

Good morning!

Exam:

plan

2 pp. box

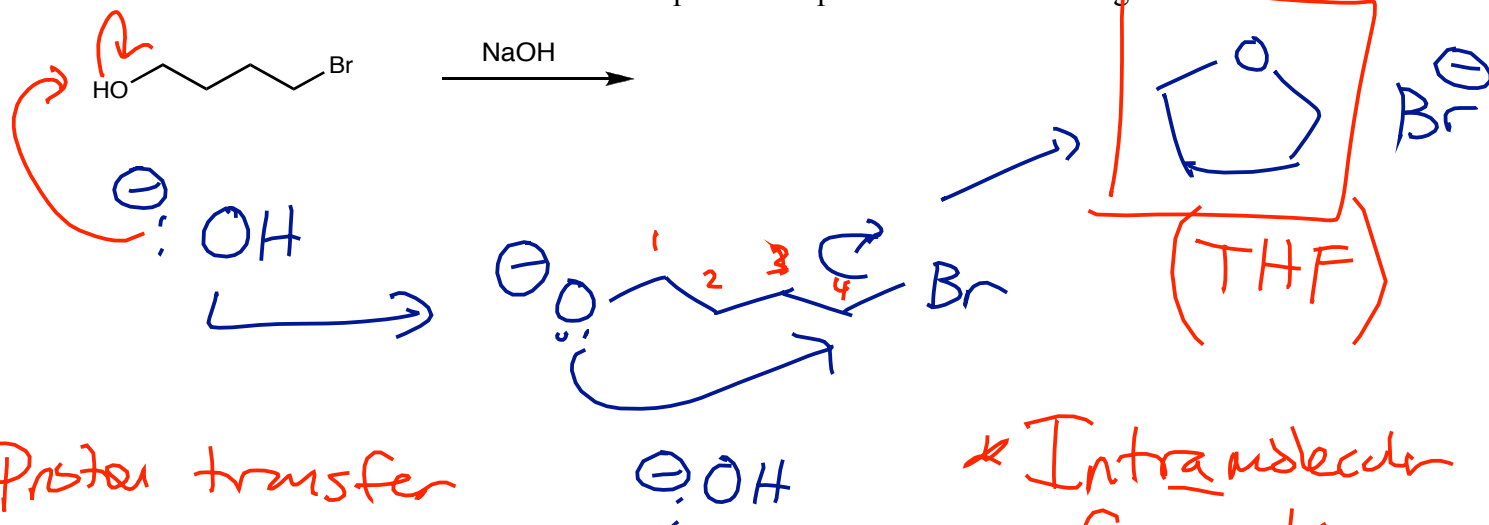
2 pp. Spect

2 pp. mech

2 pp. Synth

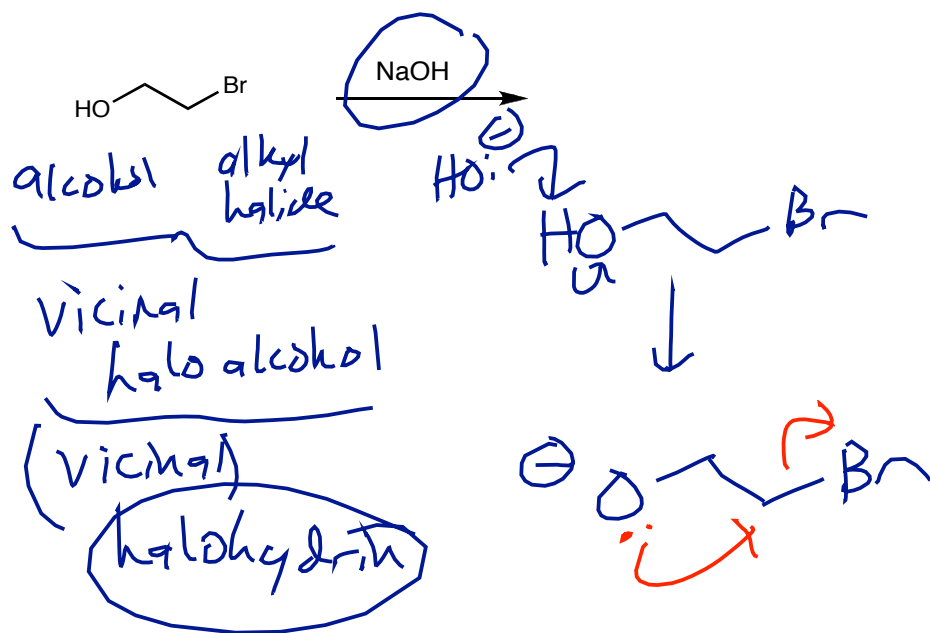
Rings! Count C's.Cyclic Ethers and Epoxides

- Draw a curved-arrow mechanism and predict the product of the following reactions:



* Proton transfer
Very fast.

* Intramolecular
faster than
Intermolecular.



epoxide
3-member.
Cyclic ether

- The three-membered cyclic ether is given the special name **epoxide**. Why might this epoxide exhibit reactivity different from that of the 5-membered ring above?

