Aldehydes and ketones can be prepared using a wide variety of reactions. Although these reactions are discussed in greater detail in other sections, they are listed here as a summary and to help with planning multistep synthetic pathways. Please use the appropriate links to see more details about the reactions.

**Oxidation of 1° alcohols with PCC to form aldehydes**

\[ RCH_2CH(OH)H + PCC \rightarrow RCH=CHH \]

**Hydration of an alkyne to form aldehydes**

Anti-Markovnikov addition of a hydroxyl group to an alkyne forms an aldehyde. The addition of a hydroxyl group to an alkyne causes tautomerization which subsequently forms a carbonyl.

**Reduction of an ester, acid chloride or nitrile to form aldehydes**

\[ RCOOR' \rightarrow 1) \text{DIBAL-H} \rightarrow \text{RCHO} \]

\[ RCOCl \rightarrow 1) \text{LiAlH(O-t-Bu)}_3 \rightarrow \text{RCHO} \]

\[ R\overset{\equiv}{C}N \rightarrow 1) \text{DIBAL-H} \rightarrow \text{RCHO} \]
Oxidation of $2^\circ$ alcohols to form ketones

Typically uses Jones reagent ($\text{CrO}_3$ in $\text{H}_2\text{SO}_4$) but many other reagents can be used

$$\begin{align*}
\text{H} & \quad \text{CrO}_3 \\
\text{R} & \quad \text{R}' \\
\text{C} & \quad \text{OH} \\
& \quad \rightarrow \\
\text{R} & \quad \text{R}' \\
\text{O} & \quad \text{C} \\
\end{align*}$$

$2^\circ$ Alcohol

Hydration of an alkyne to form ketones

The addition of a hydroxyl group to an alkyne causes tautomerization which subsequently forms a carbonyl. Markovnikov addition of a hydroxyl group to an alkyne forms a ketone.

$$\begin{align*}
\text{R} & \quad \text{C} = \text{C} \quad \text{H} \\
& \quad \rightarrow \\
\text{R} & \quad \text{H} \\
\text{C} & \quad \text{OH} \\
& \quad \rightarrow \\
\text{R} & \quad \text{H} \\
\text{O} & \quad \text{C} \\
\end{align*}$$

Friedel-Crafts acylation to form a ketone

$$\begin{align*}
\text{R} & \quad \text{C} = \text{N} \\
& \quad \rightarrow \\
\text{H}_2\text{O} & \quad \text{AlCl}_3 \\
& \quad \rightarrow \\
\text{R} & \quad \text{C} \\
\end{align*}$$

Reaction of Grignard reagents with nitriles to form ketones

$$\begin{align*}
\text{R} & \quad \text{C} = \text{N} \\
& \quad \rightarrow \\
\text{1)} & \quad \text{R'}\text{MgBr} \\
& \quad \rightarrow \\
\text{2)} & \quad \text{H}_2\text{O} \\
& \quad \rightarrow \\
\text{R} & \quad \text{C} \\
\text{R'} & \quad \text{R'} \\
\end{align*}$$

Alkenes can be cleaved using ozone ($\text{O}_3$) to form aldehydes and/or
ketones

This is an example of a Ozonolysis reaction.

Contributors

- Prof. Steven Farmer (Sonoma State University)