

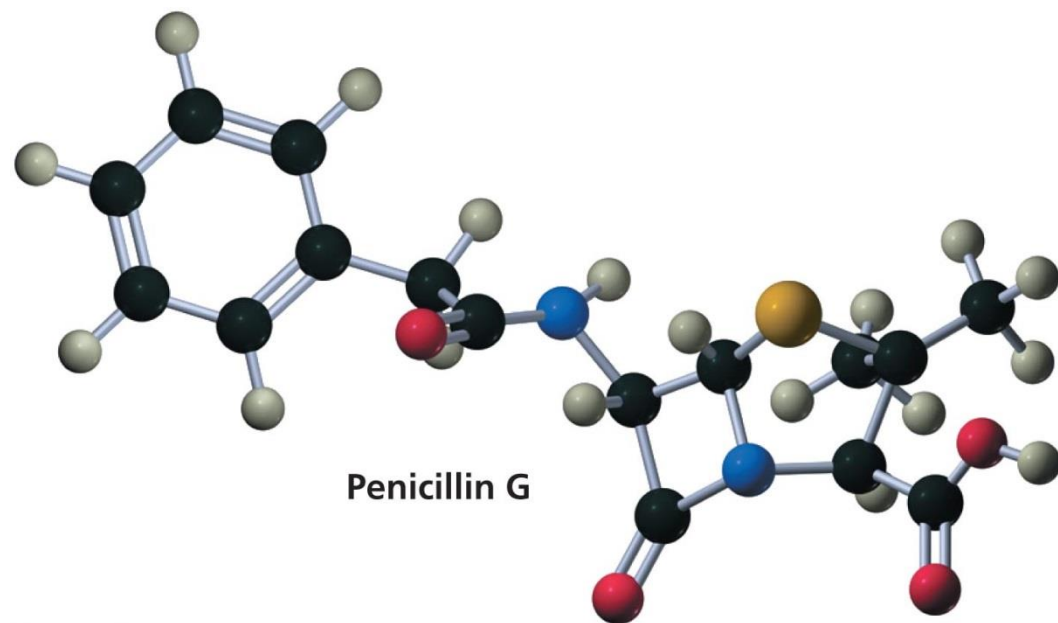
Organic Chemistry

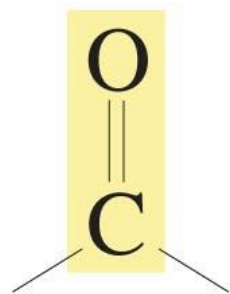
2th Edition

Paula Yurkanis Bruice

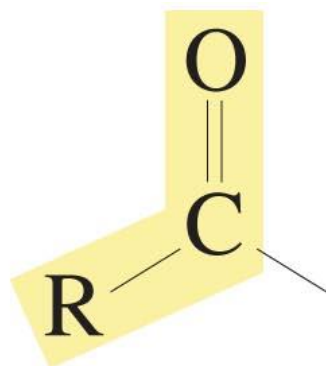
Chapter 11

Carbonyl Compounds I

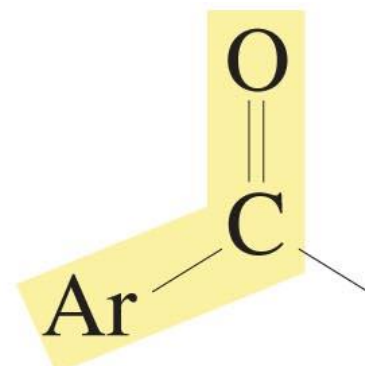




a carbonyl group



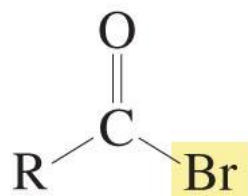
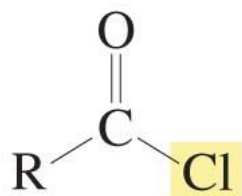
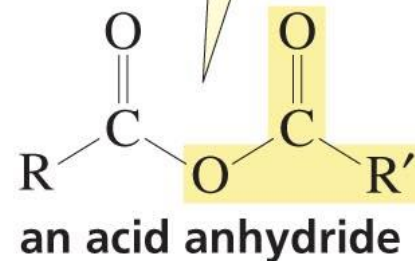
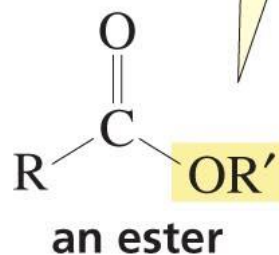
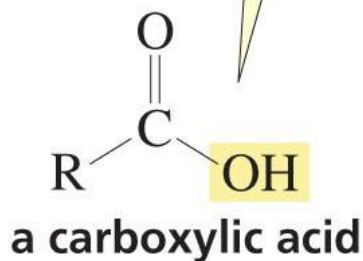
acyl groups



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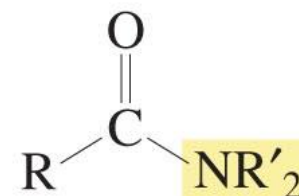
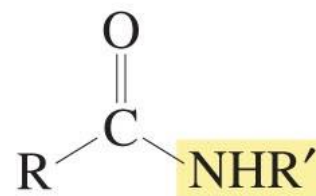
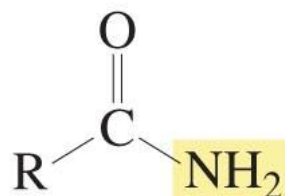
Class I Carbonyl Compounds

carbonyl compounds with groups that can be replaced by a nucleophile



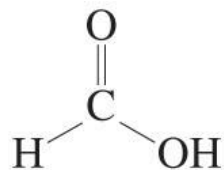
an acyl chloride an acyl bromide

acyl halides

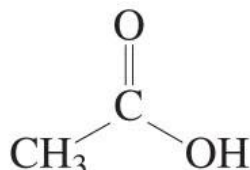


amides

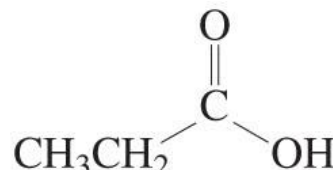
Nomenclature of Carboxylic Acids



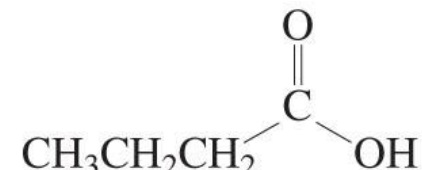
systematic name: methanoic acid
common name: formic acid



