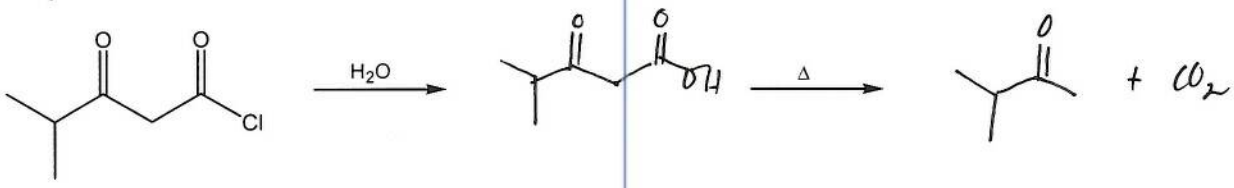
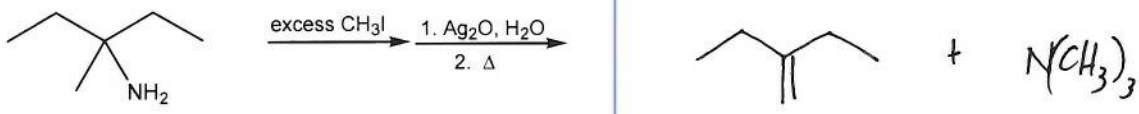
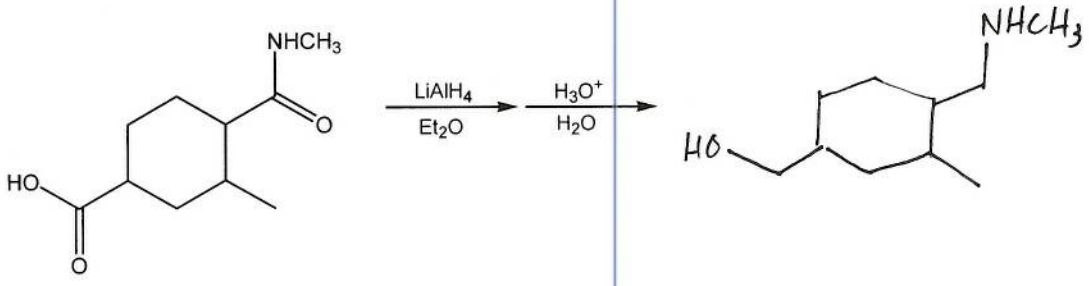
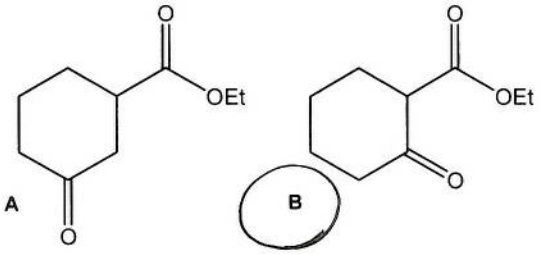
1. (6 pts each) Predict the major product of the following reactions. Mechanisms and explanations are not necessary.

