This page explains what acid anhydrides are and looks at their simple physical properties such as boiling points. It introduces their chemical reactivity in a general way. A carboxylic acid such as ethanoic acid has the structure:

\[
\text{CH}_3\text{C}^{-}\text{O}^{-}\text{H}
\]

ethanoic acid

If you took two ethanoic acid molecules and removed a molecule of water between them you would get the acid anhydride, ethanoic anhydride (old name: acetic anhydride).

\[
\begin{align*}
\text{CH}_3\text{C}^{-}\text{O}^{-}\text{H} & \quad \xrightarrow{\text{dehydrating ethanoic acid}} \quad \text{CH}_3\text{C}^{-}\text{O}^{-}\text{O}^{-}\text{CH}_3 \\
\text{ethanoic acid} & \quad \xrightarrow{\text{ethanoic anhydride}} \\
\end{align*}
\]

You can actually make ethanoic anhydride by dehydrating ethanoic acid, but it is normally made in a more efficient, round-about way.

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**Acid Anhydrides react with water to form carboxylic acids**

**General Reaction**

\[
\begin{align*}
\text{R}^{-}\text{C}^{-}\text{O}^{-}\text{C}^{-}\text{R} & + \text{H}_2\text{O} \xrightarrow{\text{Pyridine}} 2 \text{HO}^{-}\text{C}^{-}\text{R} \\
\text{Acid Anhydride} & + \text{Water} \quad \xrightarrow{} \quad \text{Carboxylic acid}
\end{align*}
\]

**Example 1:**

\[
\begin{align*}
\text{H}_2\text{C}^{-}\text{C}^{-}\text{O}^{-}\text{C}^{-}\text{H} & + \text{H}_2\text{O} \xrightarrow{\text{Pyridine}} 2 \text{HO}^{-}\text{C}^{-}\text{H} \\
\text{Acid Anhydride} & + \text{Water} \quad \xrightarrow{} \quad 2 \text{Carboxylic acid}
\end{align*}
\]

**Mechanism**

1) Nucleophilic Attack by the water molecule
Acid Anhydrides react with alcohols to form esters

Reactions of anhydrides use Pyridine as a solvent

Example 1:
Mechanism

1) Nucleophilic Attack by the Alcohol

2) Deprotonation by pyridine

3) Leaving group removal

4) Protonation of the carboxylate

Acid Anhydrides react with amines to form amides
General Reaction

Example 1:

\[
\text{Acid Anhydride} + 2 \text{H}_2\text{N} - \text{R'} \rightarrow \text{Amide} + \text{Amine}
\]

Mechanism

1) Nucleophilic Attack by the Amine

2) Deprotonation by the amine

3) Leaving group removal

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