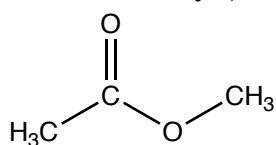
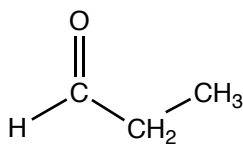


1. (12 pts.) Identify the functional groups in the following molecules (be more specific than "carbonyl").

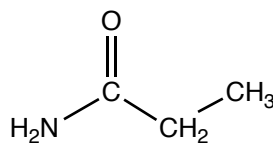
1. \_\_\_\_\_



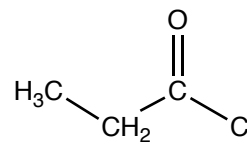
ester



aldehyde



amide



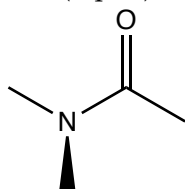
acid chloride

2. \_\_\_\_\_

3. \_\_\_\_\_

2. a. (5 pts.) Which of the following is more reactive toward nucleophilic acyl substitution?  
b. (5 pts.) Explain your choice.

4. \_\_\_\_\_



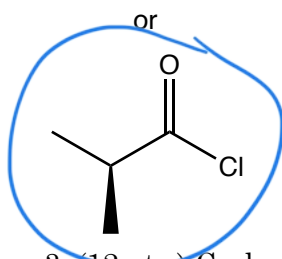
C to Cl  $\pi$  bond is weaker than C to N  $\pi$  bond. Cl's 3p orbitals don't overlap well with C's 2p orbitals, whereas 2p on N and 2p on C are a good match.

5. \_\_\_\_\_

6. \_\_\_\_\_

7. \_\_\_\_\_

8. \_\_\_\_\_



$\text{Cl}^-$  is a weaker base than  $\text{HNR}_2$  so the  $\text{Cl}^-$  is a better LG.

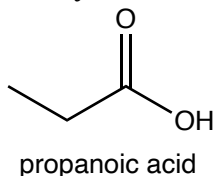
3. (12 pts.) Carboxylic acids undergo nucleophilic substitution reactions when they react with nucleophiles, whereas ketones undergo nucleophilic addition reactions. Explain why carboxylic acids do substitution reactions whereas ketones do addition reactions.

9. \_\_\_\_\_

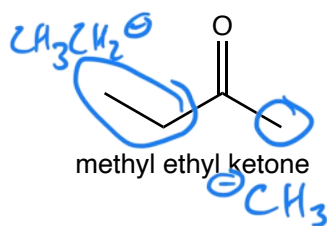
10. \_\_\_\_\_

11. \_\_\_\_\_

12. \_\_\_\_\_

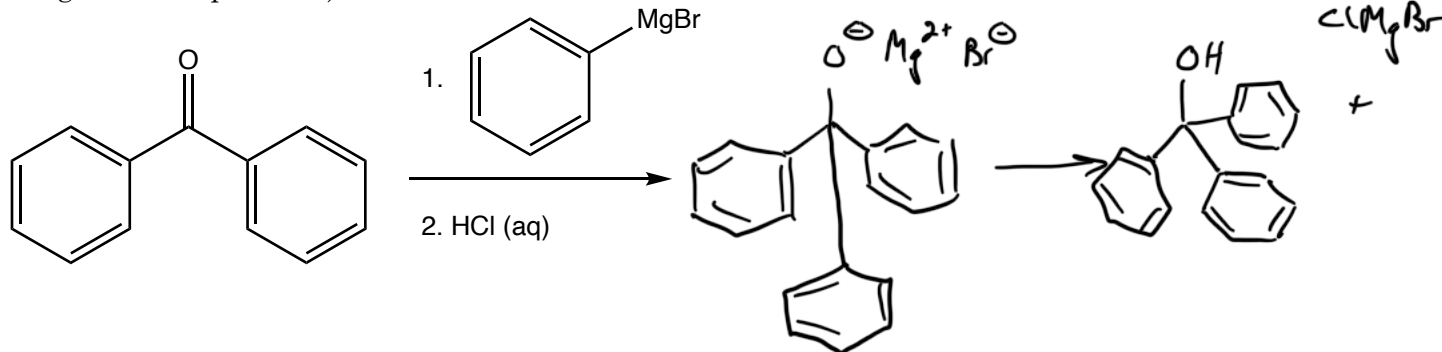


OH can be converted to a good LG by protonating ( $\text{H}_2\text{O}$ ).