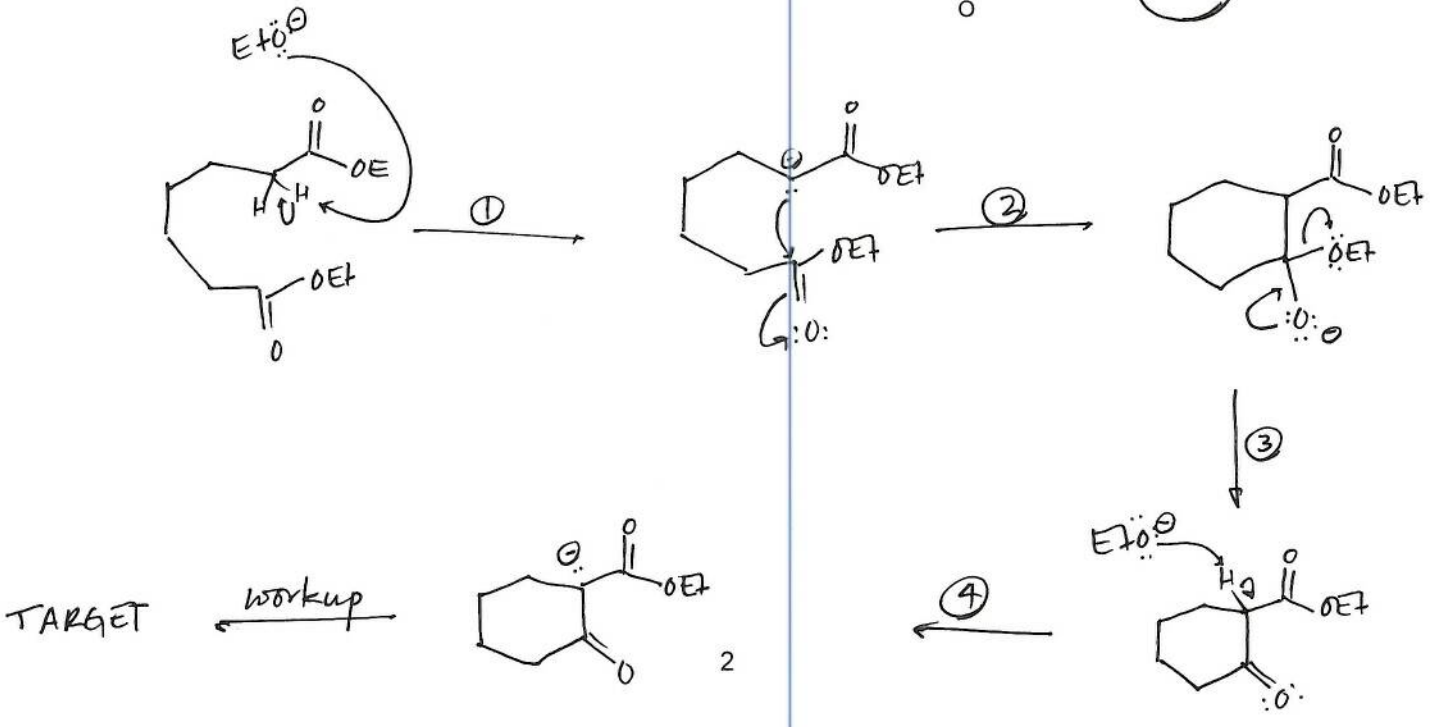
a. 

b. 

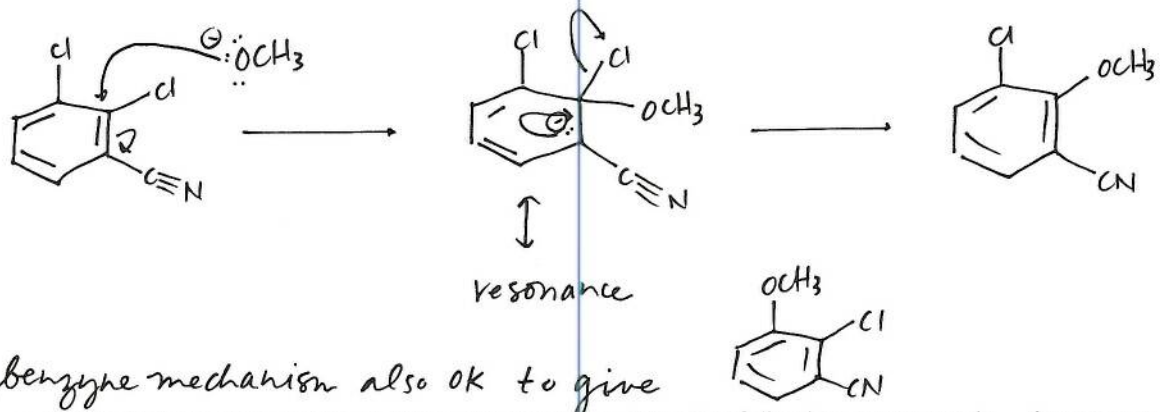
c. 