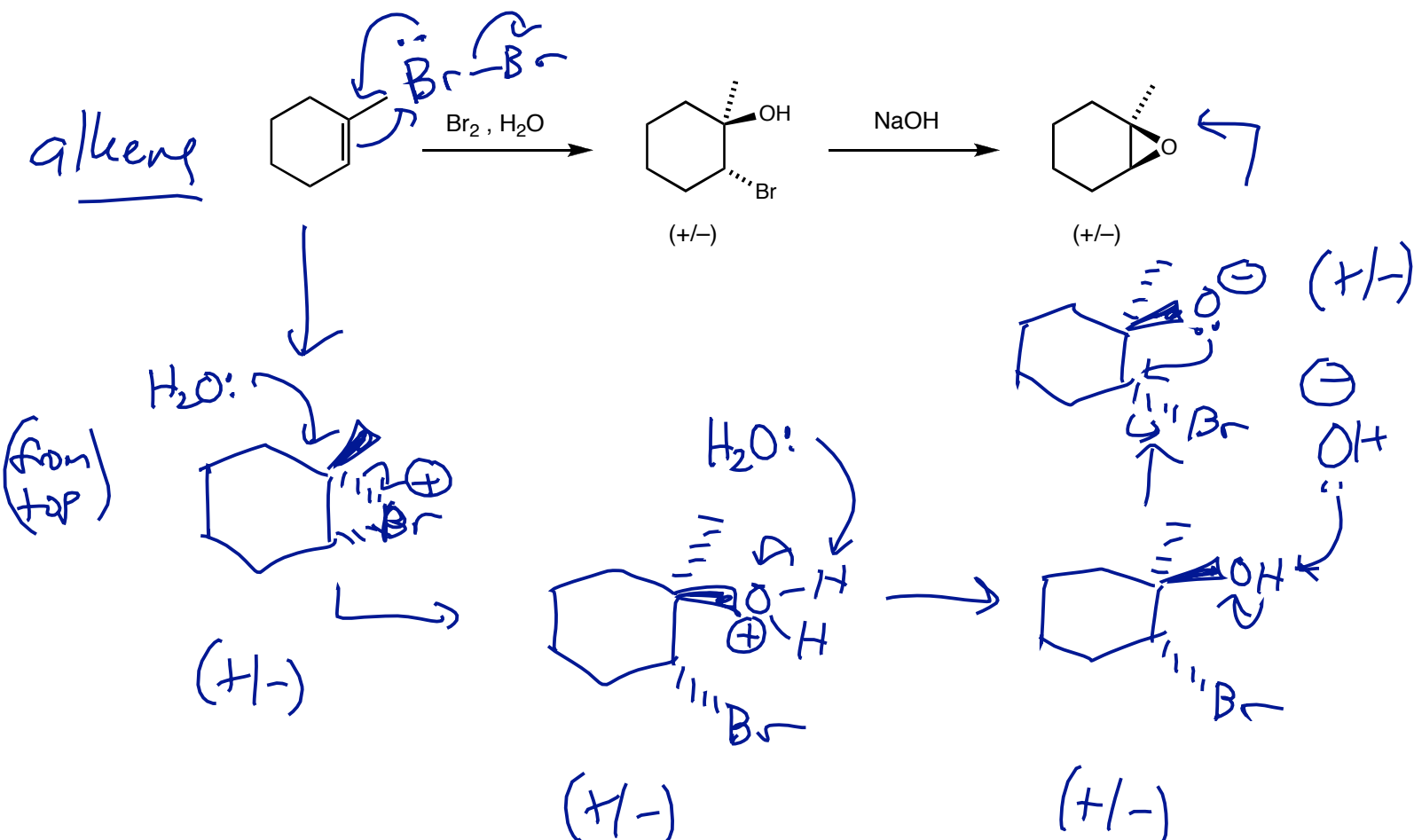
Halohydrin $\xrightarrow{\text{base}}$ epoxide

Reading: Section 11.2

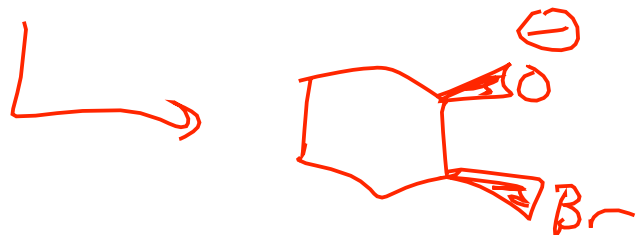
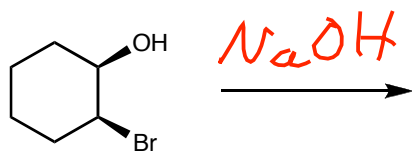
→ strong (OH⁻ or better)

Synthesis of Epoxides With Halohydrins

- Provide complete curved-arrow mechanisms for each step in the following transformation. Be sure to pay attention to stereochemistry!

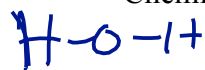


- Explain why the following halohydrin *cannot* be transformed into an epoxide:



not possible
for $\text{S}_{\text{N}}2$

Reading: Section 11.2
Intramolecular

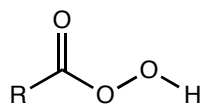


compare carbox. acid $\text{R}-\text{C}(=\text{O})\text{OH}$

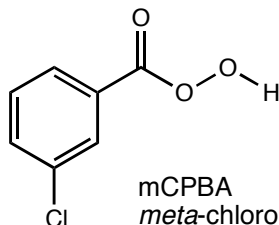


Synthesis of Epoxides With Peroxycarboxylic Acids

- A much more convenient, one-step synthesis of epoxides from alkenes uses peroxycarboxylic acids, often called "peracids." Some examples:



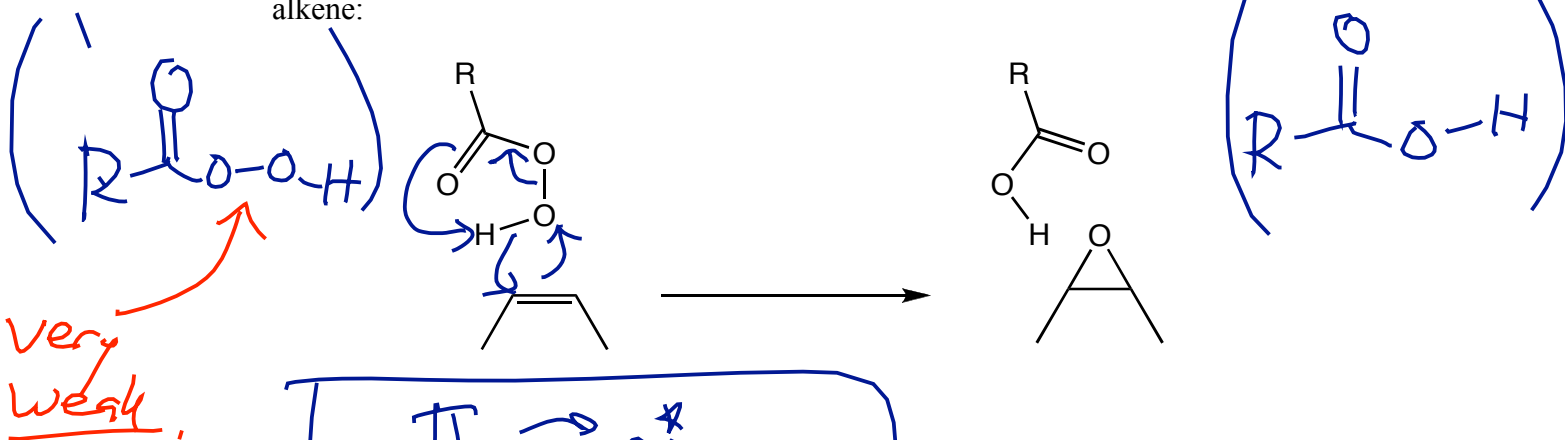
a general peracid



mCPBA
meta-chloroperoxybenzoic acid

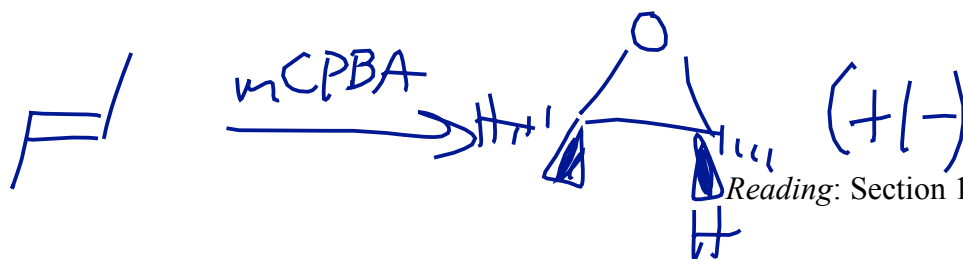
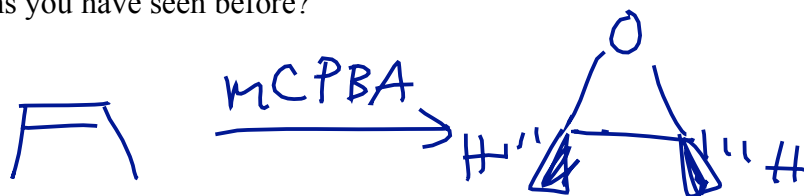
specific
(common) example

- Draw the curved arrows for the following single-step synthesis of an epoxide from an alkene:



- Identify the molecular orbitals involved in this reaction. Is this mechanism similar to any other reactions you have seen before?

Overall:

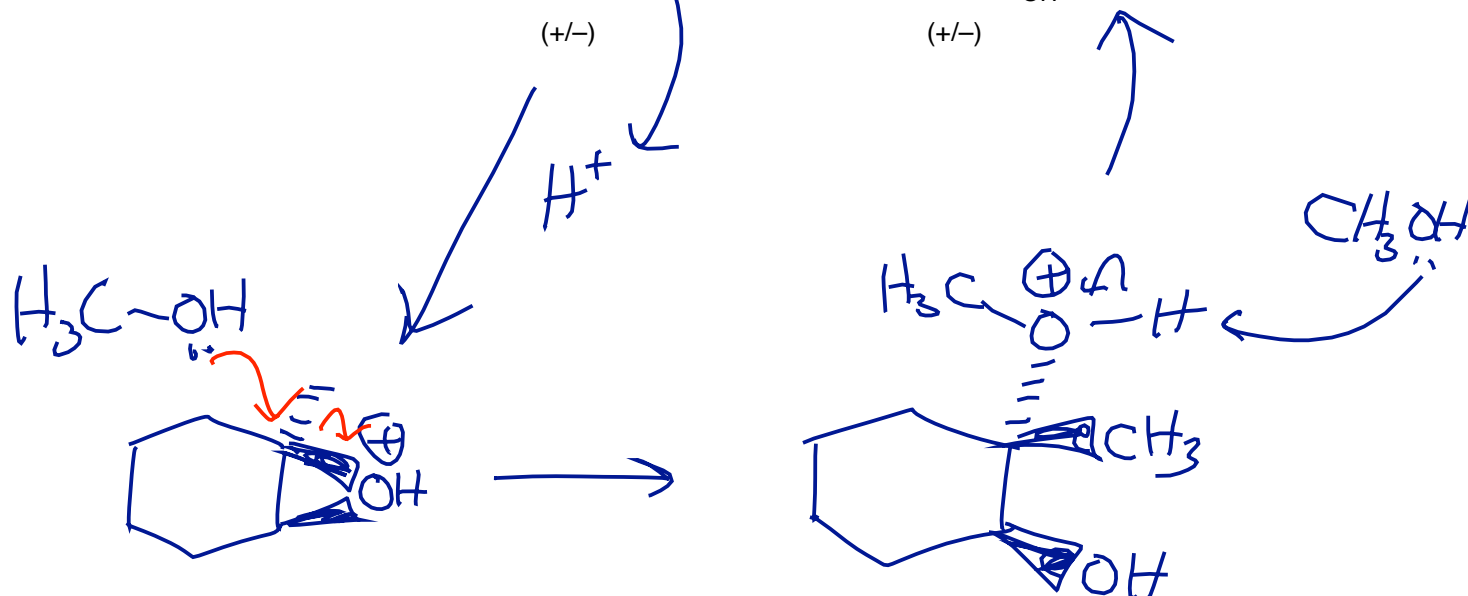
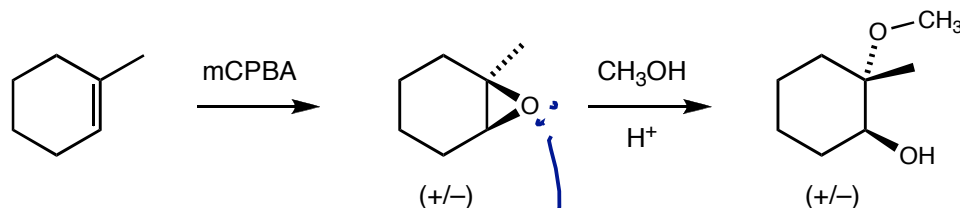


Reading: Section 11.2

Opening Epoxides: Acidic Conditions

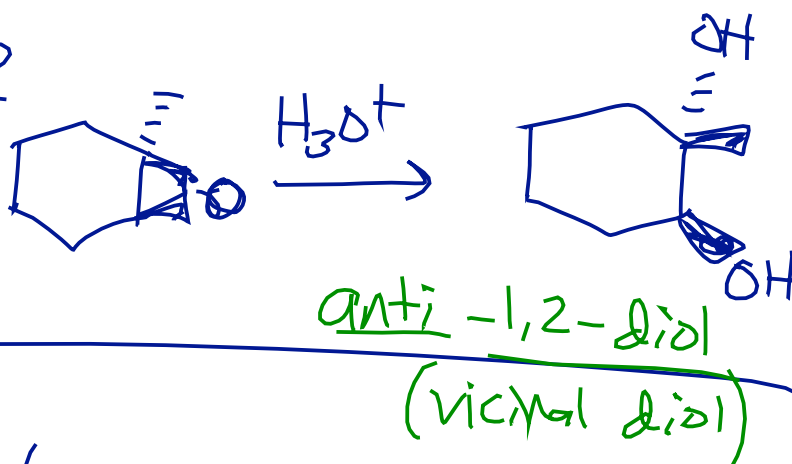
like
bromonium

- Provide a mechanism and explain why the indicated product is formed selectively in each of the following reactions:



pos charged
3-member
ring.

Also



Nuc: will attack

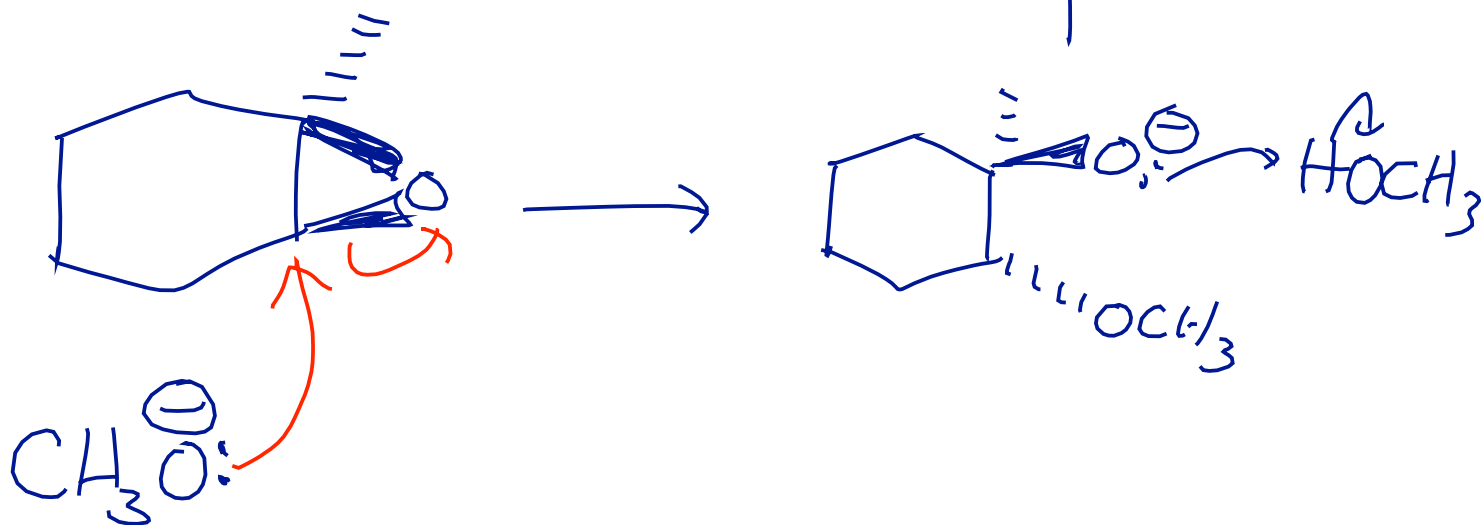
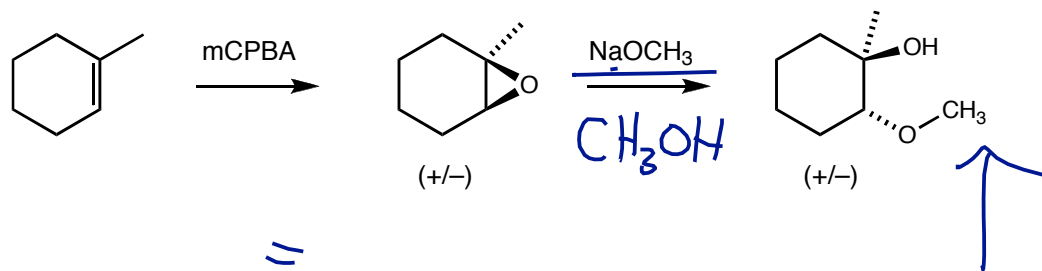
more subst carbon

just like bromonium (see p. 67)

Reading: Section 11.4

Opening Epoxides: Basic Conditions

- Provide a mechanism and explain why the indicated product is formed selectively in each of the following reactions:



Mechanism: $\text{O}^- \text{lp} \rightarrow \text{O}^* \text{C} - \text{O}$

$\text{S}_{\text{N}}2$

Steric! favor less subst.
Carbon

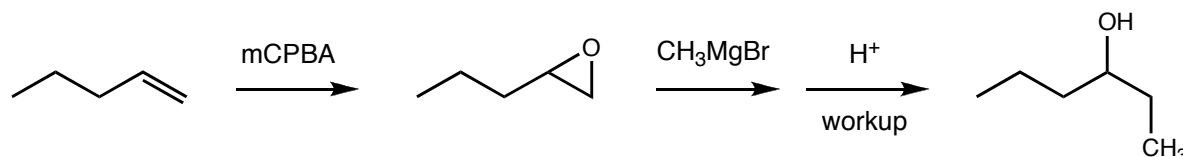
Reading: Section 11.4

NOT SN2 on R-X

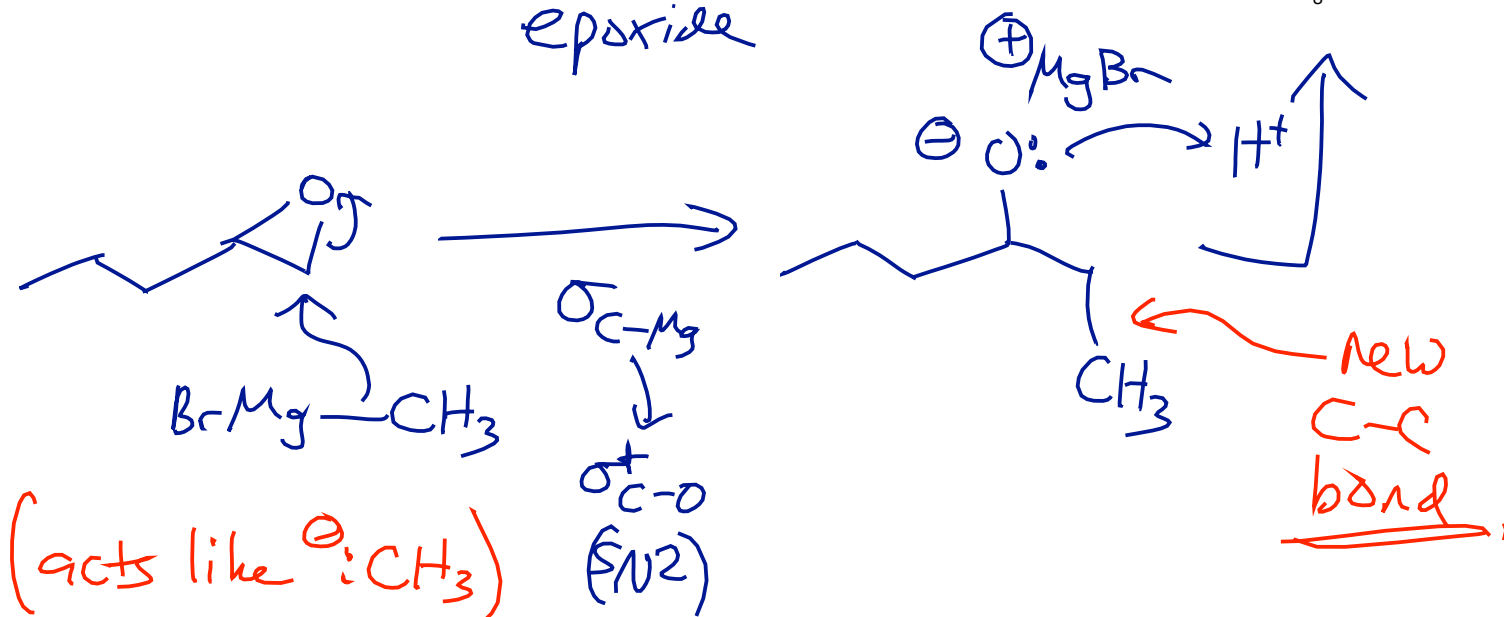
aprotic solvent

Opening Epoxides with Grignard Reagents

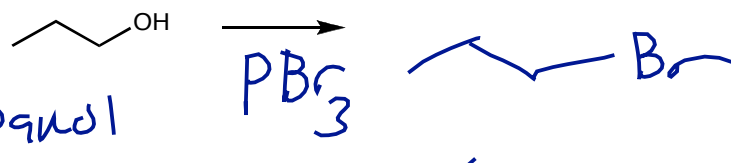
- Provide a mechanism that shows how the following epoxide reacts with the indicated Grignard reagent:



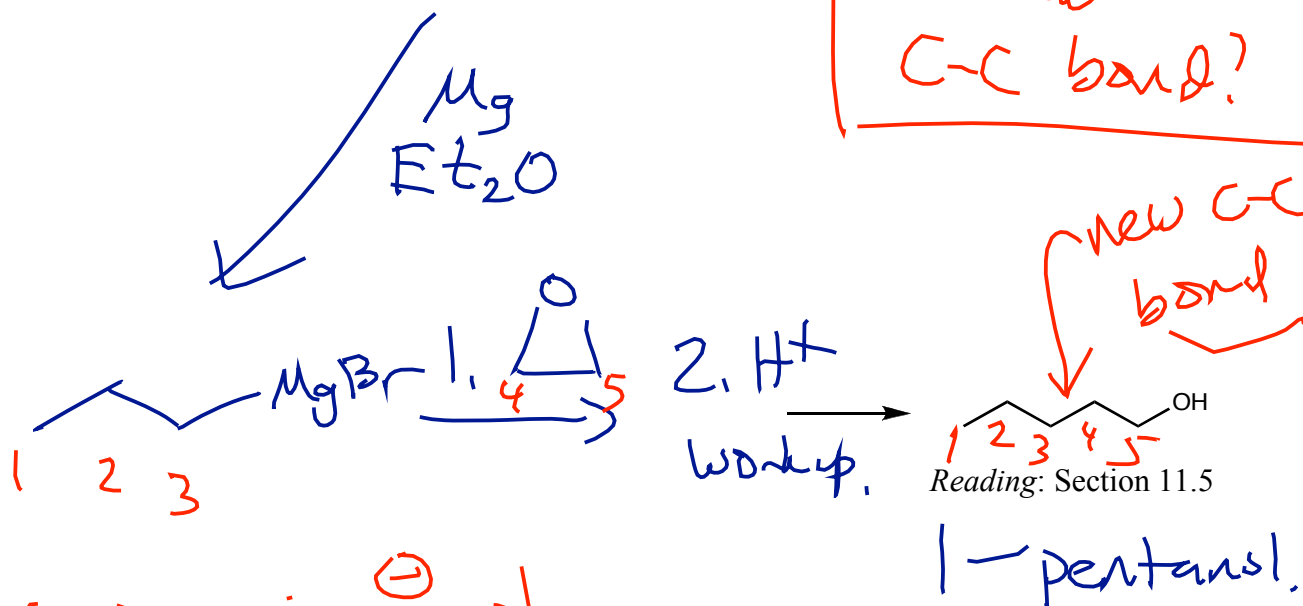
epoxide



- This reaction is quite useful for synthesis, because it forms a new **carbon-carbon bond**. Provide a synthetic route for the following transformation:



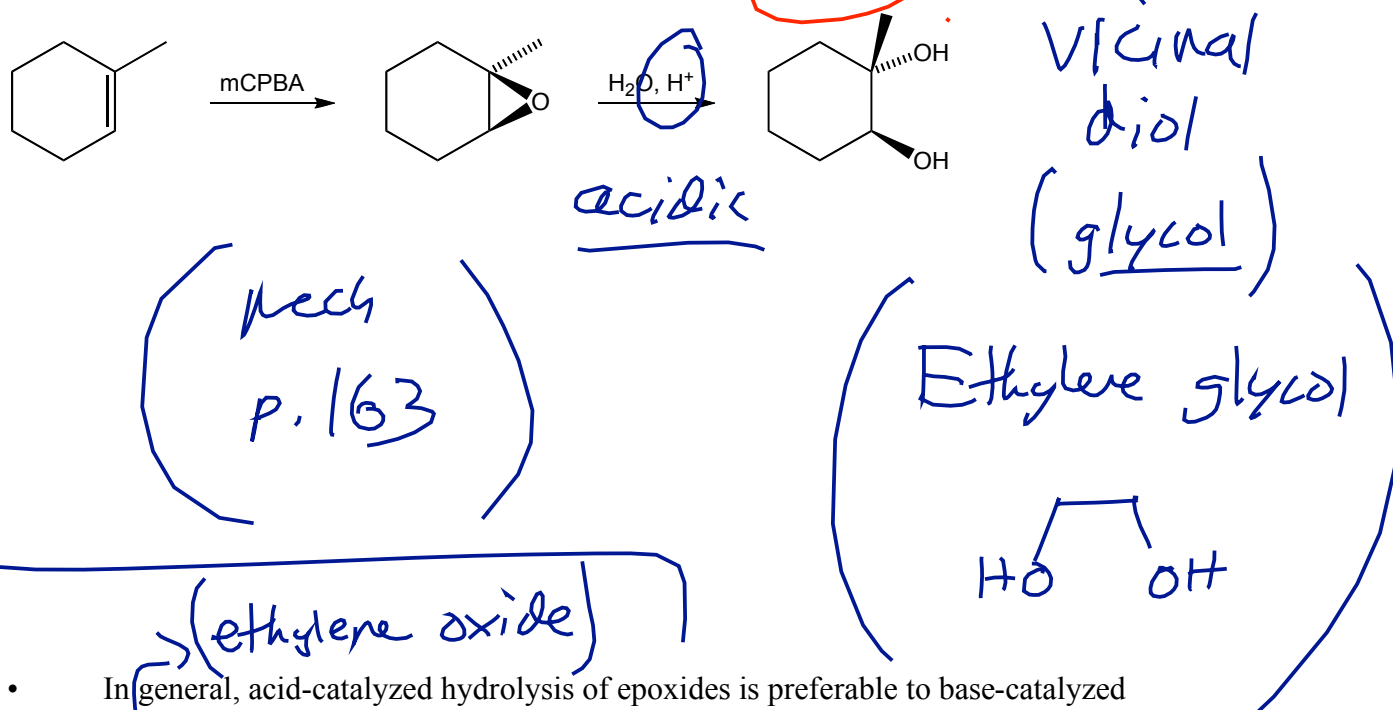
Are we forming a new C-C bond?