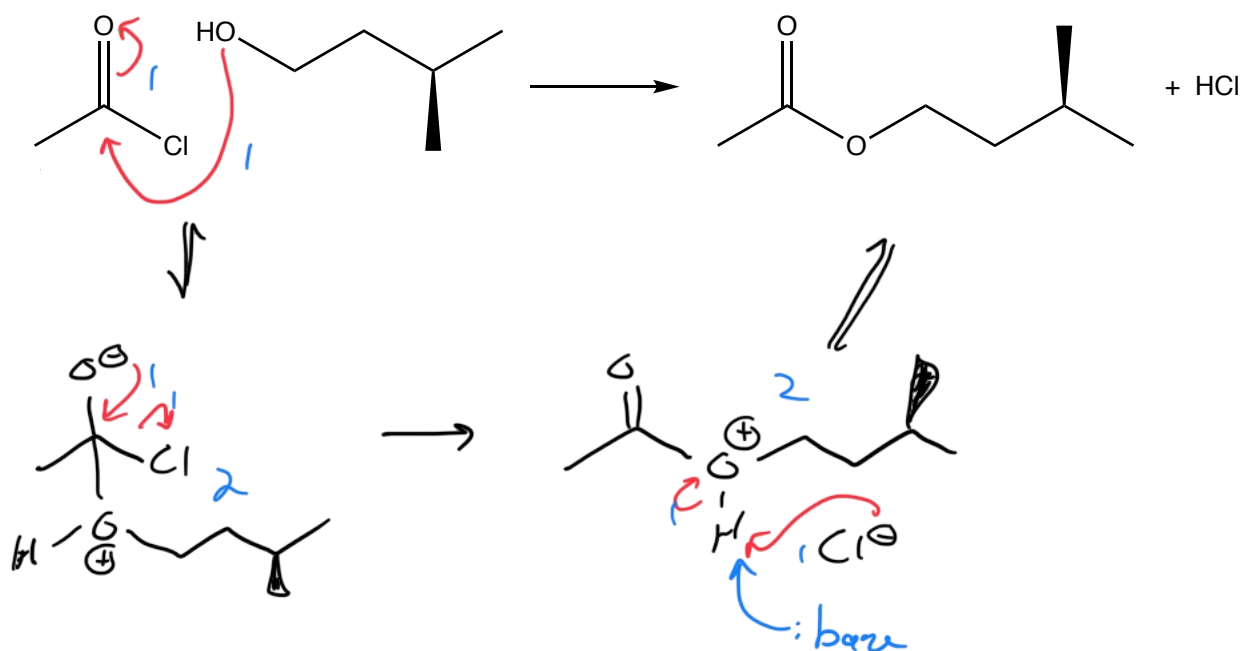


$\text{C}^-$  would have to act as the LG as a carbanion is too basic, too high in E to act as a LG.

4. (6 pts.) Predict the products for the following two step reaction sequence (list organic and inorganic/ionic products).

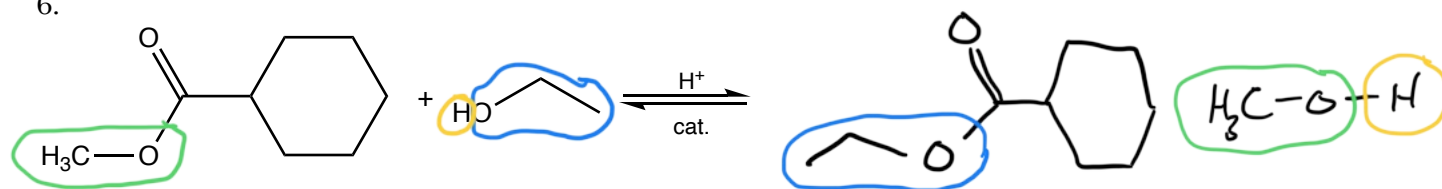


5. (10 pts.) The following reaction occurs rapidly without a catalyst. Draw a mechanism that shows how the product is formed. Remember to draw the intermediate(s) and electron movement arrows that show bonds breaking and forming.

