Skills to Develop

• To describe the preparation of carboxylic acids.

As we noted previously, the oxidation of aldehydes or primary alcohols forms carboxylic acids:

\[
\text{RCH}_2\text{OH} \xrightarrow{\text{oxidizing agent}} \text{RCHO} \xrightarrow{\text{oxidizing agent}} \text{RCOOH}
\]

A primary alcohol A aldehyde A a carboxylic acid

In the presence of an oxidizing agent, ethanol is oxidized to acetaldehyde, which is then oxidized to acetic acid.

\[
\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{oxidizing agent}} \text{CH}_3\text{CHO} \xrightarrow{\text{oxidizing agent}} \text{CH}_3\text{COOH}
\]

Ethanol Acetaldehyde Acetic acid

This process also occurs in the liver, where enzymes catalyze the oxidation of ethanol to acetic acid.

\[
\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{oxidizing agent}} \text{CH}_3\text{CHO} \xrightarrow{\text{oxidizing agent}} \text{CH}_3\text{COOH}
\]

Acetic acid can be further oxidized to carbon dioxide and water.

Summary

Whether in the laboratory or in the body, the oxidation of aldehydes or primary alcohols forms carboxylic acids.

Concept Review Exercises

1. Caproic acid (hexanoic acid) can be prepared in an oxidation reaction from
   a. what alcohol?
   b. what aldehyde?

2. Give the structures of the aldehyde and the carboxylic acid formed by the oxidation of isobutyl alcohol [(CH₃)₂CHCH₂OH].

Answers

1. a. CH₃CH₂CH₂CH₂CH₂CH₂OH
   b. CH₃CH₂CH₂CH₂CH₂CHO

2. CH₃CHCHO and CH₃CHCOOH
Exercises

1. Caprylic acid (octanoic acid) can be prepared in an oxidation reaction from
   a. what alcohol?
   b. what aldehyde?

2. Give the structures of the aldehyde and the carboxylic acid formed by the oxidation of 1,4-butanediol (HOCH₂CH₂CH₂CH₂OH).

Answer

1. a. CH₃CH₂CH₂CH₂CH₂CH₂CH₂CH₂CH₂OH
   b. CH₃CH₂CH₂CH₂CH₂CH₂CH₂CHO