

Chapter 8. Alcohols, Ethers, and Thiols

Learning objectives:

1. Provide both IUPAC and common names for alcohols, ethers, and thiols.
2. Recognize the physical properties of alcohols, ethers, and thiols.
3. Remember the approximate pK_a values for alcohols, water, and hydronium ion.
4. Write the reaction equations of alcohols reacting with active metals, such as Li, Na, and K.
5. Write the reaction and electron-pushing (arrow-pushing) mechanism for the conversion of alcohols to alkyl halides.
6. Write the reaction and electron-pushing (arrow-pushing) mechanism for the conversion of alcohols to alkenes, and explain the regioselectivity when applicable.
7. Write the oxidation from primary alcohol to aldehydes then to carboxylic acids, and recognize the difference in using chromic acid versus PCC.
8. Write the epoxidation from alkenes to epoxides including the reagent used.
9. Write the acid-catalyzed ring-opening of epoxides, and explain the observed stereochemistry of the products.

Sections to be covered (in the order of delivery):

- 8.1 Introduction[#]
- 8.2 Alcohols
- 8.3 Reactions of Alcohols^{*}
- 8.4 Ethers
- 8.5 Epoxides^{*}
- 8.6 Thiols
- 8.7 Reactions of Thiols

* Sections that will be focused

[#] Sections that will be skipped

Recommended additional problems

8.12 – 8.44

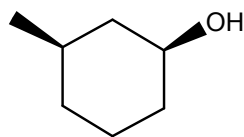
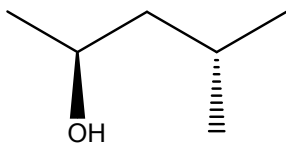
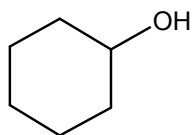
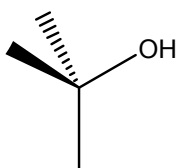
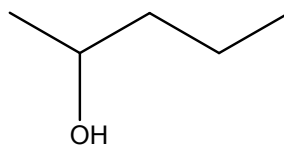
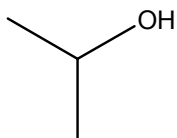
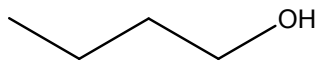
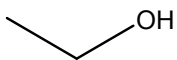
8.2 Alcohols

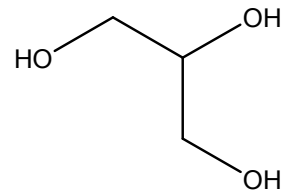
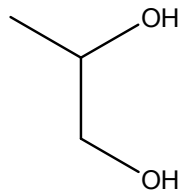
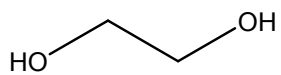
A. Structure

ROH

Know how to classify primary (1°), secondary (2°) and tertiary (3°) alcohols.

B. Nomenclature





C. Physical Properties

8.3 Reactions of Alcohols

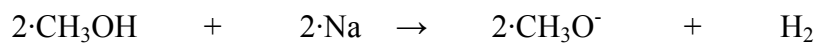
A. Acidity of Alcohols

Know the estimated pK_a of water, methanol and ethanol (Table 8.2).

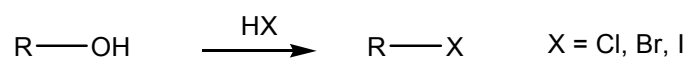
B. Basicity of Alcohols

Know the estimated pK_a of H_3O^+ and ROH_2^+ .

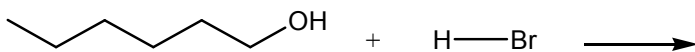
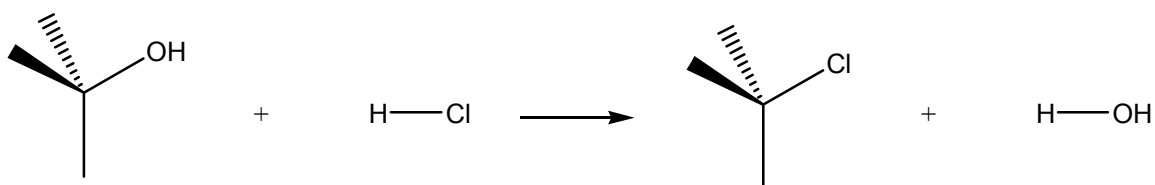
C. Reaction with Active Metals



D. Conversion to Haloalkanes

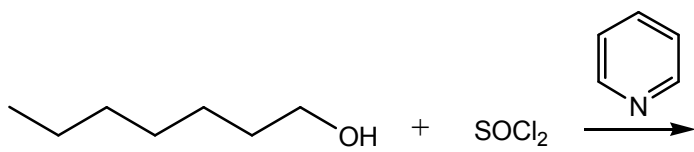


(i) Examples

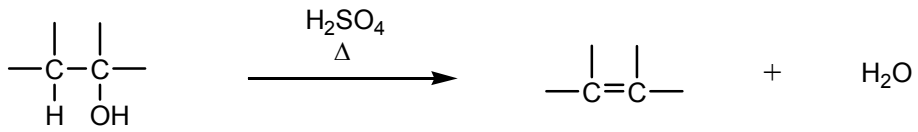


(ii) Mechanism ($\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$)