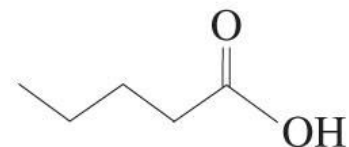
systematic name: ethanoic acid
common name: acetic acid



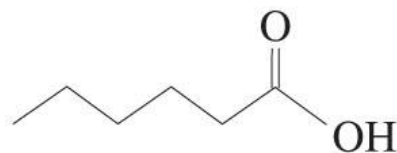
systematic name: propanoic acid
common name: propionic acid



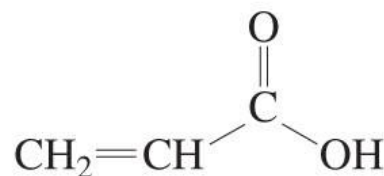
systematic name: butanoic acid
common name: butyric acid



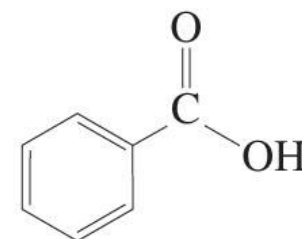
systematic name: pentanoic acid
common name: valeric acid



systematic name: hexanoic acid
common name: caproic acid



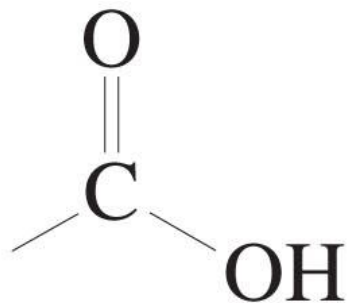
systematic name: propenoic acid
common name: acrylic acid



systematic name: benzenecarboxylic acid
common name: benzoic acid

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The functional group of a carboxylic acid is called a carboxyl group

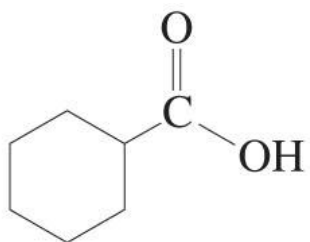


a carboxyl group

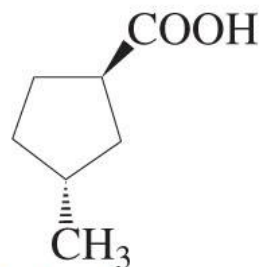


carboxyl groups are frequently shown in abbreviated forms

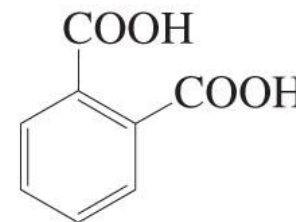
Naming Cyclic Carboxylic Acid



cyclohexanecarboxylic acid



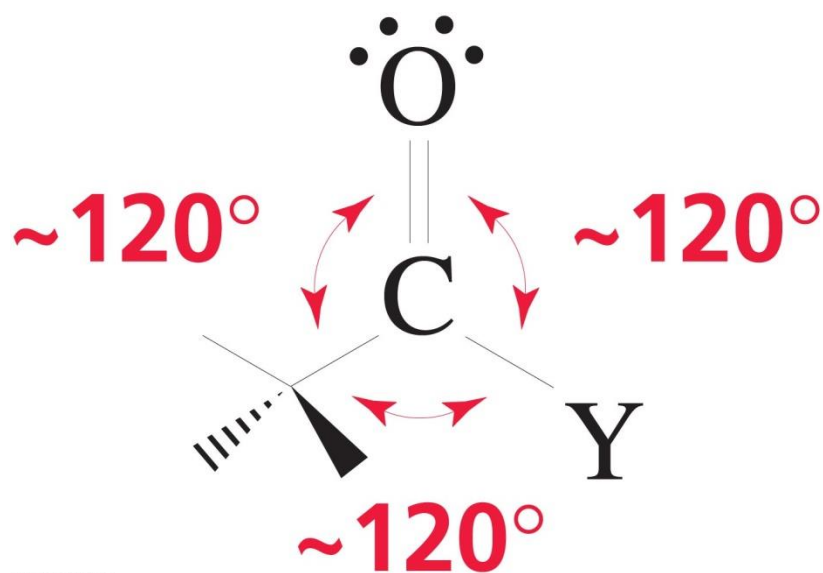
***trans*-3-methylcyclopentanecarboxylic acid**



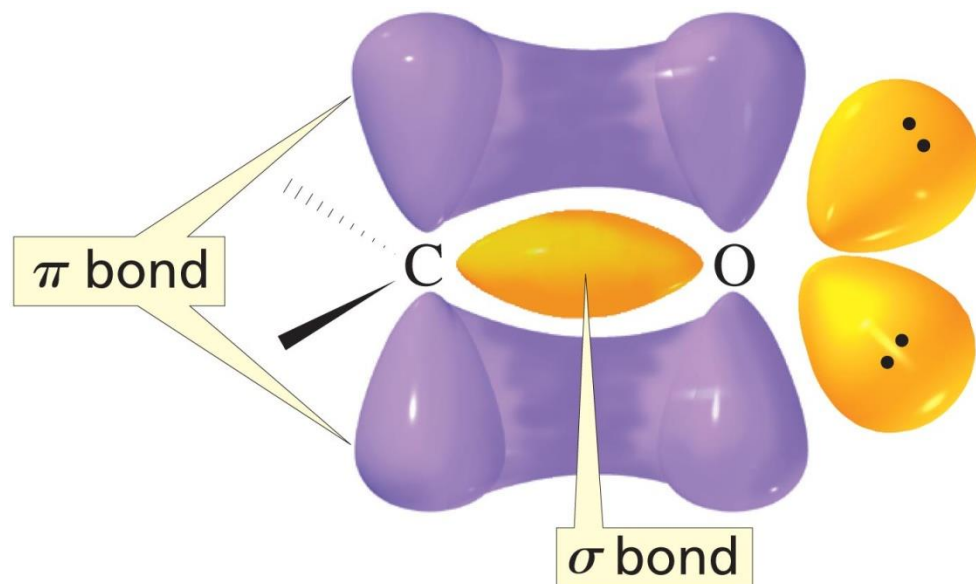
1,2-benzenedicarboxylic acid

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Structures of Carboxylic Acids and Carboxylic Acid Derivatives