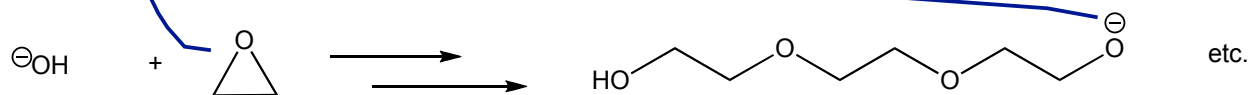
(also SN2 with ICN^-)

Synthesis of Glycols (Vicinal Diols) from Epoxides

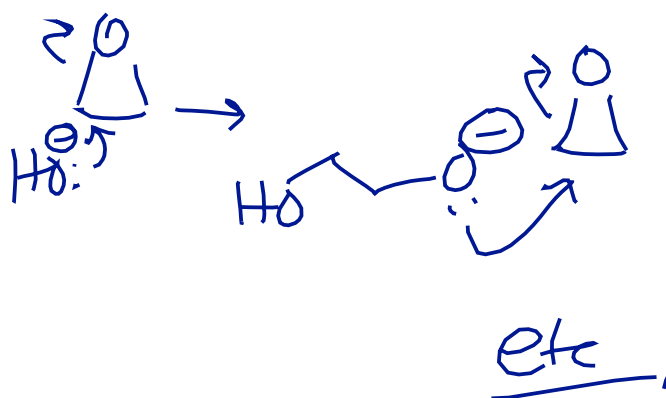
- Glycols can be synthesized from epoxides. What is the overall stereochemistry of the following transformation?



- In general, acid-catalyzed hydrolysis of epoxides is preferable to base-catalyzed hydrolysis, because base-catalyzed hydrolysis can result in **polymerization**:



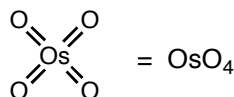
This polymerization reaction is extremely exothermic, and can be dangerous!



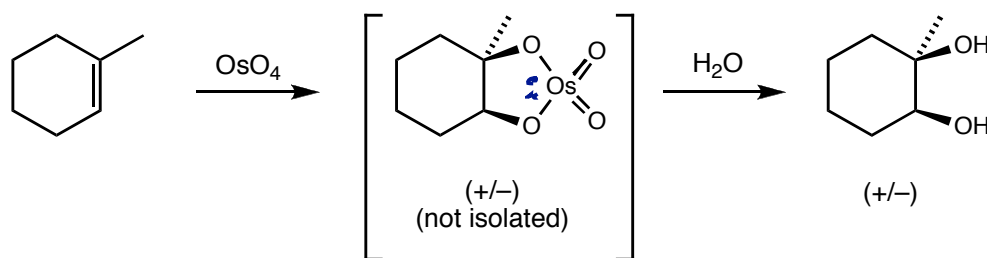
Reading: Section 11.5

Synthesis of Glycols (Vicinal Diols) from Alkenes

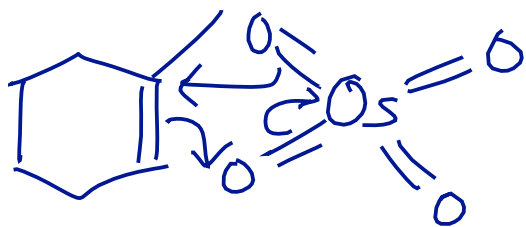
- There is a *direct* route to synthesis of glycols from alkenes using osmium tetroxide, OsO_4 . Draw the curved arrows for the following reaction. What is the overall stereochemistry of this reaction?



Osmium tetroxide

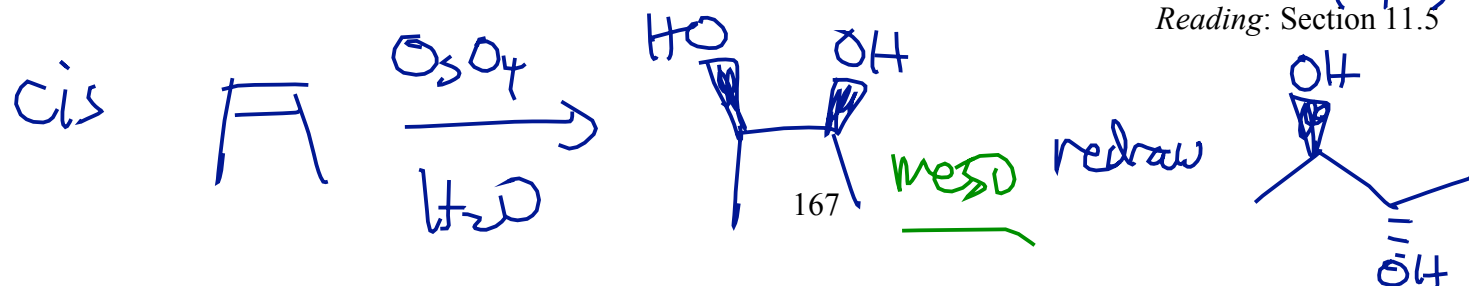
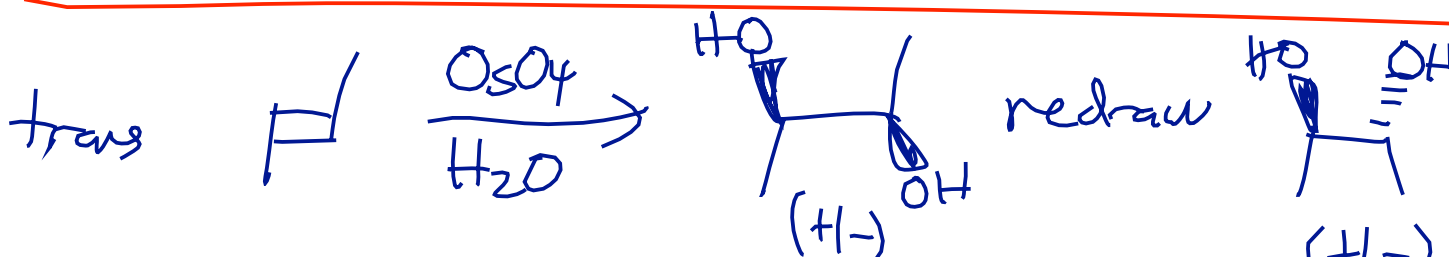


syn
vicinal
diol



Cyclic
osmate
ester

OsO_4 adds both oxygens
to same face of alkene.

