Comprehensive Organic Chemistry - Chem 225b

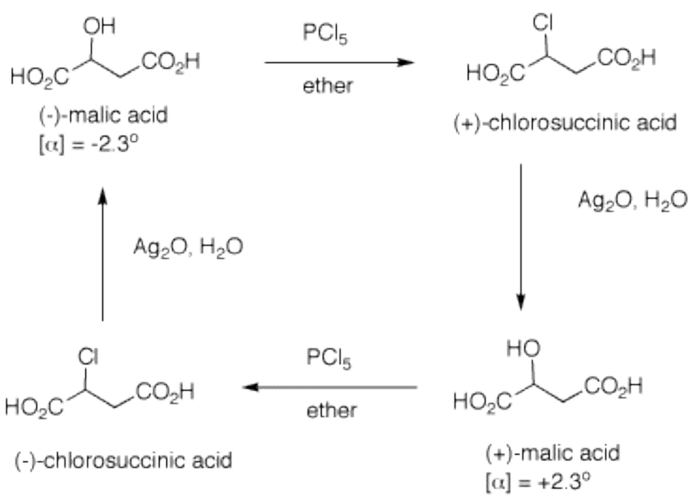
Problem Set 5

Chapter 6

Due: Monday, February 25, 2008

Study #2 and #3 in the Alkyl Halide module and #1 in the Ether module in ORGO.

A Walden Cycle



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Paul Walden (1863-1957)

here also

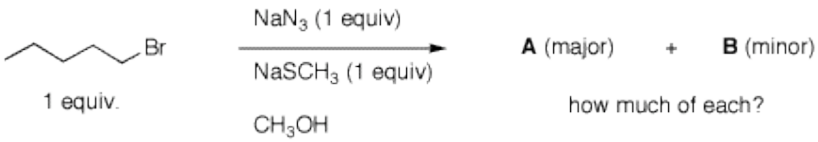
1. The inversion of configuration in an S_N2 reaction is often called a Walden inversion, named after its discoverer, Paul Walden. In the cycle shown above, the overall conversion of one enantiomer of malic acid to the other one must require an inversion of configuration. Similarly, the same is true of the chloro acids. More generally, each interconversion of enantiomers must require an odd number of inversions. The PCl_5 reaction requires a single inversion which means that the Ag_2O reaction involves an even number of inversions of configuration, namely two in this instance. (-)-Malic acid is of the (*S*)-configuration.

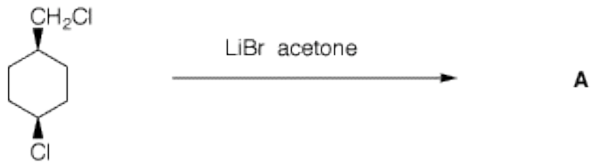
a) Show how malic acid, like any alcohol, might react with PCl_5 and then undergo inversion to form a chloride. Remember that phosphoric acid is a strong acid and its conjugate base and analogs thereof are also good leaving groups.

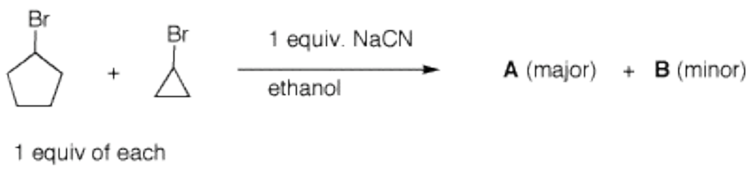
b) Silver oxide is an anhydrous form of AgOH. The carboxylic acid group closest to the hydroxyl group plays a role in the process. The reaction medium is mildly alkaline.

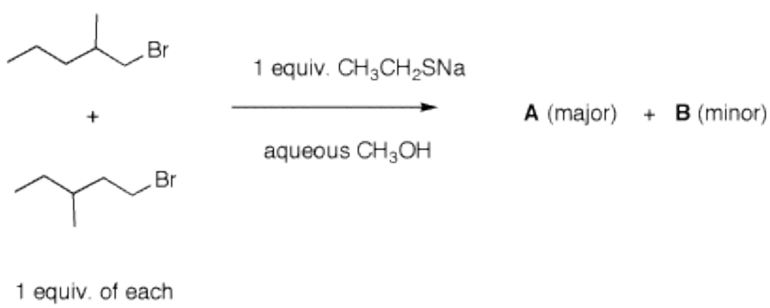
c) Draw these four enantiomers as Fischer projections. (-)-Malic acid is of the (*S*)-configuration.

2. In each of the following reactions, predict the expected products. Explain.

a) 

b) 

c) 

d) 

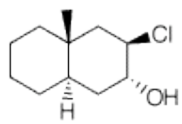
3. Show how you would convert (*R*)-2-heptanol into (*R*)-2-heptanethiol.

4. (3R,6R)-6-Bromo-3-octanol (**A**) forms optically inactive **B** ($C_8H_{16}O$) upon exposure to aqueous NaOH. A stereoisomer of **A**, namely, **C** also forms **B** under the same conditions. Two other stereoisomers of **A**, namely **D** and **E** as a 50/50 mixture, form optically inactive **F**, a diastereoisomer of **B**. What are the structures of A-F. Explain and illustrate with mechanisms.

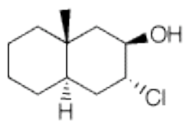
1.

5. Provide the unknown product of each reaction. In all cases, provide mechanisms and a rationale.

a) (2*S*,5*S*)-2,5-dichlorohexane $\xrightarrow[\text{aqueous KOH}]{H_2S}$ **A** ($C_6H_{12}S$)

b) 

$\xrightarrow[CH_3OH]{NaOCH_3}$ **A** ($C_{11}H_{18}O$)

c) 

$\xrightarrow[CH_3OH]{NaOCH_3}$ **A** ($C_{11}H_{18}O$)

d) (*1R, 4S*))-$CH_3CH_2CH(CH_3)CH_2CH_2CHDCl$ $\xrightarrow[\text{methanol}]{NaN_3}$ **A**

6. There are 16 possible stereoisomers of bromoalcohol **1**. Only one of them can produce optically active cyclic ether **2**.

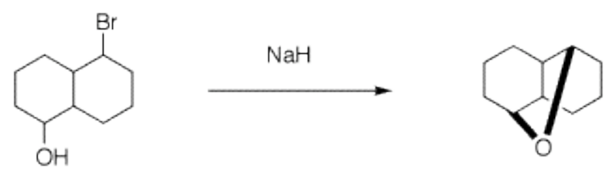
a) What is the absolute sterochemistry of **1**?

b) Provide a mechanism for this reaction using 3-D illustrations. Explain why your assignment of stereochemistry is needed.

c) Assign RS-descriptors to the asymmetric carbons in **2**.

d) What optically active stereoisomer of **1** gives the enantiomer of **2**?

e) Ether **2** has only 5 chemically different carbon atoms. Explain.



1 **2**