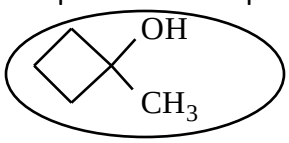
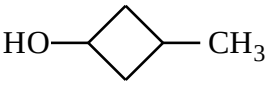
CHEM 2320

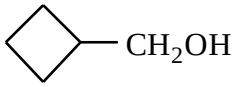
Practice Final Exam-Answers

1) Circle the correct answer for each description below.

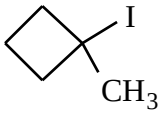
a) The compound that requires the lowest temperature for an E_1 reaction with concentrated H_2SO_4.

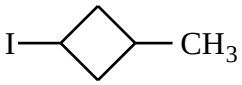


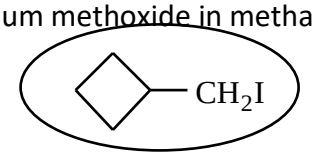




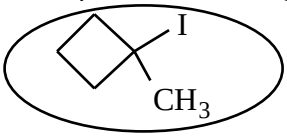
b) The compound that will give the least amount of E_2 product with sodium methoxide in methanol.

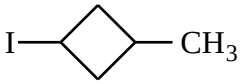


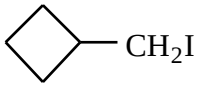




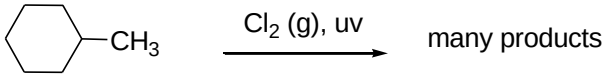
c) The compound that will give the fastest solvolysis reaction with H_2O.



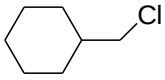


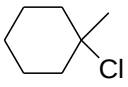


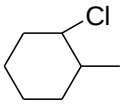
2) Methylcyclohexane was subjected to reaction with Cl_2 (g) and light.

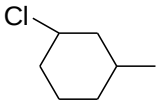


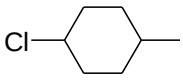
a) Provide the structure of the possible monochlorination products i.e. **one** chlorine atom incorporated **per molecule**. **Do not show stereochemistry on the structures that you draw.**











b) Provide the number for each of the listed terms that describe the outcome of the monochlorination reaction described above.

5 positional isomers

3 achiral compounds

2 pairs of enantiomers

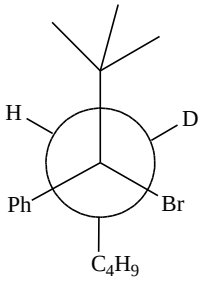
3 pairs of geometric isomers

3) Assign the absolute configuration (R/S) of the stereocentres for compound **A** in the boxes provided. Complete

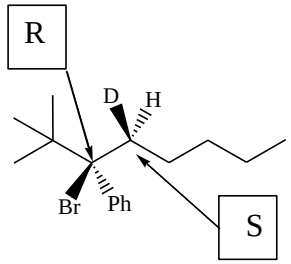
a) the Newman Projection for the lowest energy conformer of **A**,

b) the Fischer projection for **A**, and

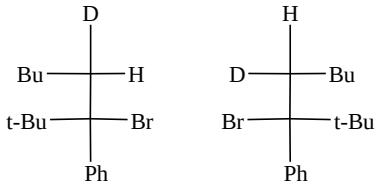
c) the Fischer projection for a diastereomer of **A**.



C4 to C3

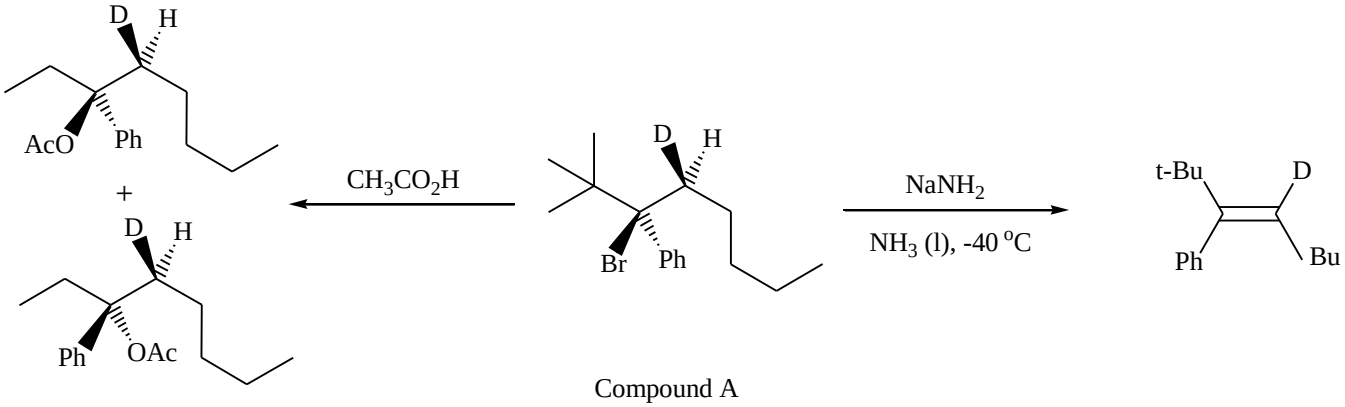


Compound **A**



Compound **A**

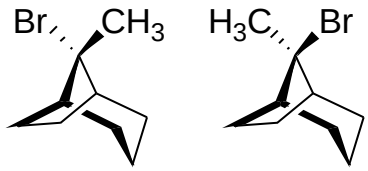
4) Complete the formulas on the left for the products formed by reaction of **A** with acetic acid, and the structure on the right for the major product formed in the E_2 reaction with $NaNH_2$.



