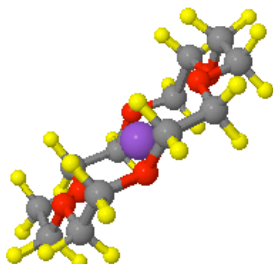


Chem 220 - Organic Chemistry

Problem Set 10

Chapter 14 - Ethers and Epoxides

Due: Monday, November 29, 2010



Jmol

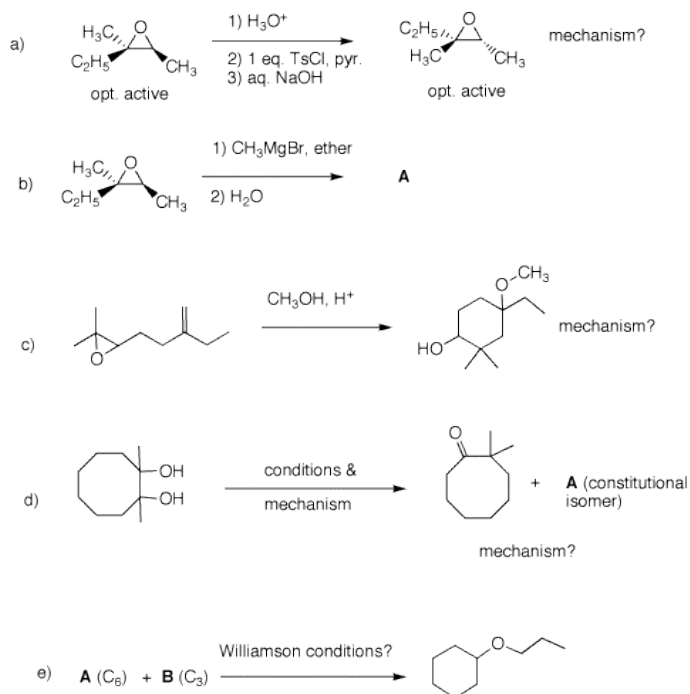
[How to manipulate Jmol structures.](#)

- Potassium cation solvated by the cyclic polyether, 18-crown-6 [18-membered ring; 6 oxygen atoms]. Each of the ethano groups is in a staggered conformation with each of the O-C-C-O dihedral angles at $\sim 60^\circ$ [gauche]. For a dynamic version, [click here](#). Note that the six oxygen atoms occupy the same spatial arrangement as do the six carbon atoms in chair cyclohexane. The discovery of the crown ethers by [Charles Pedersen](#) of DuPont earned him a share in the 1987 Nobel Prize in Chemistry.
- Diethyl ether (ether) may well be the first organic compound prepared that does not appear in Nature. For a chemical history of ether [click here](#). A different Powerpoint version is [here](#).
- [Theory of Etherification, A. W. Williamson, Quarterly J. Chem. Soc., 1852, 4, 106.](#) [See page 23 in the .pdf file.]

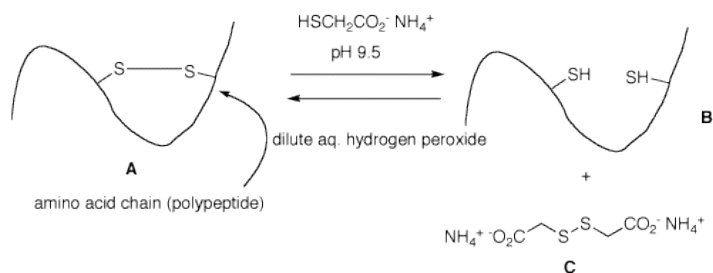
"The following experiments were made with the view of obtaining new alcohols, by substituting carburetted hydrogen for hydrogen in a known alcohol. Iodide of potassium was readily formed on the application of a gentle heat, and the desired substitution was effected; but, contrary to expectation, the compound thus formed had none of the properties of an alcohol -- it was nothing else than common ether, $C^4H^{10}O$."