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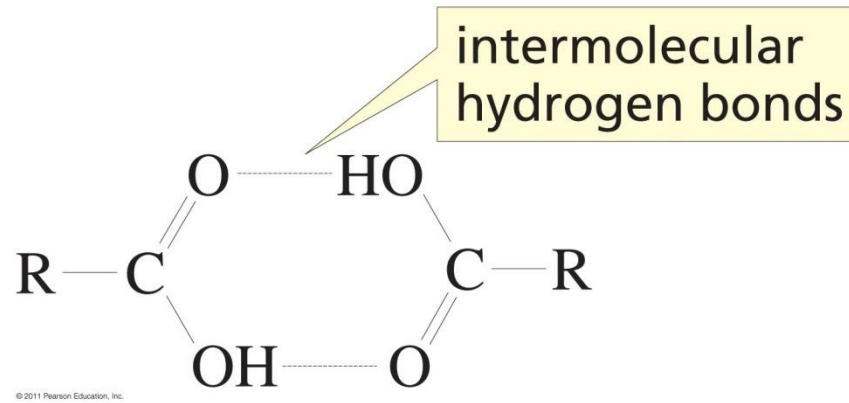


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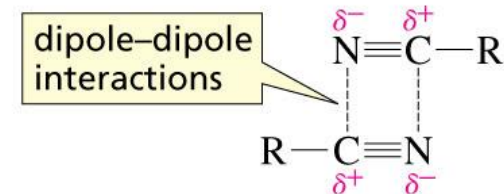
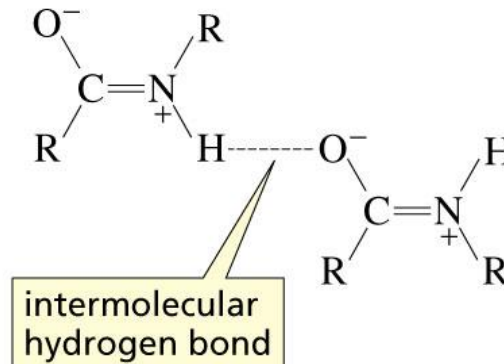
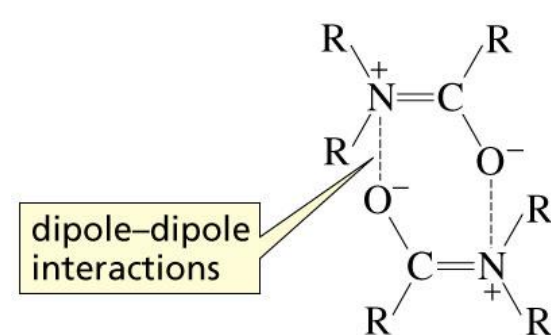
Physical Properties of Some Organic Compounds

Formula	IUPAC Name	Molecular Weight	Boiling Point	Water Solubility
<u>CH₃(CH₂)₂CONH₂</u>	<u>butanamide</u>	<u>87</u>	<u>216 °C</u>	<u>soluble</u>
<u>CH₃(CH₂)₂CO₂H</u>	<u>butanoic acid</u>	<u>88</u>	<u>164 °C</u>	<u>very soluble</u>
<u>CH₃(CH₂)₃CN</u>	<u>pentanenitrile</u>	<u>88</u>	<u>140 °C</u>	<u>slightly soluble</u>
<u>CH₃(CH₂)₄OH</u>	<u>1-pentanol</u>	<u>88</u>	<u>138 °C</u>	<u>slightly soluble</u>
<u>CH₃(CH₂)₃CHO</u>	<u>pentanal</u>	<u>86</u>	<u>103 °C</u>	<u>slightly soluble</u>
<u>CH₃CO₂C₂H₅</u>	<u>ethyl ethanoate</u>	<u>88</u>	<u>77 °C</u>	<u>moderately soluble</u>
<u>CH₃(CH₂)₄CH₃</u>	<u>hexane</u>	<u>86</u>	<u>69 °C</u>	<u>insoluble</u>

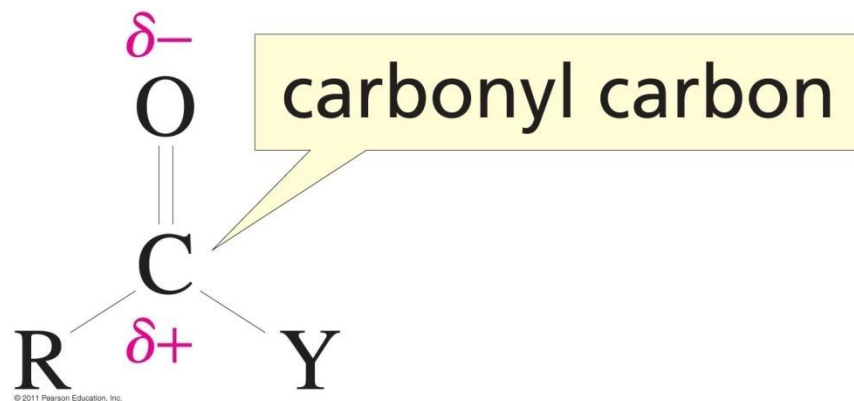
Carboxylic acids have relatively high boiling points because...