2. (14 pts) Only one of the keto esters to the right can be formed by a Claisen (Dieckmann) condensation. Determine which one, show the necessary reactant(s), and write a complete mechanism for the reaction you propose. For partial credit, you may show any correct Claisen mechanism.



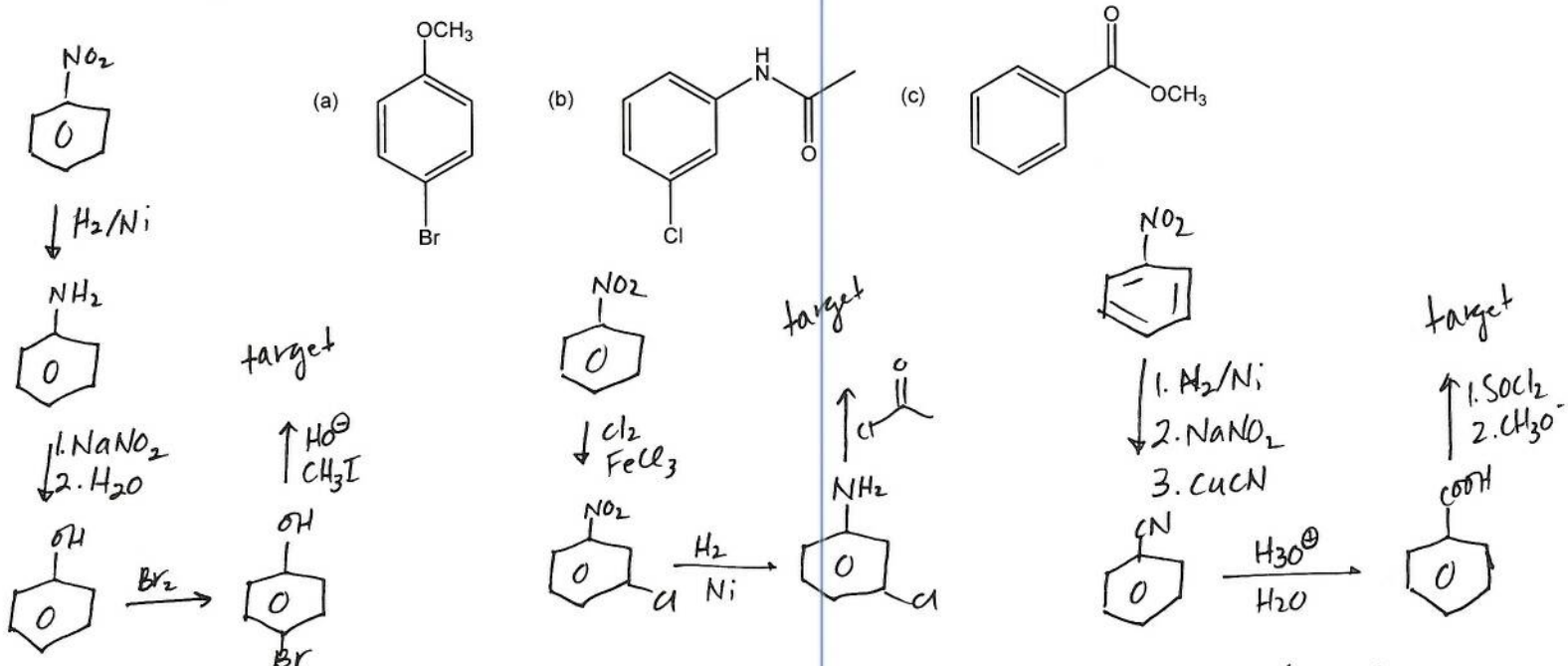


3. (10 pts) When 1,2-dichloro-3-cyanobenzene is treated with $NaOCH_3$ at 100 °C, one major product is obtained. Write an equation for the substitution, showing the product you expect. Give a mechanism to account for the formation of your proposed product.

