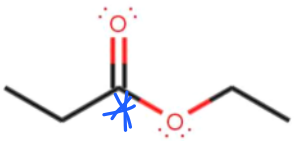
Carbon Reactivity

Carbon Reactivity

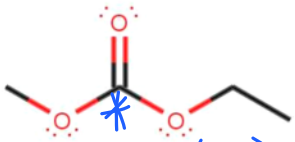
1. Consider the three compounds below.

A



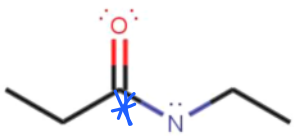
ester

B



ester (x2) → technically, this is an anhydride

C



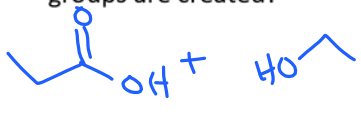
amide

a. What functional groups are present in each compound?

b. For each compound, identify the atom that is most susceptible to attack by water (this is the most electropositive atom). Each electrophile is denoted by a *

c. Add water across the bond and predict the products of the hydrolysis reaction. What new functional groups are created?

A)

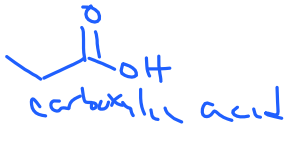


carboxylic acid + alcohol

B)

carboxylic acid + alcohol

C)

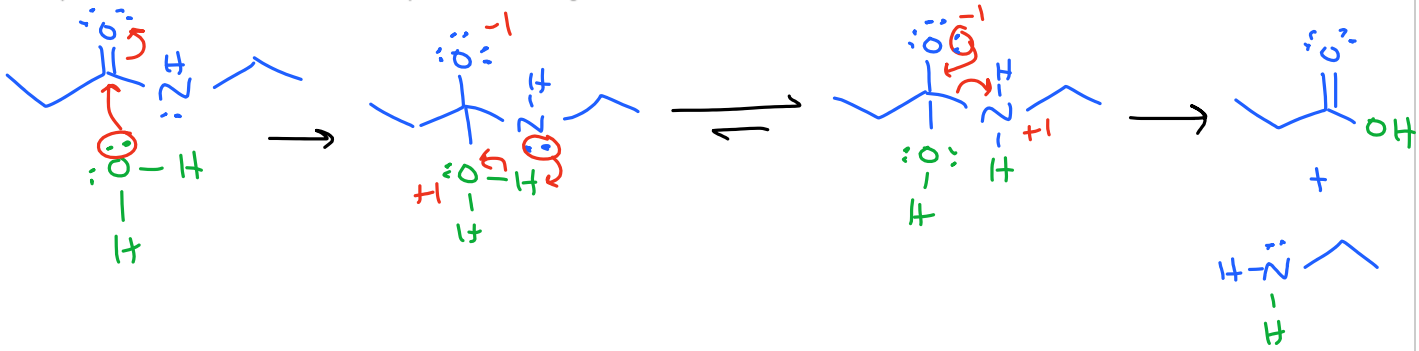


carboxylic acid + amine

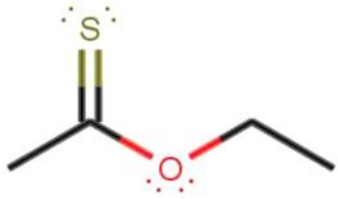
d. Which of these compounds do you think is most likely to be hydrolyzed? Explain your choice.

B. the carbonyl carbon (*) is surrounded by the most electronegative atoms. This means it is most susceptible to being attacked

2. Draw a 3-step reaction process for the hydrolysis of compound C from problem 1. The first step should be an attack on the electrophile and breaking of the double bond. The second step is an equilibrium step. The third step is reformation of the carbonyl and breaking of a bond.



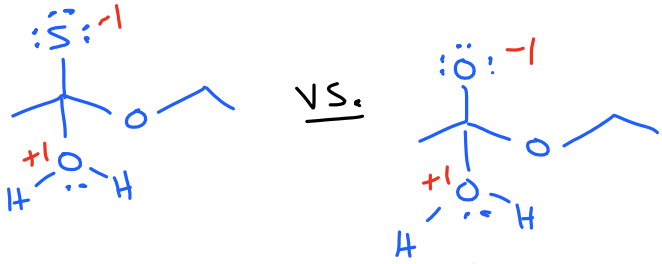
3. Now consider this compound. Do you think it is more or less likely to be hydrolyzed than the ester in problem 1A? Consider the following two questions for guidance. Less!



   a. Think critically about what happens in the first step of the reaction. Which is most susceptible to attack by a nucleophile? Explain your choice.

The carbon in this compound is not as electrophillic because sulfur is not as electronegative as oxygen. In fact C–S bonds are NOT polar, so the carbon is only polarized by one C–O bond. Consequently, the C is less susceptible to attack.

   b. Now draw the transition state for each compound. Which is more stable? Why does that influence the likelihood of a hydrolysis reaction?



Since oxygen is more EN, it is more stable with a (–) than sulfur. This makes the first transition state higher energy (so a larger Ea)!

4. Predict the products of the condensation reaction between these two compounds: