Objectives

After completing this section, you should be able to

1. write an equation to illustrate a Claisen condensation reaction.
2. write a detailed mechanism for a Claisen condensation reaction or its reverse.
3. identify the product formed in a given Claisen condensation reaction.
4. identify the ester and other reagents needed to form a given β-keto ester by a Claisen condensation reaction.

Key Terms

• Claisen condensation reaction

Study Notes

You have already seen that ethyl acetoacetate-type compounds are very useful in organic syntheses. Any reaction which results in the formation of these compounds will also be of importance. In the next section, you will see how the range of β-keto esters that can be prepared by this method is extended through the use of two different esters as starting materials.

Because esters can contain α hydrogens they can undergo a condensation reaction similar to the aldol reaction called a Claisen Condensation. In a fashion similar to the aldol, one ester acts as a nucleophile while a second ester acts as the electrophile. During the reaction a new carbon-carbon bond is formed. The product is a β-keto ester. A major difference with the aldol reaction is the fact that hydroxide cannot be used as a base because it could possibly react with the ester. Instead, an alkoxide version of the alcohol used to synthesize the ester is used to prevent transesterification side products.

Claisen Condensation

\[
\text{H}C\text{O}R + \text{H}C\text{O}R \xrightarrow{1) \text{NaOR}} \xrightarrow{2) \text{H}_2\text{O}^+} \text{C}O\text{O} \text{R} \to \beta\text{-Ketoester}
\]

Going from reactants to products simply

Example 23.7.1: Claisen Condensation
Claisen Condensation Mechanism

1) Enolate formation

2) Nucleophilic attack

3) Removal of leaving group

Contributors

- Dr. Dietmar Kennepohl FCIC (Professor of Chemistry, Athabasca University)
- Prof. Steven Farmer (Sonoma State University)