(iii) Reaction with Thionyl Chloride (SOCl₂)



E. Acid-Catalyzed Dehydration to Alkenes

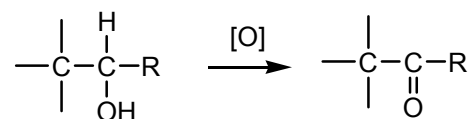
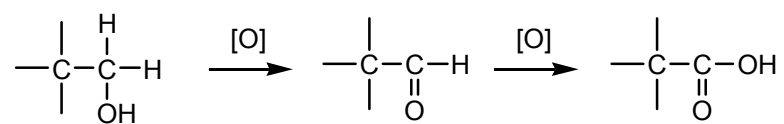


(i) General Mechanism

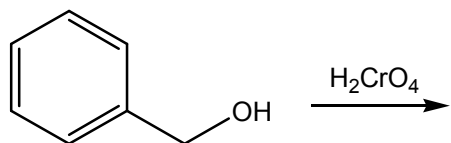
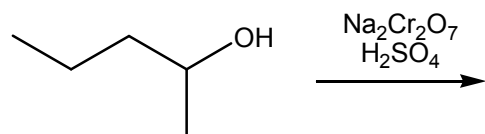
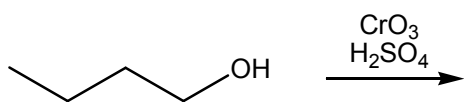
(ii) Comparison with Hydration Reaction of Alkenes

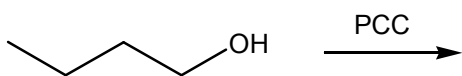
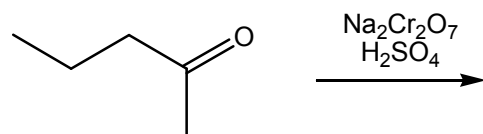
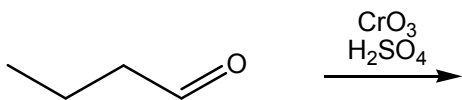
F. Oxidation of Primary and Secondary Alcohols

(i) General Reactions



(ii) Examples

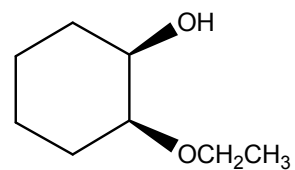
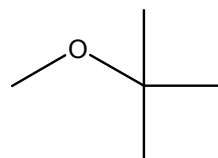
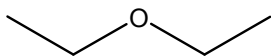


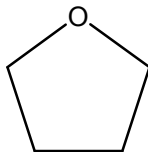
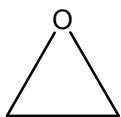


8.4 Ethers

A. Structure

B. Nomenclature





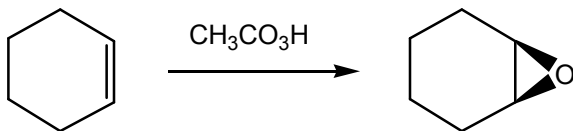
8.5 Epoxides

A. Structure and Nomenclature

B. Synthesis from Alkenes



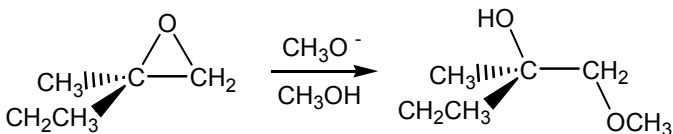
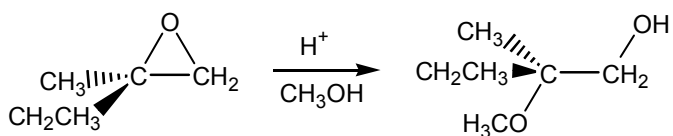
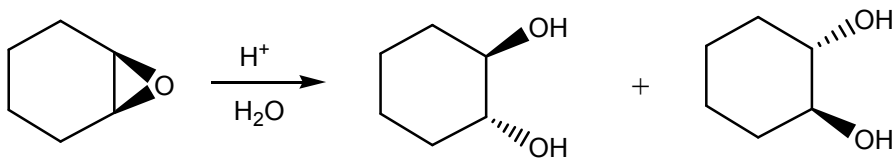
(i) Example



(ii) Stereoselectivity

C. Ring-Opening Reactions

(i) Examples



(ii) Issues in Stereoselectivity and Regioselectivity

- Ring-opening in acidic condition

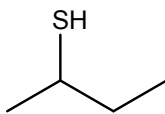
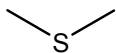
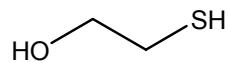
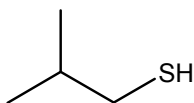
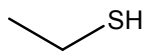
- Ring-opening in basic condition

(iii) Comparison with Dihydroxylation Using OsO_4

8.6 Thiols

A. Structure

B. Nomenclature



8.7 Reactions of Thiols

A. Acidity

B. Oxidation to Disulfide (skipped)