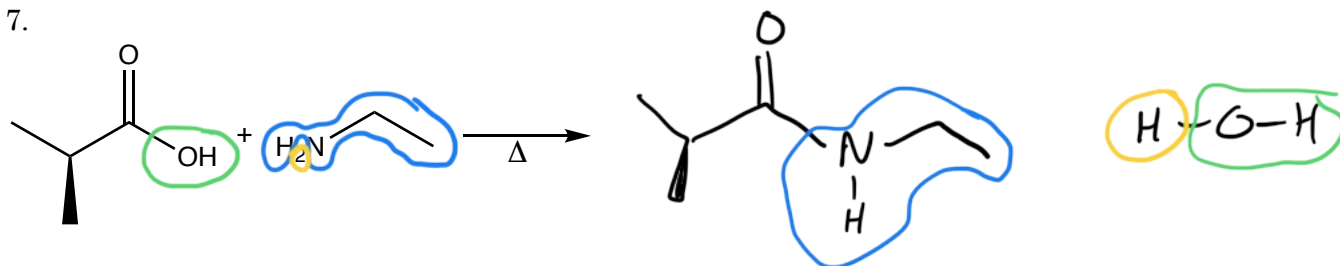


(6 pts. ea.) Predict the products of the following nucleophilic acyl substitution reactions.

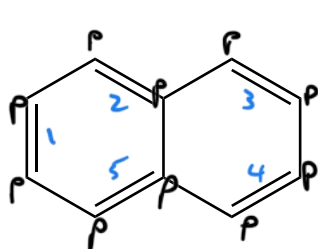
6.



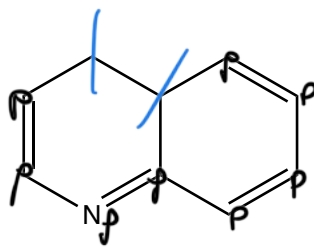
7.



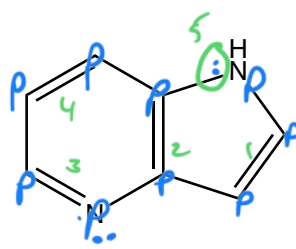
8. (12 pts.) Identify the following molecules as aromatic, antiaromatic, or neither.



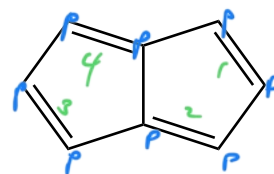
aromatic



neither  
(no complete circle of  
p orbitals)

