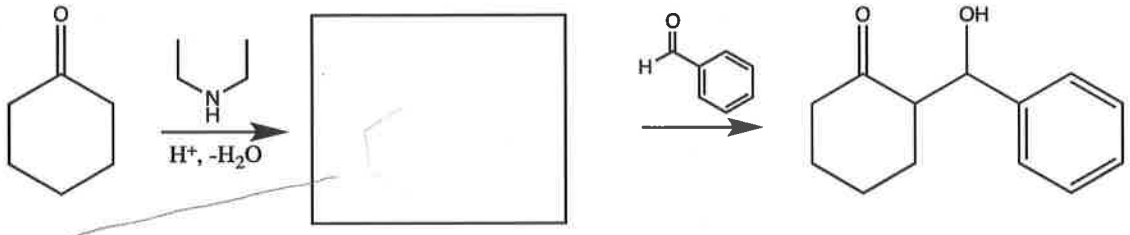


1.) $Br_2, h\nu, \Delta$
2) $N_3^{\ominus}$ (S_N2)
3.) H_2, Pd-C



* Benzylic carbonyl reduced by H_2, Pd-C

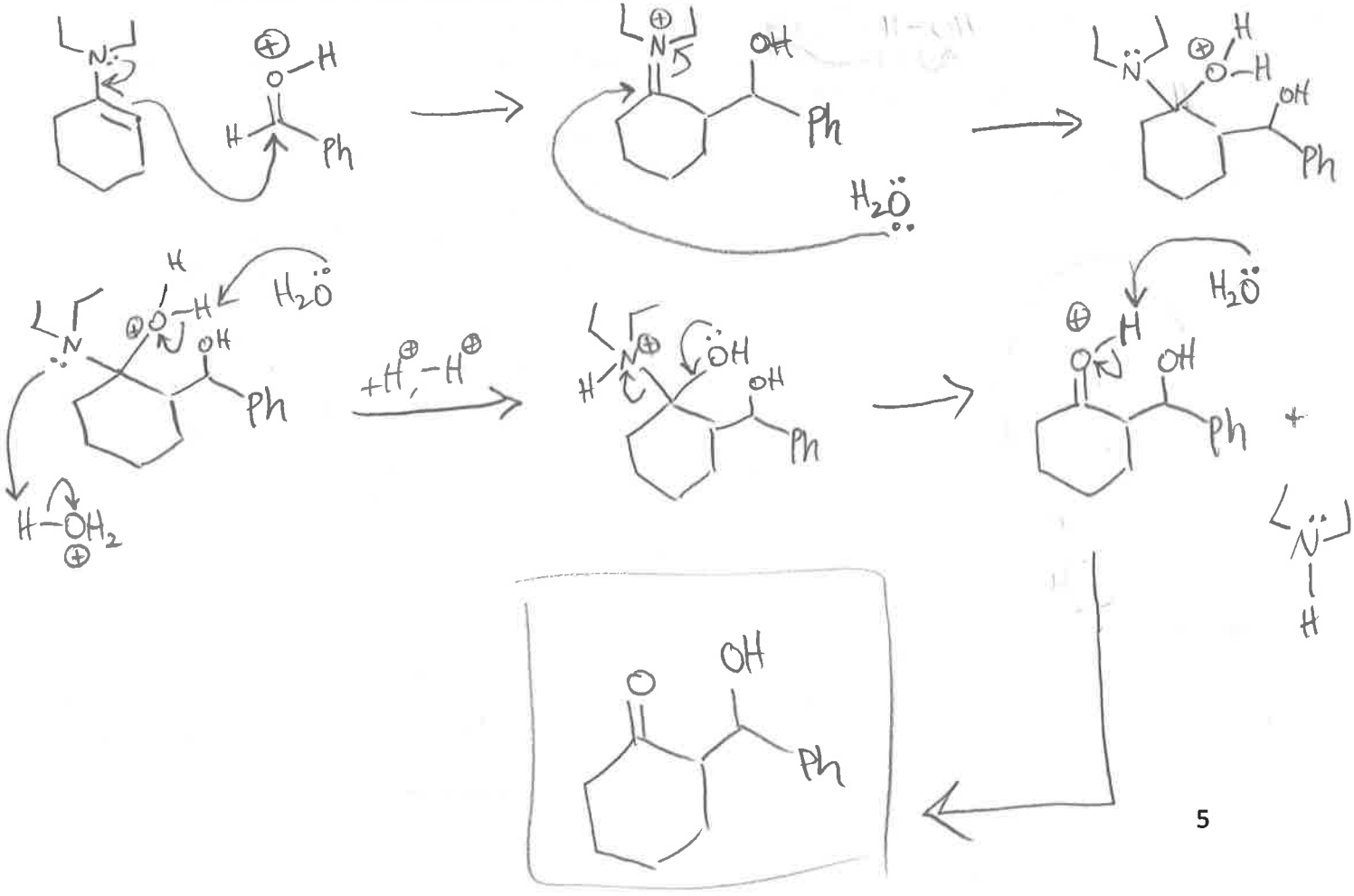
3.) Shown below is an aldol reaction where the nucleophile in the reaction is an enamine.