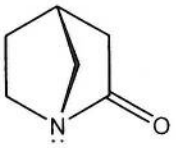


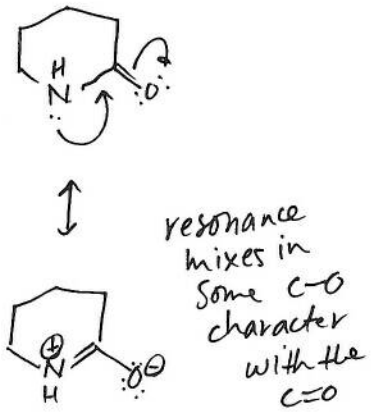
a benzyne mechanism also ok to give

4. (10 pts each) Show how you would convert nitrobenzene into the following compounds. Assume any reagents you need are available. Mechanisms and explanations are not required. Answer any TWO of the three parts.

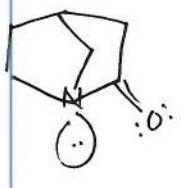


5. (10 pts) The amide shown to the right exhibits an IR stretch for the carbonyl at 1751 cm^{-1}. Relative to the normal stretching range for an amide carbonyl (1680-1700 cm^{-1}), this value is quite high. Using a combination of drawings and words, explain why the amide carbonyl of this amide exhibits an unusually high stretching frequency.



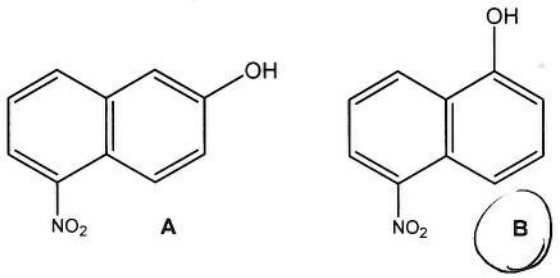


resonance mixes in some C–O character with the C=O



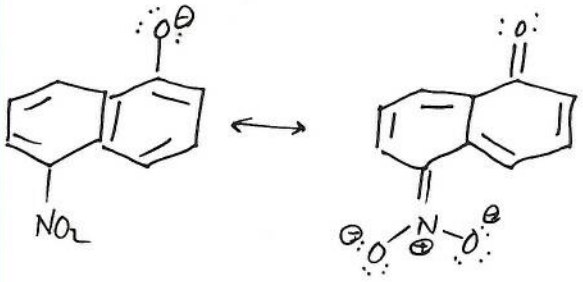
no resonance since N lone pair is ⊥ to pi orbital of C=O

6. a. (8 pts) Which of the phenols to the right is the stronger acid. Justify your answer using both words and drawings. Show any resonance structures that are central to your argument.



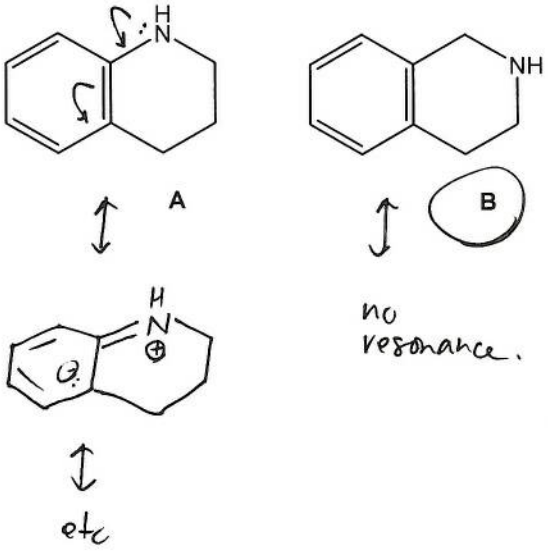
B conjugate base has extra resonance w/ NO_2

Since conj base is more stable, B is the stronger acid



b. (8 pts) Which of the amines to the right is the stronger base? Justify your answer using both words and drawings. Show any resonance structures that are central to your argument.

B lacks the base weakening resonance effect of the aromatic ring and the base weakening e⁻ withdrawing effect of the aromatic ring.



7. (12 pts) Provide a mechanism for the reaction shown below.