

Chapter 10. Reactions of Alcohols, Amines, Ethers, and Epoxides

Learning objectives:

1. Provide both IUPAC and common names for alcohols and ethers.
2. Recognize the physical properties of alcohols and ethers.
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 reaction and electron-pushing (arrow-pushing) mechanism for the nucleophilic substitution of ethers.
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):

- 10.1 The nomenclature of alcohols
- 10.2 Substitution reactions of alcohols
- 10.3 Elimination reactions of alcohols: dehydration
- 10.4 Oxidation of alcohols
- 10.5 Amines do not undergo substitution or elimination reactions
- 10.6 Nomenclature of ethers
- 10.7 Nucleophilic substitution reactions of ethers
- 10.8 Nucleophilic substitution reactions of epoxides
- 10.9 Using carbocation stability to determine the carcinogenicity of an arene oxide[#]

[#] Sections that will be skipped

Recommended additional problems

22, 23, 24, 29, 32, 33, 39, 49

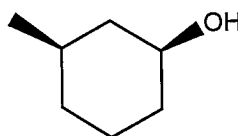
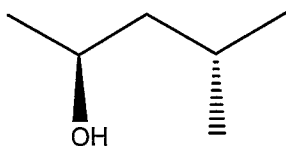
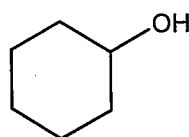
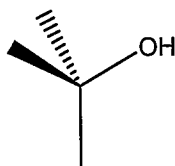
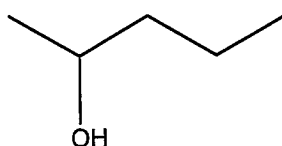
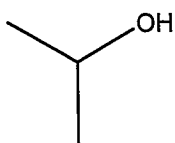
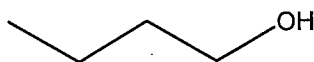
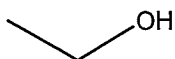
10.1 The nomenclature of alcohols

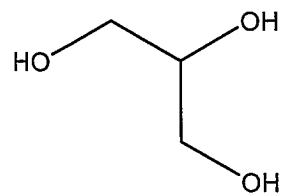
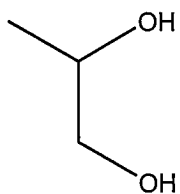
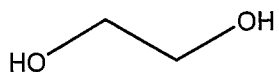
A. Structure

ROH

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

B. Nomenclature





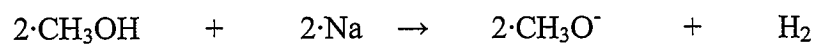
C. Physical Properties

10.2 Substitution reactions of alcohols

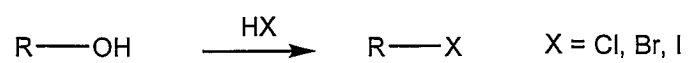
A. Acidity of Alcohols

Know the estimated pKa of water, hydronium (H_3O^+), methanol and ethanol.

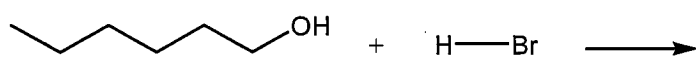
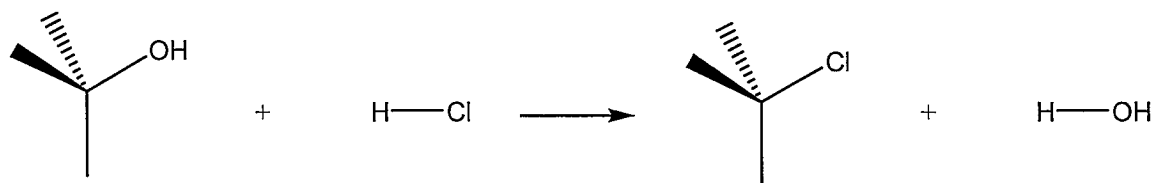
B. Reaction with Active Metals



C. Conversion to Haloalkanes



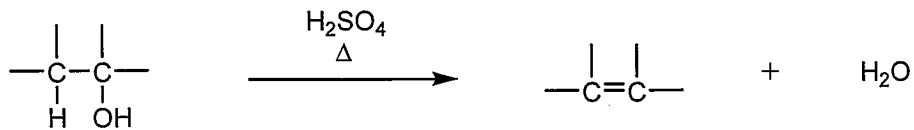
(i) Examples



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

10.3 Elimination reactions of alcohols: dehydration

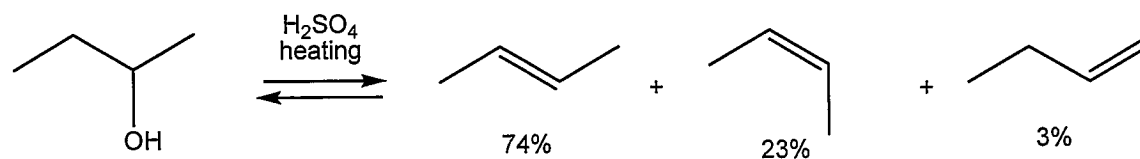
A. Acid-Catalyzed Dehydration to Alkenes



