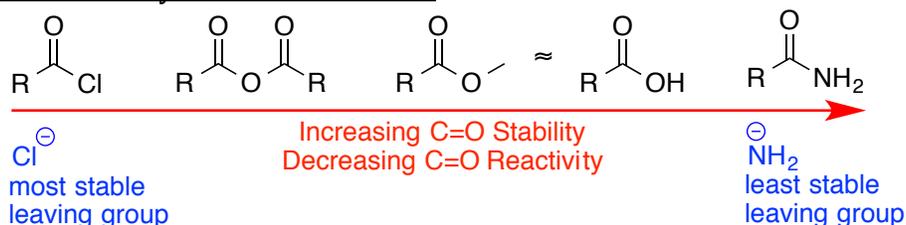


## Chapter 21 Reaction Summary

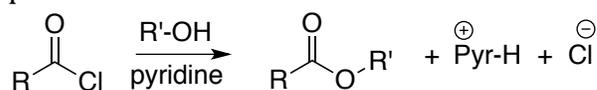
### Reactions of Carboxylic Acids and Carboxylic Acid Derivatives

#### Reactivity Order of Carboxylic Acid Derivatives

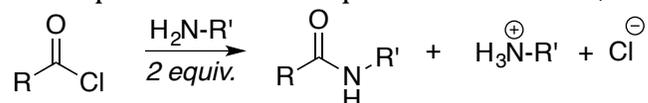


#### Reactions of Acid Chlorides

- Reaction of an acid chloride with an alcohol in the presence of a base such as pyridine produces an ester.



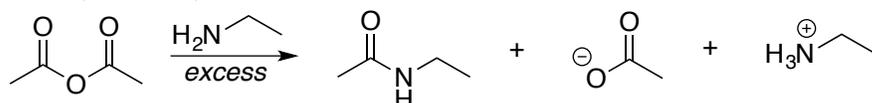
- The pyridine can be considered a “proton sponge” because it reacts with the HCl generated during the course of the reaction (effectively it soaks up the HCl).
- Similarly, water can be used rather than an alcohol to provide a carboxylic acid.
- In the presence of two equivalents of amine, acid chlorides can be converted to amides.



- NH<sub>3</sub>, primary, and secondary amines work in this reaction.

#### Reactions of Anhydrides

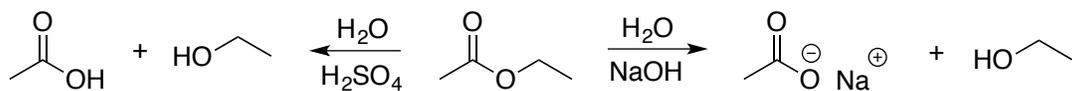
- Like acid chlorides, anhydrides are reactive towards a number of nucleophiles including water, alcohol, and amines.



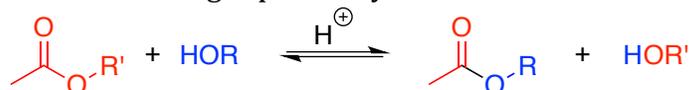
- Although it's not always necessary, an external base is often added to accelerate the reactions with anhydrides.

#### Reactions of Esters

- Hydrolysis: Esters can be hydrolyzed to carboxylic acids and alcohols in the presence of water and acid or base.



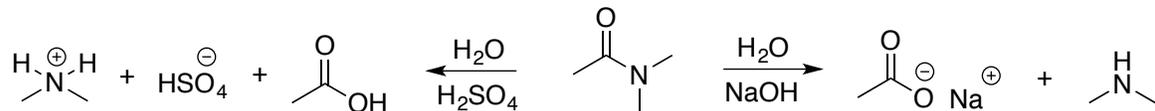
- Under basic conditions the product is a carboxylate salt because the HO<sup>-</sup> or RO<sup>-</sup> deprotonates the carboxylic acid as soon as it is produced. The reaction mixture can be subsequently acidified to provide the carboxylic acid product.
- Transesterification: Very similar to the acid catalyzed hydrolysis (mechanism wise) with the H-O-H being replaced by H-O-R.



- The mechanisms for the forward and reverse reactions are identical.
- To drive the reaction to the right, use an excess of alcohol (HOR).

### Reactions of Amides

- Hydrolysis: Like esters, amides can be hydrolyzed to carboxylic acids and amines in the presence of water and an acid or a base.



- Under basic conditions the product is a carboxylate salt. Driving force = formation of a stable salt.
- Under acidic conditions the amine that is produced gets protonated forming an ammonium ion. Formation of the amine salt is the driving force for this reaction. Common acids include H<sub>2</sub>SO<sub>4</sub> and HCl.