(enamine)

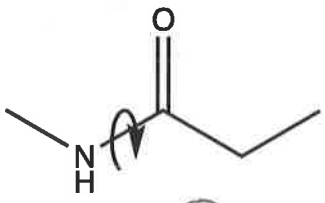
a.) Draw the structure of the enamine that is made in this reaction before it performs the aldol reaction.

b.) Draw the full arrow-pushing mechanism that illustrates the aldol reaction above. You **DO NOT** need to provide the mechanism for the formation of the enamine (you can go ahead and start with the enamine already made.)

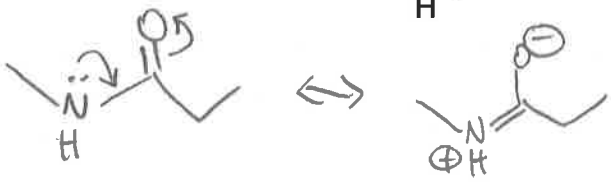


4.)

a.) In all amides, it is observed that the carbon-nitrogen sigma bond has limited rotation about the bond axis. Using structures **and a brief explanation**, illustrate why this hindered bond rotation is observed, given the amide below.



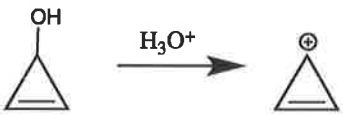
(Hindered)



Resonance structure is a significant contributor, so the bond has π bond-like character ⇒ limited rotation

b.) Cycloprop-2-en-1-ol undergoes carbocation formation very easily and quickly in the presence of acid, while cyclopenta-2,4-dien-1-ol does not. BRIEFLY explain why this phenomenon is observed.

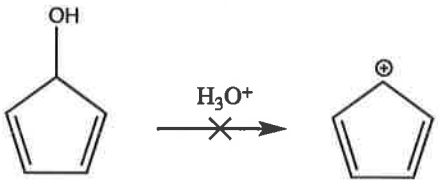
aromatic result:



$4n + 2 = 2$

$(n=0)$

- formation of the carbocation is favorable



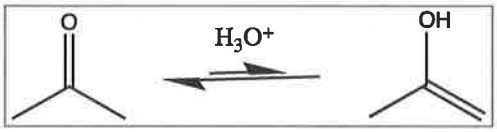
anti-aromatic result:

$4n = 4$

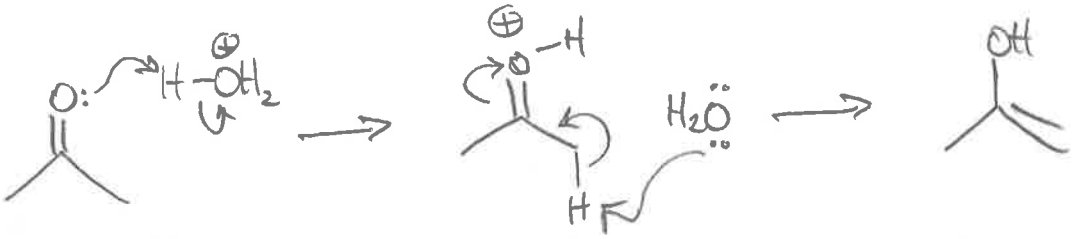
$(n=1)$

- Carbocation formation is unfavorable

5.) It is known that the **keto** form is favored in Keto-Enol Tautomerism. Shown below is the keto-enol equilibrium exhibited by acetone in an **acidic** environment.



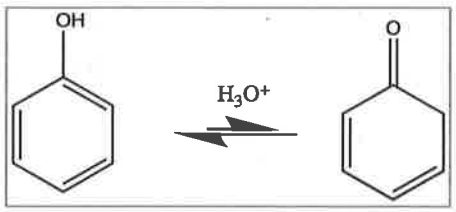
a.) Draw the arrow pushing mechanism that illustrates how acetone's keto form tautomerizes to the enol form (aka, show how the ketone transforms into the enol) in acidic conditions.



b.) Provide a **BRIEF explanation** as to why the keto form is favored over the enol form.

The carbon-oxygen double bond (ketone) is stronger/more stable than the carbon-carbon (enol) double bond.

c.) Knowing all of this, BRIEFLY explain why phenol exists as a **stable enol** as opposed to tautomerizing to its keto form.



The aromaticity of the ring is so beneficial, so the enol persists over the ketone.

Big step: Mannich rxn

6.) Propose an efficient synthesis of the given target molecule (on the right hand side of the page) with benzene, ethyl chloride, and propyl chloride as your only sources of carbon. You may use whatever inorganic reagents (including ammonia) you may need to complete the transformation.