Chapter 20-- Nomenclature sec 20.1
Note bp data, p 1009 Table 20.1; Note pKa data, p 1010 Table 20.2; IR C=O stretch table 20.3
Note: NMR data Table 20.4

DERIVATIVES OF CARBOXYLIC ACIDS:

\[
\begin{align*}
\text{carboxylic acid ester} & \quad \text{"ester"} \\
\text{thiol ester} & \\
\text{amide} & \\
\text{anhydride} & \quad \text{X = F,Cl, Br, I}
\end{align*}
\]

\[
\begin{align*}
\text{carboxylic acid} & \\
\text{phosgene} & \\
\text{carbonic acid} & \\
\text{urea} & \\
\text{carbamic acid} & \\
\text{a carbonate ester} & \\
\text{a carbamate} & \\
\text{carboxylic acid halide} & \quad \text{"acid halide"}
\end{align*}
\]

READ: Nomenclature, text 19.1

Caboxylc Acids:

Dominant feature: acidity and influence of structure on acidity. You know all of this stuff.

Structure:

\[
\begin{align*}
\text{H-bonded dimer} & \\
\text{General intermolecular H-bonding} & \quad \text{ Accelerated by acid and base}
\end{align*}
\]

Dominant reaction:

\[
\begin{align*}
\text{O*} = ^{17}\text{O}
\end{align*}
\]
Not very interesting for carboxylic acids; not even noticeable unless the water is labeled.

**BUT:** a major reaction with other nucleophiles. Addition/elimination

\[
\begin{align*}
\text{Nu}^+ &+ \text{H} \rightarrow \\
\text{Nu}^{-} &+ \text{H} \\
\end{align*}
\]

**Formation of Esters:**

\[
\begin{align*}
\text{R} &\rightarrow \text{O} & \text{CH}_3 &\rightarrow \text{O} \\
\text{HOH} &\rightarrow \text{CH}_3 \text{OH} + \text{H}_2\text{O} \\
\text{R} &\rightarrow \text{O} & \text{OCH}_3 &\rightarrow \text{O} \\
\end{align*}
\]

Completely reversible: also serves as a mechanism for hydrolysis of esters to carboxylic acids:

\[
\begin{align*}
\text{R} &\rightarrow \text{O} & \text{CH}_3 &\rightarrow \text{O} & \text{H} \\
\text{HOH} &\rightarrow \text{CH}_3 \text{OH} + \text{CH}_3 \text{OH} \\
\end{align*}
\]

Drive the reaction by using excess of one or the other of the reactants: e.g., MeOH as solvent to make ester water as solvent to hydrolyze ester

What about reaction under basic conditions?
What about amines as the nucleophile? Amide bond formation.

rigid

Better Leaving Group? Cl

text p 978
Chapter 20: Reactions of Acid Chlorides (fig 20.23)

Recall correlation of IR stretching frequencies of C=O with substituent effect, via polar resonance structure (more resonance stabilization, less reactive toward nucleophiles)

A. Addition of stabilized nucleophiles (O, N)

\[
\text{RCl} + \text{H}_2\text{O} \rightarrow \text{ROH} + \text{HCl}
\]

\[
\text{RCl} + \text{MeOH} \rightarrow \text{ROMe} + \text{HCl}
\]

\[
\text{RCl} + \text{RO}^- \rightarrow \text{RO} = \text{OR} + \text{Cl}^-
\]

\[
\text{RCl} + \text{HNMe}_2 \rightarrow \text{RNMMe}_2 + \text{HCl}
\]

Aslo:

\[
\text{ROOMe} + \text{HNMe}_2 \rightarrow \text{RONMe}_2
\]

\[\text{MeOH very slow}\]
B. Addition of reactive carbon anions

2.0 mol-equiv

\[ \text{ROCl} + \text{R'}-\text{Li} \xrightarrow{\text{fast}} \text{ROR'} \]

\[ \text{very fast} \]

\[ \text{R'}-\text{Li} \]

\[ \text{stable} \]

synthesis of tertiary alcohols

Same for esters, anhydrides.

But

1.0 mol-equiv

\[ \text{R'ONMe}_2 + \text{R'}-\text{Li} \xrightarrow{\text{fast}} \text{R'ONMe}_2 \xrightarrow{\text{slow}} \text{RCOR'} \]

Ketone product conc. does not build up until reactant R'Li is gone

\[ \text{H}_2\text{O} \]

\[ \text{HNMe}_2 \]

\[ \text{RCOR'} \]

C. Addition of metal hydrides

\[ \text{ROX} + \text{LiAlH}_4 \xrightarrow{[\text{H}_2\text{O}]} \text{R'OH} \]

Double addition of H? Mechanism?

\[ X = \text{Cl, OR}, \text{OH}, \text{etc} \]
RON + LiAlH₄ → [H₂O] → Double addition of H⁻

MeLi + AlH₃ → [H₂O] → Double addition of H⁻

Analogy with Nitriles:

R–C≡N

MeMgI → Na⁺ + NH₃
via: R–NH₂

Write mechanisms: multistep

Enolate chemistry of esters:

R–COOMe ↔ R–COOMe⁻ + H⁺
pKa 24-25 Ketone is ca 20. Why the difference?

Li N(iPr)₂ → fast → aldol-like reaction