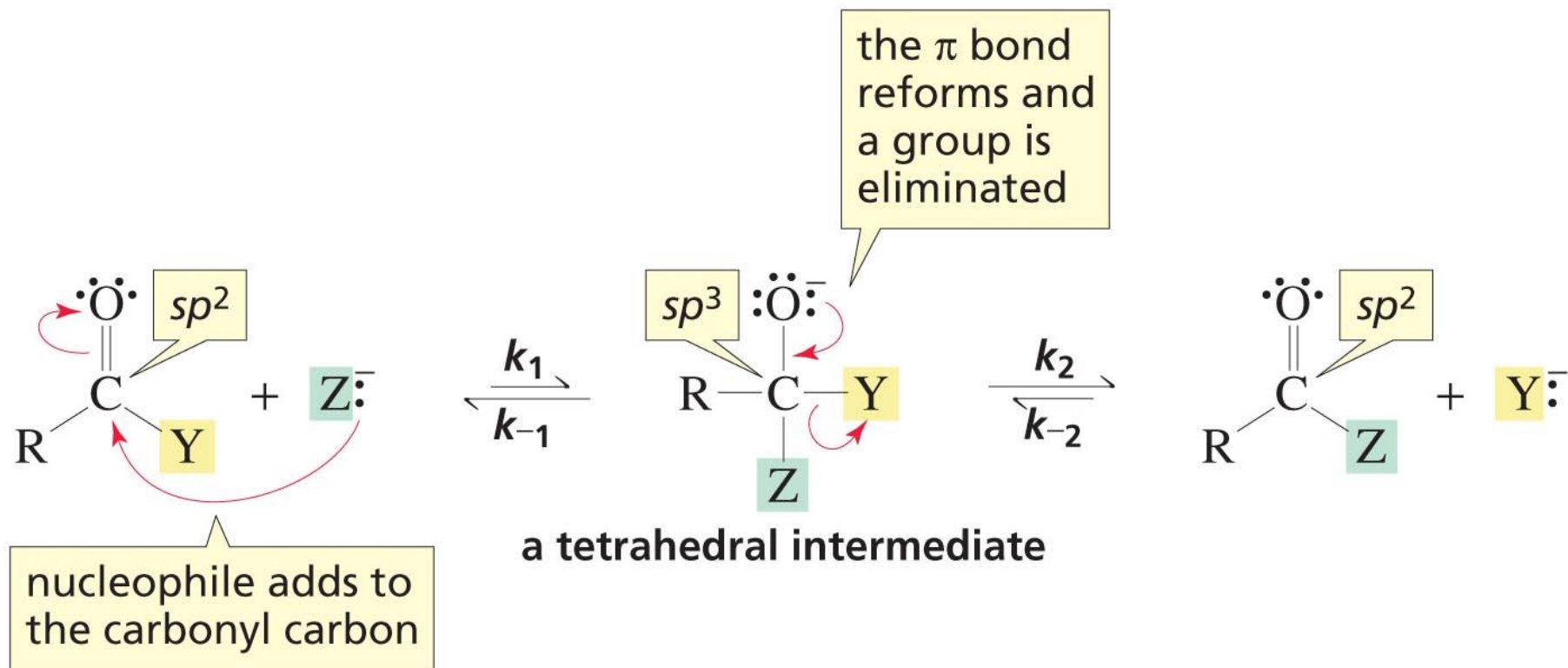
Amides have the highest boiling points:



The reactivity of carbonyl compounds resides in the polarity of the carbonyl group:



The tetrahedral intermediate is a transient species that eliminates the leaving group Y^- or the nucleophile Z^- :

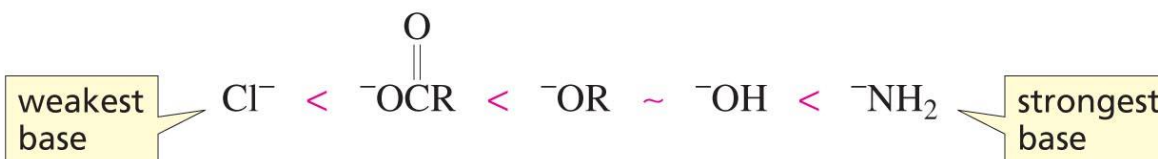


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This is a nucleophilic acyl substitution reaction

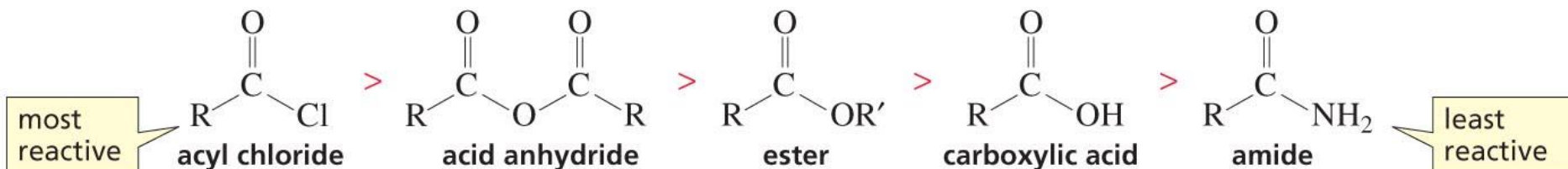
The reactivity of a carboxylic acid derivative depends on the basicity of the substituent attached to the acyl group:

relative basicities of the leaving groups



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relative reactivities of carboxylic acid derivatives



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A carboxylic acid derivative can be converted only into a less reactive carboxylic acid derivative:

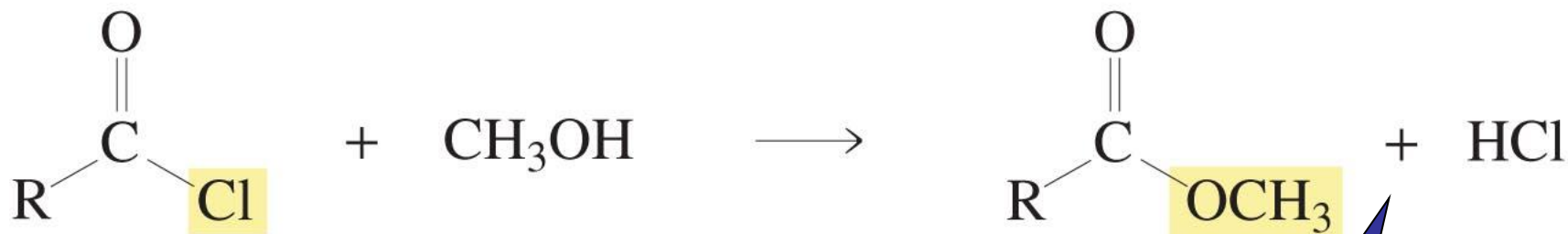
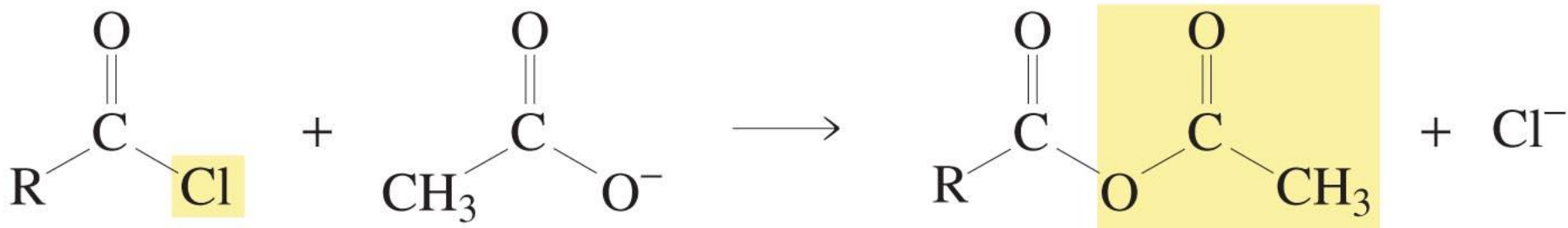


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Reactions of Acyl Halides

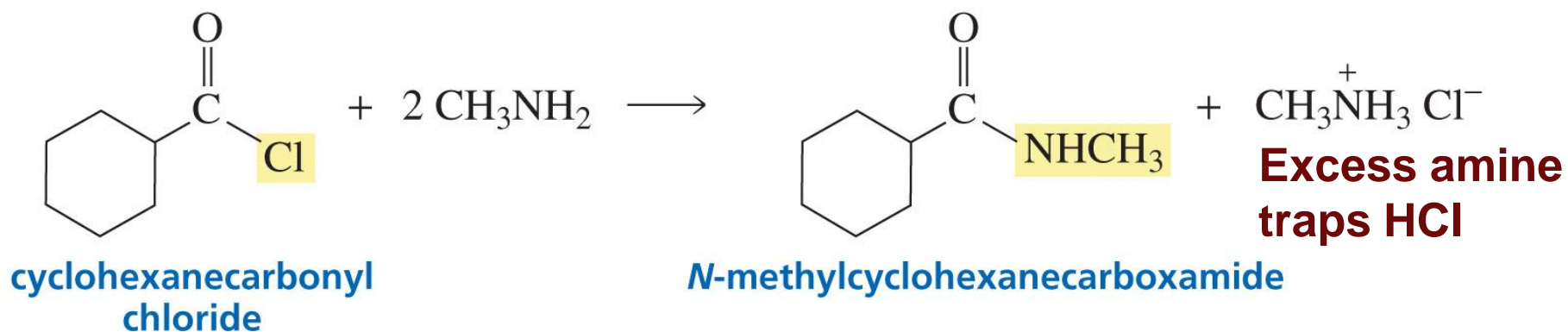
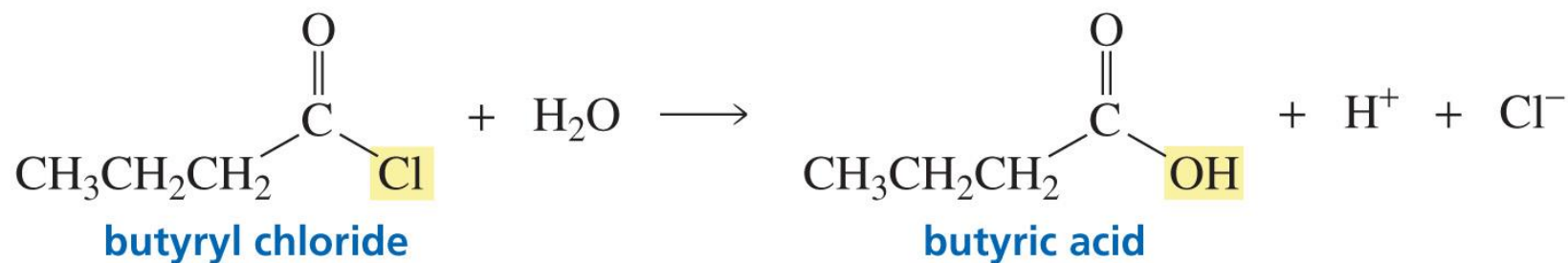
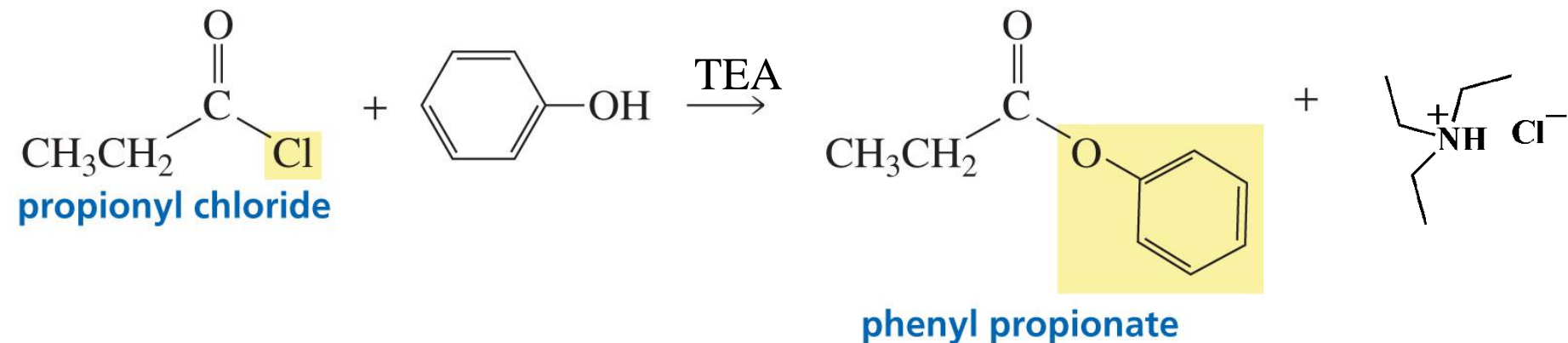


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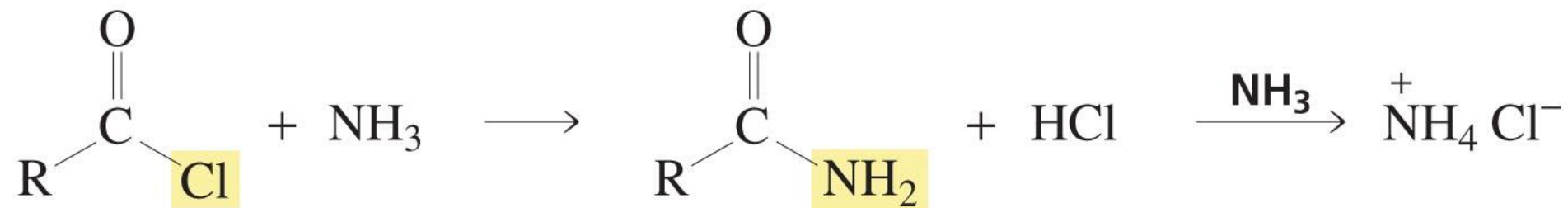
A base is required to trap the HCl product

Suitable bases include triethylamine (TEA) and pyridine

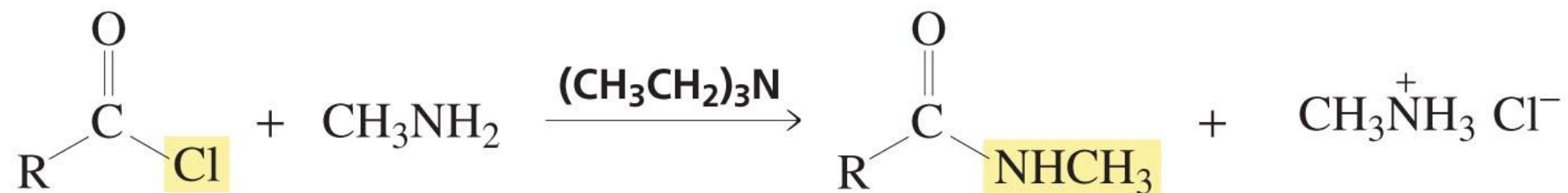
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Formation of Amides from Acyl Halides



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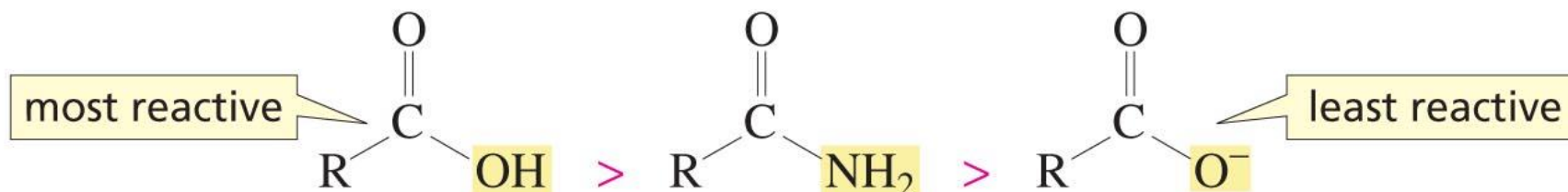


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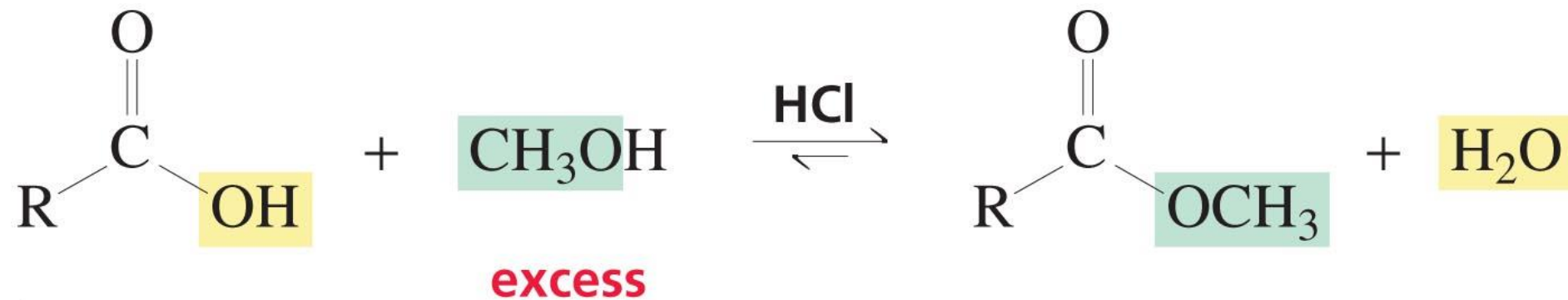
Tertiary amines cannot form amides

Reactions of Carboxylic Acids

relative reactivities toward nucleophilic acyl substitution



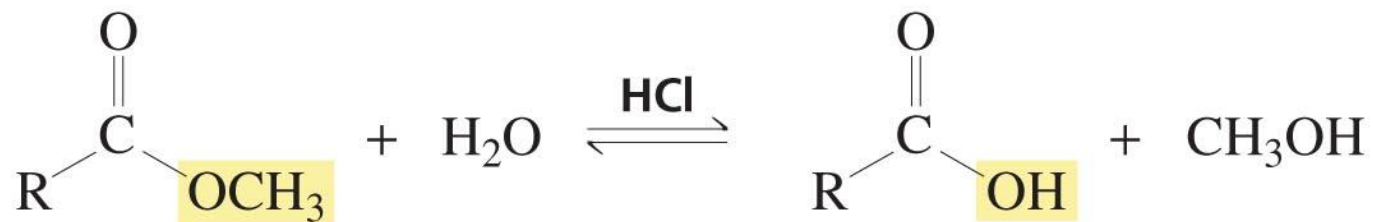
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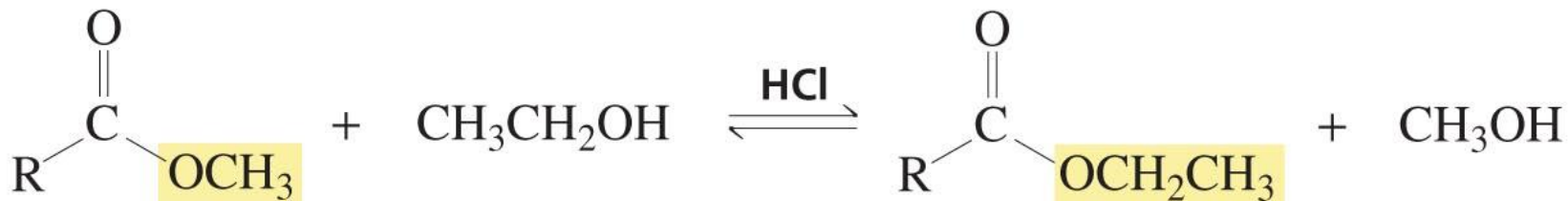
Reactions of Esters

a hydrolysis reaction



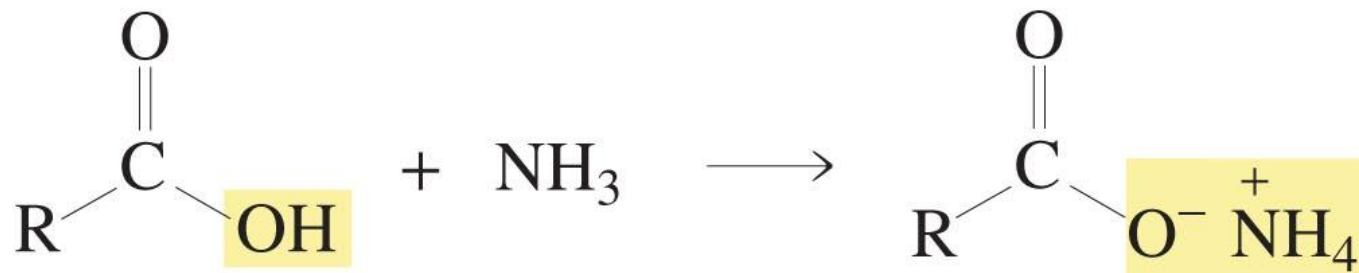
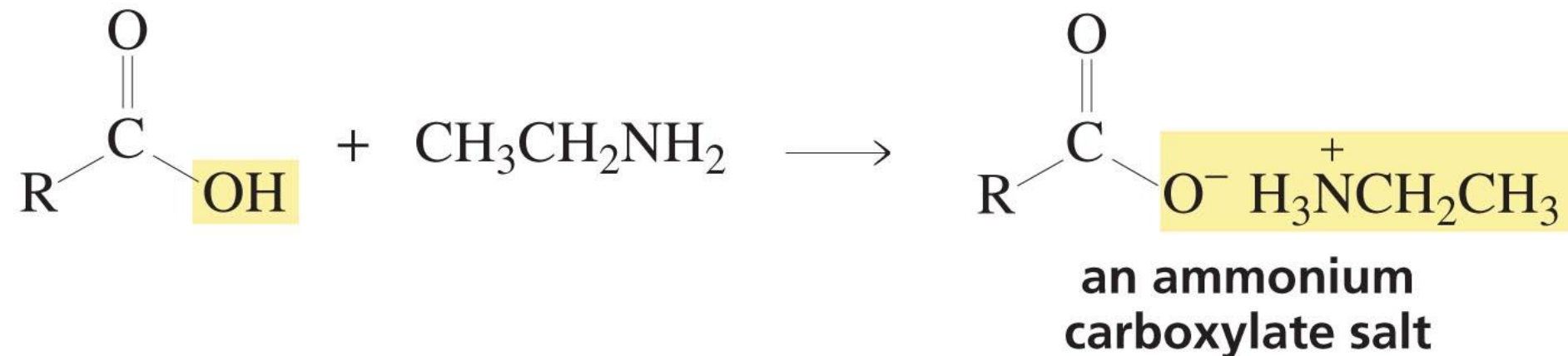
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a transesterification reaction



