When a primary amine bearing one or more beta hydrogens is treated with methyl iodide, followed by aqueous silver oxide, followed by heat, the primary amine is converted to an alkene. This reaction is known as Hofmann elimination, not to be confused with Hofmann rearrangement.

eg:

\[
\text{CH}_3\text{CH}_2\text{NH}_2 \xrightarrow{3 \text{ eq. CH}_3\text{I}} \text{CH}_3\text{CH}_2\text{Ni(CH}_3)_3\text{I}^{-} \xrightarrow{\text{aq. Ag}_2\text{O}} \text{CH}_2=\text{CH}_2
\]

The net reaction is 1,2-elimination, hence the name Hofmann Elimination.

Hofmann elimination occurs in three stages.

Mechanism

Stage 1:
Stage 2:

\[ \text{Ag}_2\text{O} (s) + \text{H}_2\text{O} \rightarrow \text{AgOH} (s) \]

\[ 
\text{CH}_3\text{C}_\text{H}_2\text{NCH}_2\text{C}_\text{H}_3\text{OH} + \text{Ag} (s) \rightarrow \text{CH}_3\text{C}_\text{H}_2\text{NCH}_2\text{C}_\text{H}_3 \text{I}^- + \text{Ag}^+ + \text{OH}^- 
\]

Stage 3:

\[ \text{H}_2\text{O} \rightarrow \text{H}^+ + \text{OH}^- \]

\[ \text{CH}_3\text{C}_\text{H}_2\text{NCH}_2\text{C}_\text{H}_3 + \text{OH}^- \rightarrow \text{CH}_3\text{C}_\text{H}_2\text{NCH}_2\text{C}_\text{H}_3 \text{OH} + \text{H}_2\text{O} \]

Stage 3 is a 1,2-elimination via E1cB mechanism.

Hofmann elimination is regioselective. Since the 1,2-elimination in Stage 3 occurs via E1cB mechanism, Hofmann rule is used to predict the major product. eg:
see also quaternary ammonium salt

Contributors

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