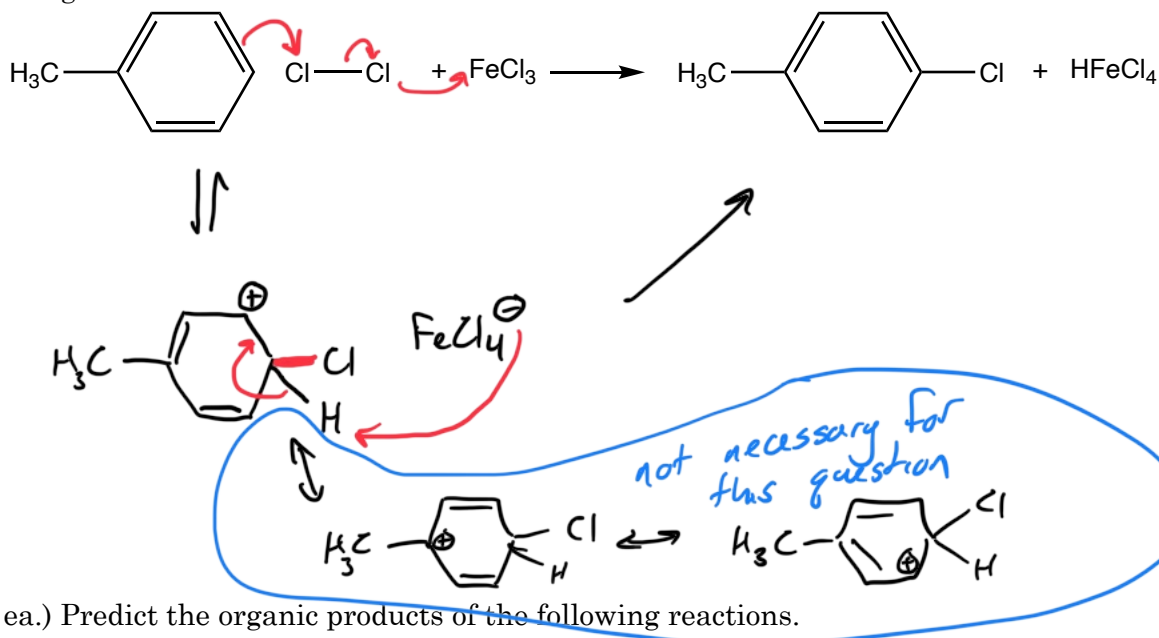


aromatic



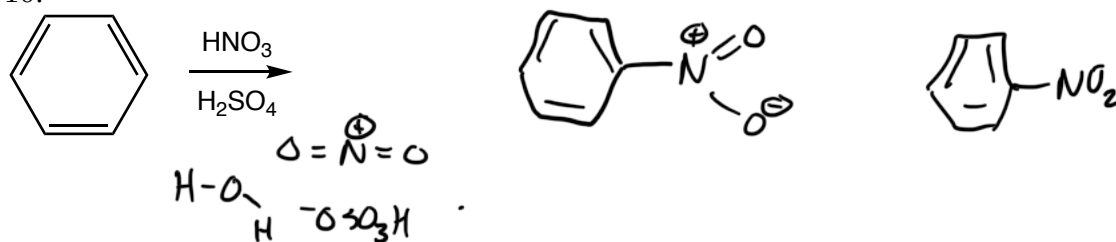
antiaromatic

9. (10 pts.) Draw a mechanism that shows the how the product is formed in the following reaction. Remember to draw the intermediate(s) and electron movement arrows that show bonds breaking and forming.

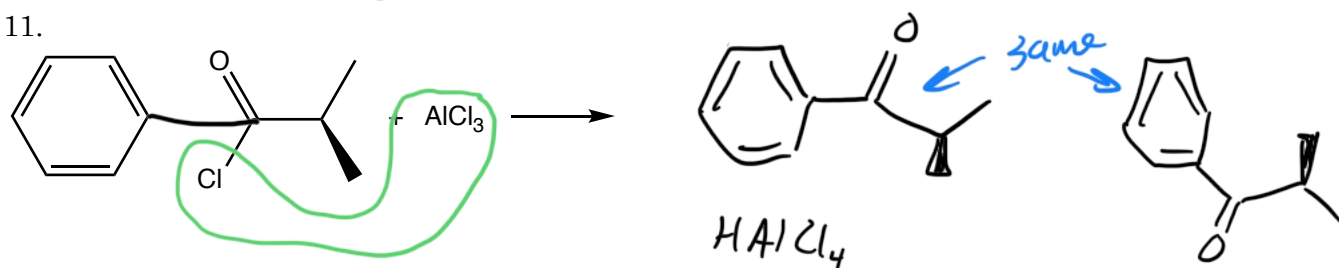


(6 pts. ea.) Predict the organic products of the following reactions.

10.



11.



12. (8 pts.) Carbonyl groups deactivate benzene rings toward electrophilic aromatic substitution. Draw **one** resonance contributor that demonstrates how the carbonyl group deactivates the benzene ring.