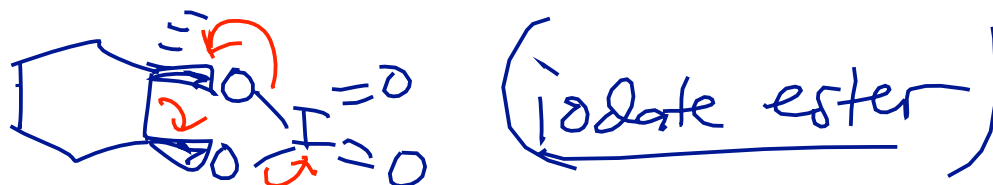
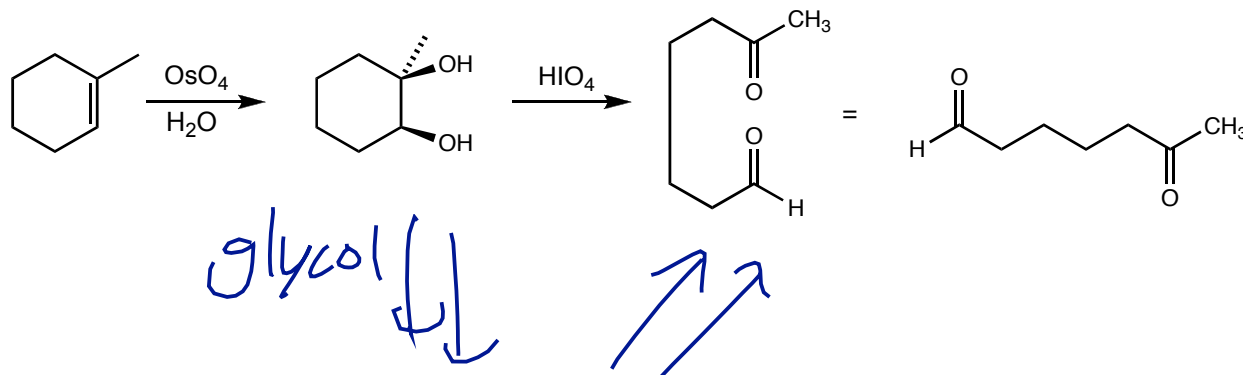


Reading: Section 11.5

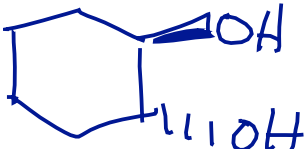
HIO_4 periodic acid

Cleavage of Glycols: It's Kinda Like Ozonolysis

- Glycols react with HIO_4 (periodic acid . . . how do you pronounce that?) to give products in which the C-C bond of the glycol has been cleaved:



Save product as 1. O_3 2. $(\text{CH}_3)_2\text{S}$

Also works with  trans-glycols

- Is this overall transformation reminiscent of anything?

Ozonolysis

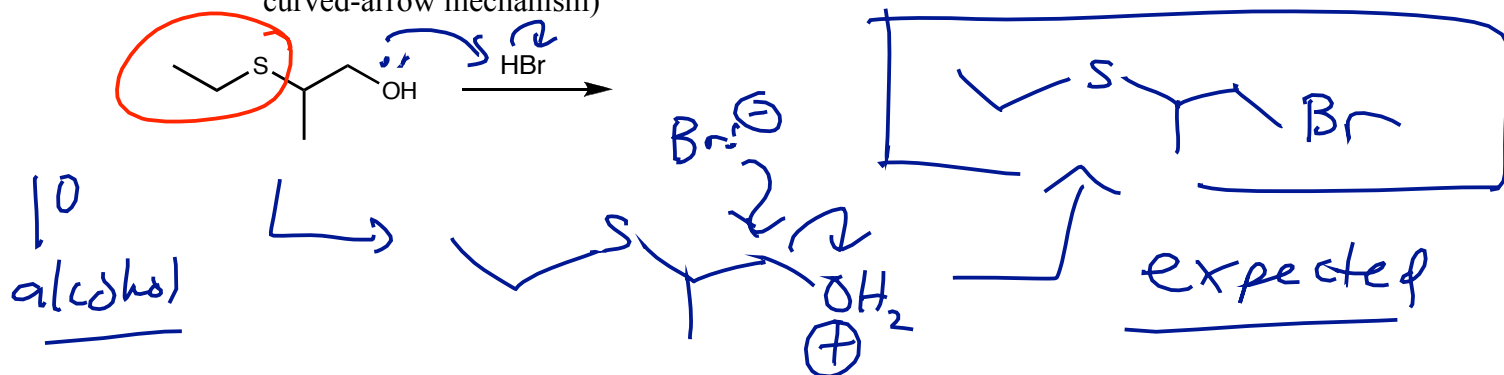
with reductive workup

Neighboring-Group Participation

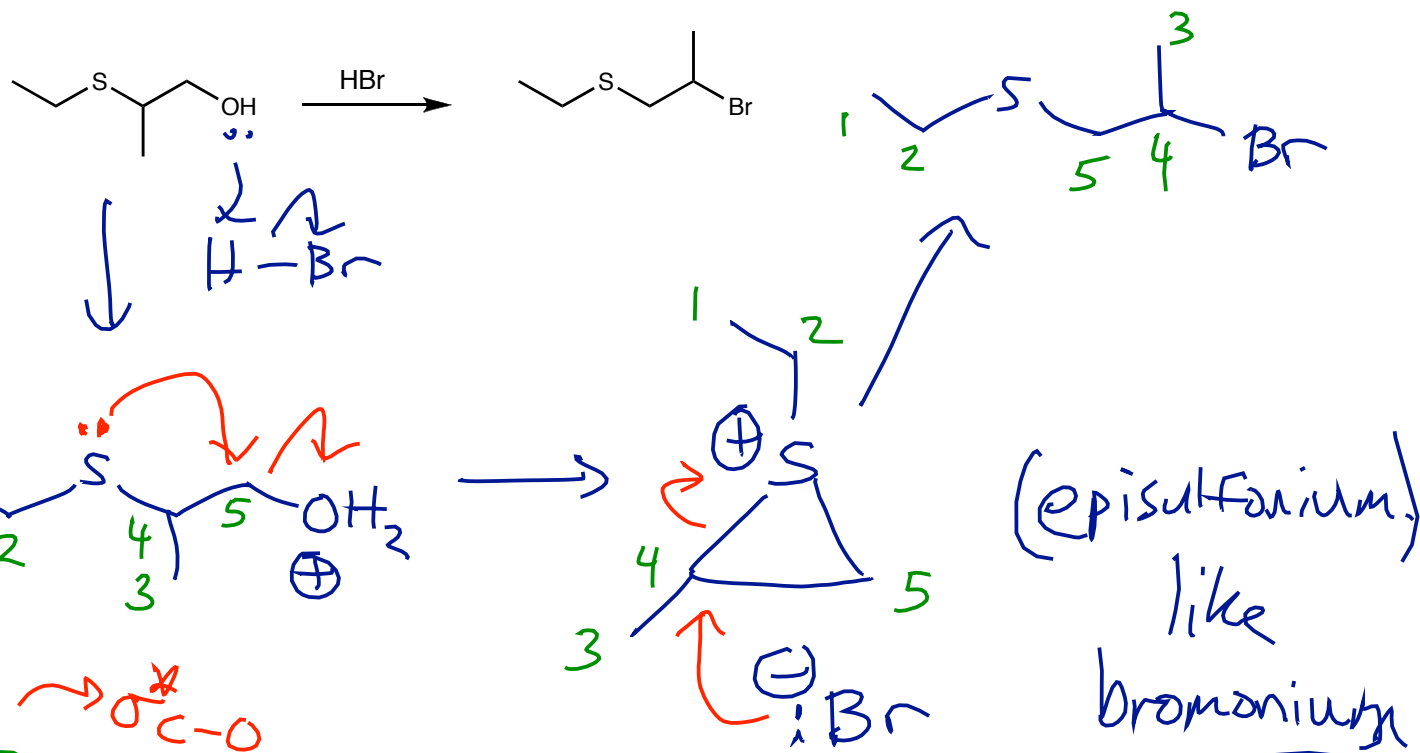
"double S_N2 "