B. General Mechanism

C. Relative ease of dehydration

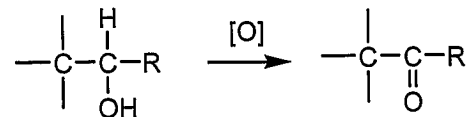
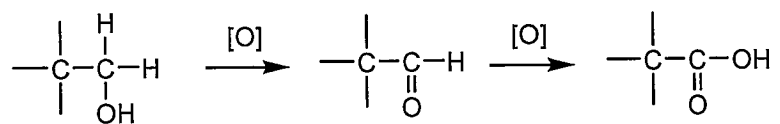
D. Example



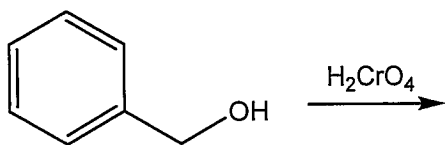
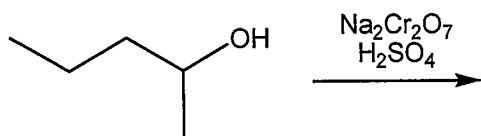
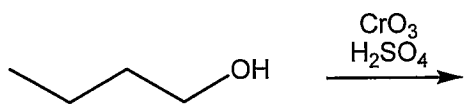
E. Comparison with Hydration Reaction of Alkenes

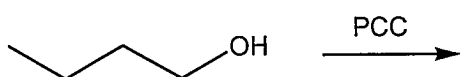
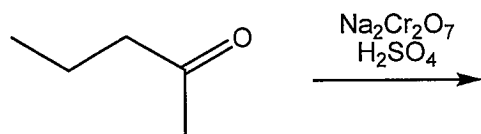
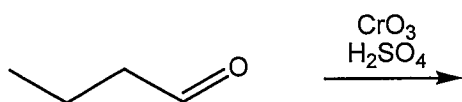
10.4 Oxidation of alcohols

A. General Reactions



B. Examples



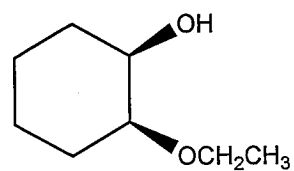
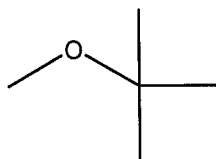
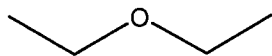


10.5 Amines do not undergo substitution or elimination reactions

10.6 Nomenclature of ethers

A. Structure

B. Nomenclature





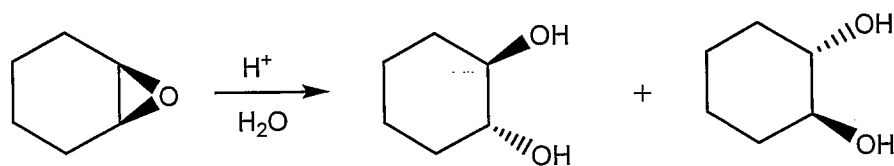
10.7 Nucleophilic substitution reactions of ethers

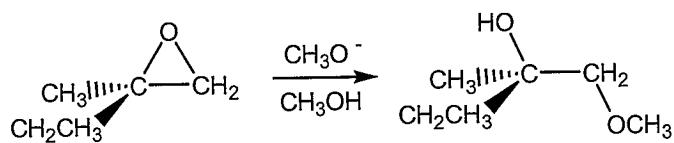
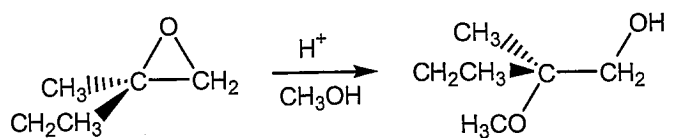
10.8 Nucleophilic substitution reactions of epoxides

A. Structure and Nomenclature

B. Ring-Opening Reactions

(i) Examples





C. Stereoselectivity and Regioselectivity

(i) Ring-opening in acidic condition

(ii) Ring-opening in basic condition