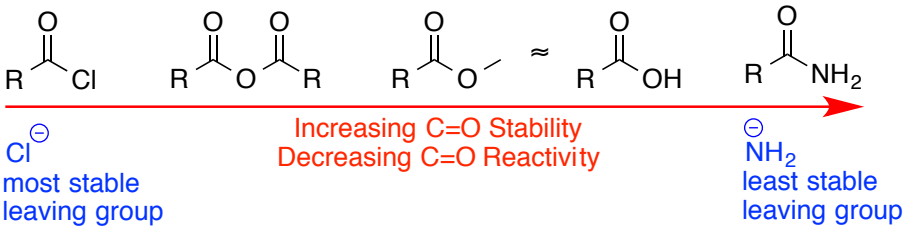
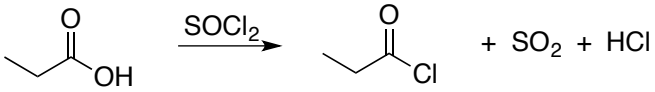
Chapter 20 Reaction Summary
Reactions of Carboxylic Acids and Nitriles

Reactivity Order of Carboxylic Acid Derivatives



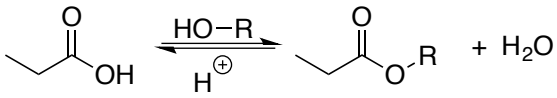
Conversion to an Acid Chloride

- Subjecting a carboxylic acid to thionyl chloride ($SOCl_2$) converts it to an acid chloride.



Fischer Esterification

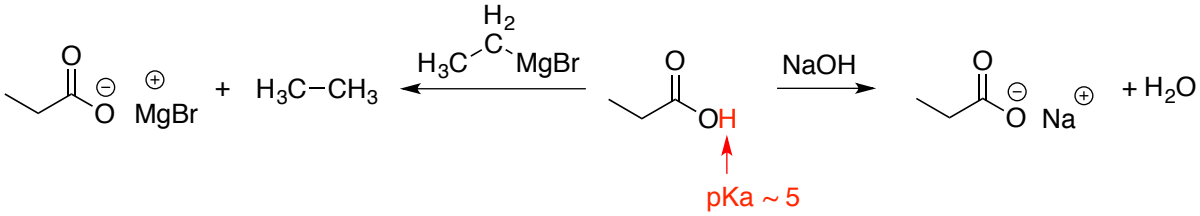
- In the presence of an acid catalyst carboxylic acids and alcohols react to form esters.



  - Most commonly H_2SO_4, H_3PO_4, and HCl are used as the acid catalysts.
  - The reaction equilibrium favors products when excess reagent (carboxylic acid or alcohol) is used or when water is removed as the reaction progresses.
  - Methyl, primary, and secondary alcohols can be used. Tertiary alcohols don't generally work well due to steric hindrance.
  - An intramolecular Fischer Esterification can occur when a molecule has both a carboxylic acid and alcohol functional group. Generally 5 or 6 membered rings (lactones) can be formed.

Reaction with a Base (Carboxylate Formation)

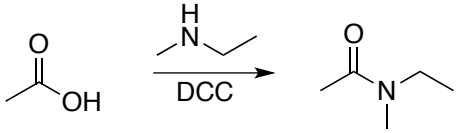
- Bases will react with carboxylic acids to form carboxylate salts.



  - Common bases include: MOH, Grignard Reagents, and organolithium compounds.

Conversion to Amides

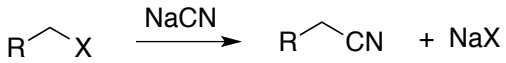
- Carboxylic acids can be converted to amides in the presence of an amine and DCC.



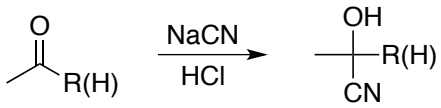
  - NH_3, H_2NR (primary), and HNR_2 (secondary) amines work well while tertiary do not.
  - DCC converts the alcohol into a good, aprotic, leaving group.

Preparation of Nitriles

- Nucleophilic Substitution: Alkyl Halides + NaCN



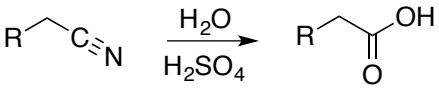
  - This reaction is a useful method to add a carbon atom to a compound.
  - Methyl, primary, and secondary halides work in this reaction.
- Nucleophilic Addition of NaCN to C=O produces a cyanohydrin.



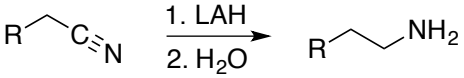
Reactions of Nitriles

Nitriles are considered carboxylic acid derivatives because they, like other carboxylic acid derivatives, can be hydrolyzed to carboxylic acids.

- Hydrolysis to a Carboxylic Acid: Subjecting nitriles to acid and water provides carboxylic acids. Base hydrolysis also works, but we didn't cover this in class.



- Reduction to an Amine: Subjecting nitriles to LAH followed by water provides the amine product.



- Conversion to a Ketone: Subjecting a nitrile to an organometallic reagent such as a Grignard reagent or organolithium compound provides a ketone product.