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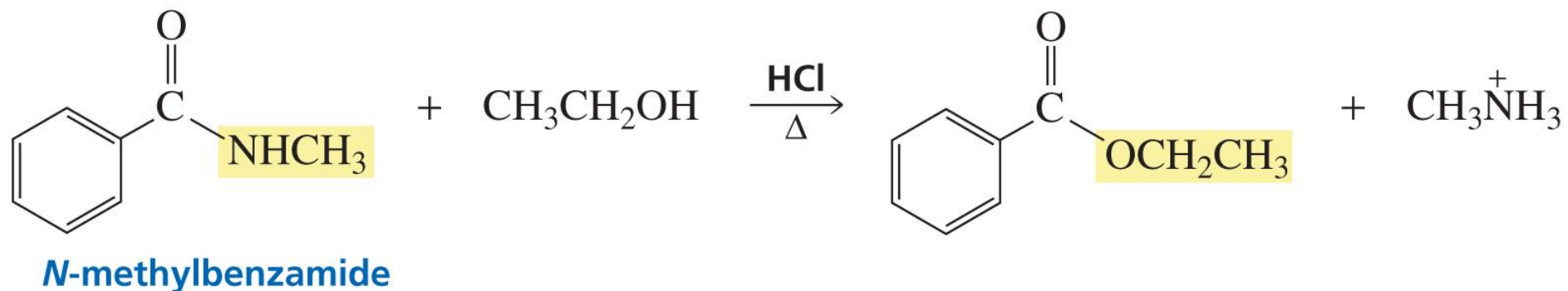
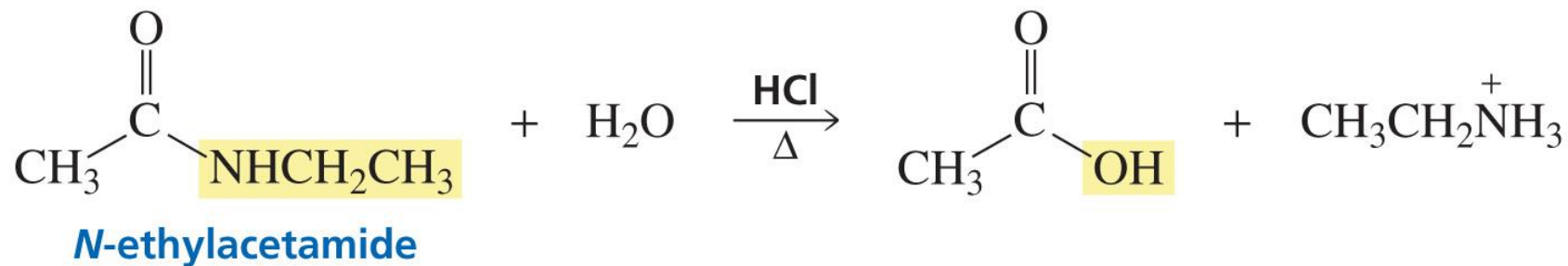
Carboxylic acids do not undergo nucleophilic acyl substitution reactions with amines at room temperature



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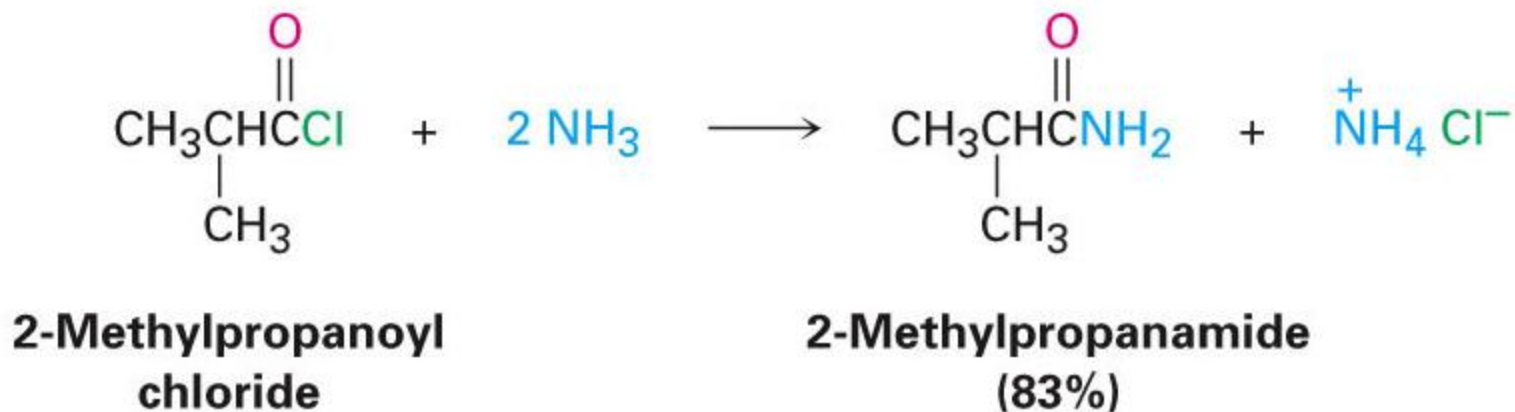
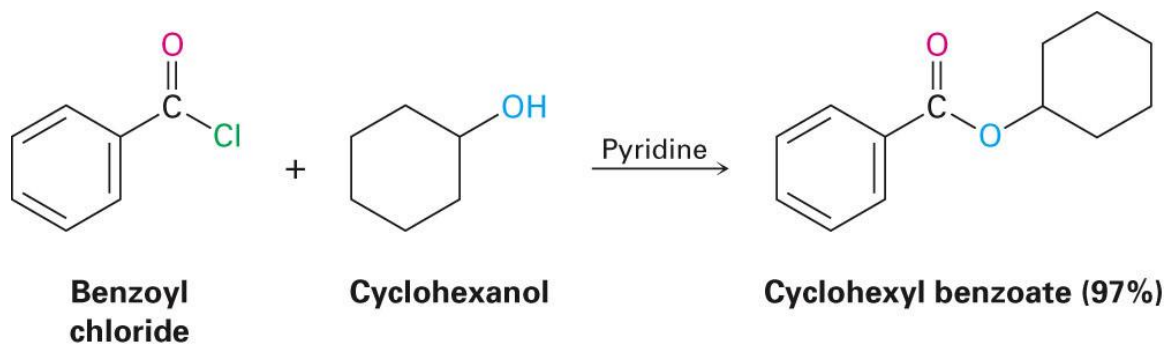
Heating the ammonium carboxylate will afford the amide and water

Amides can react with water and alcohols if an acid catalyst is present:



Synthesis of Carboxylic Acid Derivatives

- Acid chlorides are prepared from carboxylic acids by reaction with SOCl_2



The Hydrolysis of Nitriles. Synthesis of carboxylic acid