- [On Etherification, A. W. Williamson, Quarterly J. Chem. Soc., 1852, 4, 229.](#)

1. In the following problems, provide the missing information. Provide explanations for your choices. **Pay attention to stereochemistry.**



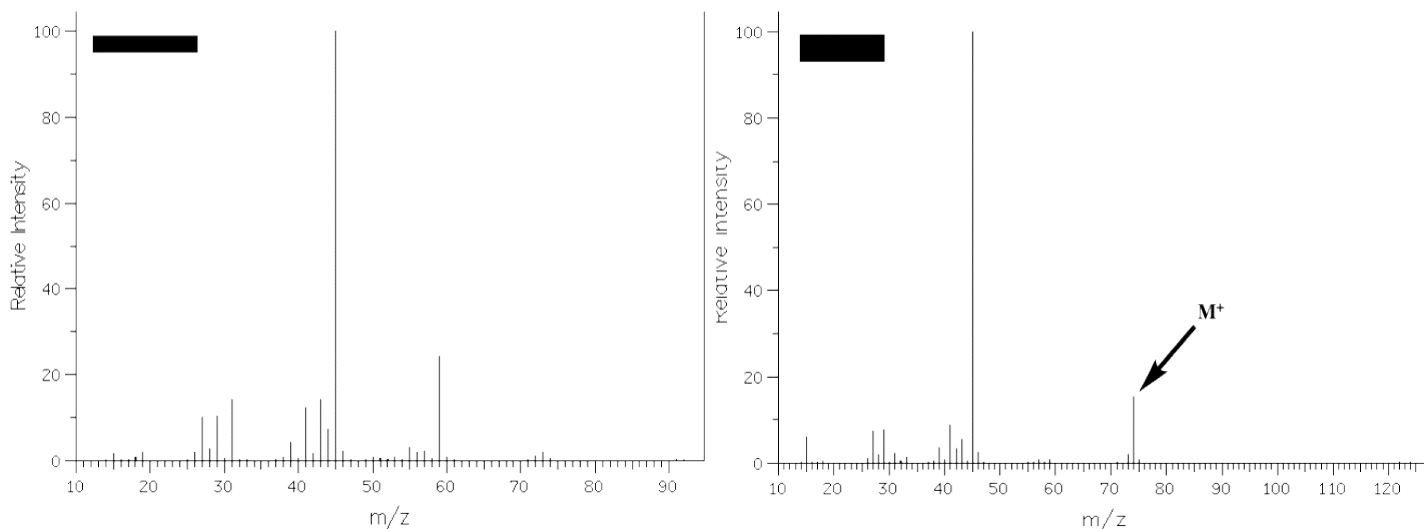
2. Cartoon **A** represents the cross-linking of a disulfide bond in hair. This property gives hair its natural curl or an artificial "permanent wave". When a solution of ammonium thioglycolate at alkaline pH is applied to the hair, it goes straight to form a dithiol (cartoon **B**) and disulfide **C**, which is water soluble and is rinsed away. To restore the curl, the hair is washed with a mild oxidant. Provide a mechanism for the formation of **B** and **C** from **A**, and the formation of **A** from **B**.



3. The mass spectra of two constitutional isomers, **A** and **B**, are shown below. Compound **A** reacts with pyridinium chlorochromate (PCC); compound **B** is inert to this reagent. What are the structures of **A** and **B**? Interpret the molecular ions and any fragments with m/z greater than or equal to 20% relative intensity. [Note: The mass spectra on pg. 634 (7th ed.) and pg. 632 (6th ed.) will be of help.]

Spectrum A:

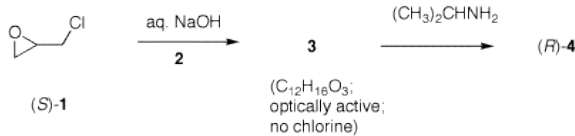
Spectrum B:



4. Design two independent syntheses of 3-cyclopentyl-3-heptanol using two different disconnections and using 1-butene and cyclopentene as the only source of carbon. All other reagents are available to you. What can you say about the optical rotation of 3-cyclopentyl-3-heptanol in each of your syntheses?

5. Toprol (**4**; Lopressor; Metoprolol) is a β -blocker used for the treatment of hypertension. It is a racemic drug sold as its monosuccinate salt. A seasoned chemist wants to prepare Toprol as its (*R*)-enantiomer using the synthesis of the racemate. She follows the steps shown on the right.

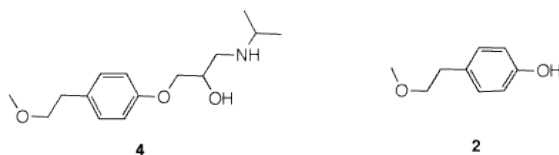
a) Why is Toprol a racemate?



b) Draw a structure of the (\pm)-succinate salt.

c) What is the role of aq. NaOH? [Check here.](#)

d) What is the structure and CIP designation for **3**?



e) What does the sequence of reactions and their chirality tell you about the mechanism of the double $\text{S}_{\text{N}}2$ reaction sequence? e) Write mechanisms for the two reactions.

f) How can she prepare (*S*)-**4** without resorting to the use of (*R*)-**1**?