When an alkyl halide has a nucleophilic atom (often S or N) nearby in the same molecule, the molecule can undergo an **intramolecular** S_N2 reaction that may then be followed by an **intermolecular** S_N2 reaction!

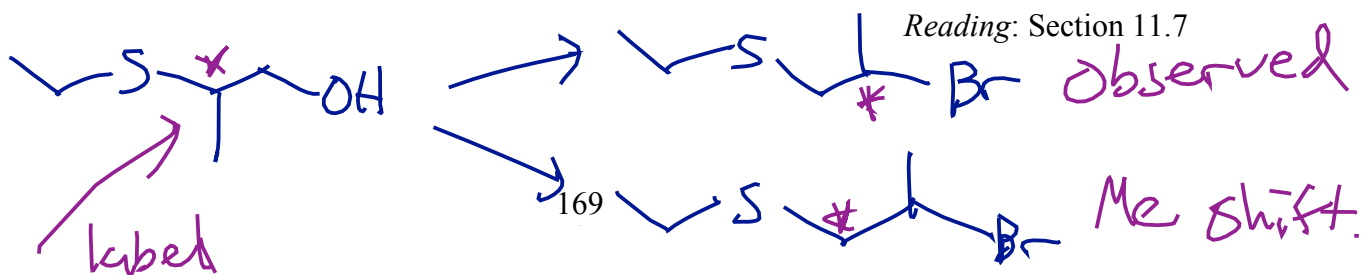
What product would you expect to be formed by the following reaction: (Include a curved-arrow mechanism)



The actual product is shown below. Draw a curved-arrow mechanism that can account for the unusual product. (Note that this is *not* a simple methyl shift!)



What is one experiment you could do to prove that this mechanism is not a simple methyl shift?



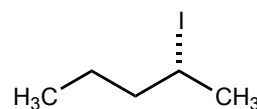
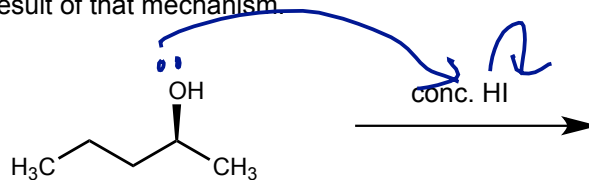
Reading: Section 11.7

S lp → C-O
good
Nucleophile

Test Yourself Now!

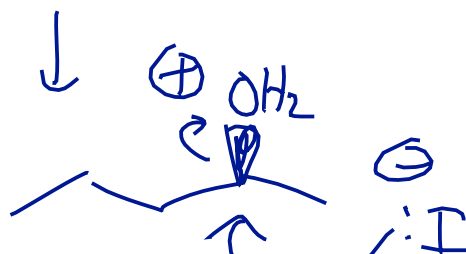
The following three reactions are very similar, yet each has a different stereochemical result. For each reaction, provide a complete curved-arrow mechanism **and** explain briefly how the observed stereochemistry arises as a result of that mechanism.

alcohol

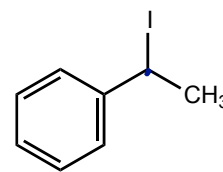
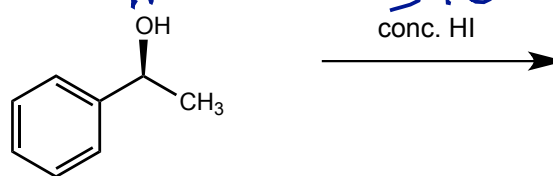


alkyl
halide.

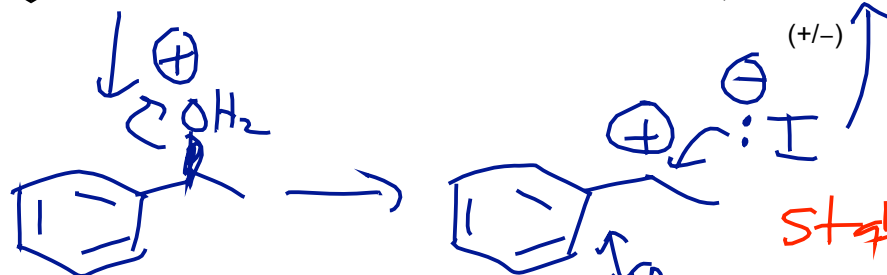
inversion
(S_N2)



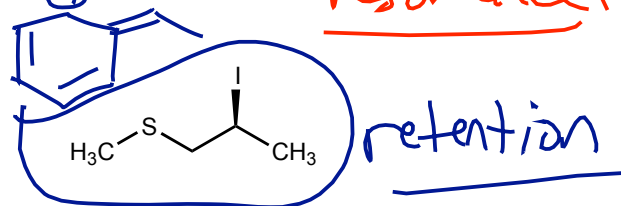
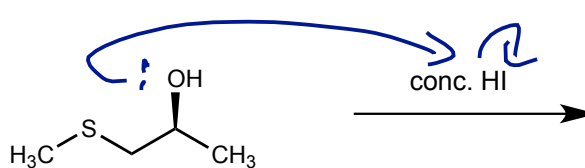
ring
aromatic
(stable)
Week 4.



racemic
(S_N1)



stab. by
resonance.



retention