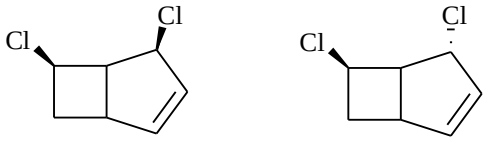
Compound A

5) Complete the structures below in order to illustrate each of the listed terms.

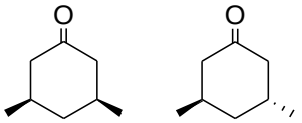
a) a pair of enantiomers (place a methyl group and a bromine atom on each structure)



b) a pair of diastereomers (place two chlorine atoms and a C=C group on each structure)



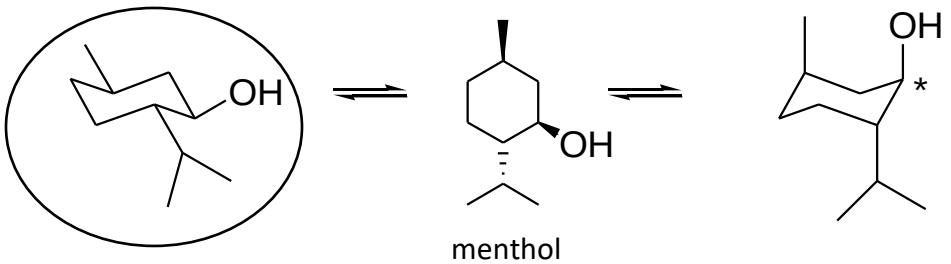
c) a meso compound (on the left structure) and a diastereomer of the meso compound (place two Me groups and a C=O group on each structure)



d) a pair of tautomers (use the formula $C_6H_{10}O$)

6) The structure of the natural product menthol (isolated from peppermint) is shown below. The stereoisomer shown has a boiling point of 207 °C and a specific rotation of -28°.

a) Complete the two chair conformational isomers below and then circle the more stable one. The * indicates the OH group should be placed on the structure to the right.



menthol

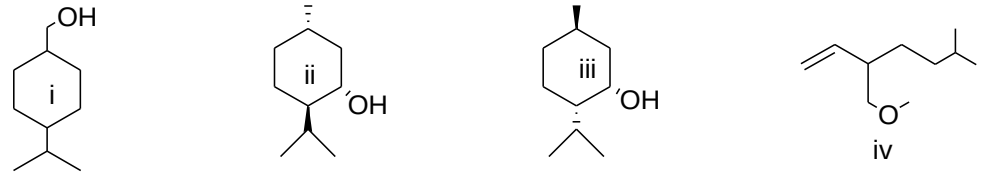
b) Complete the structures below, *clearly indicating the stereochemistry*, such that:

i. a constitutional isomer of menthol which has a specific rotation of 0°

ii. a stereoisomer of menthol which has a specific rotation of +28°

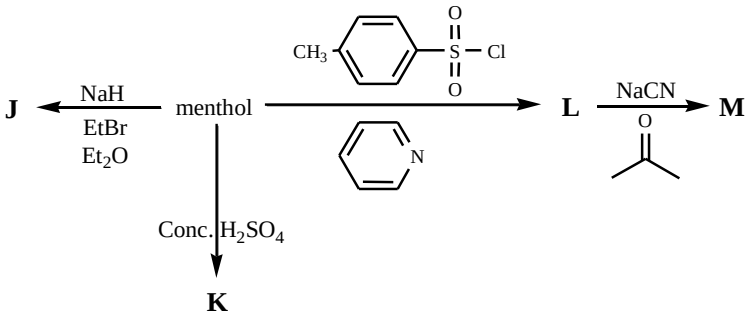
iii. a stereoisomer of menthol which has a boiling point not equal to 207 °C

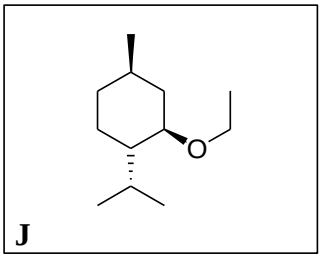
iv. a functional isomer of menthol which is optically active

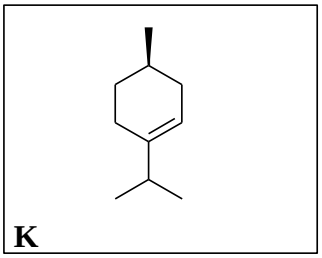


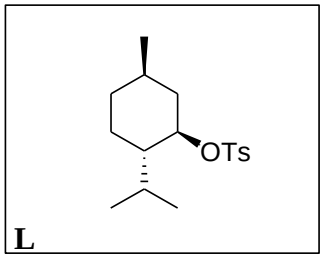
achiral enantiomer diasteriomer

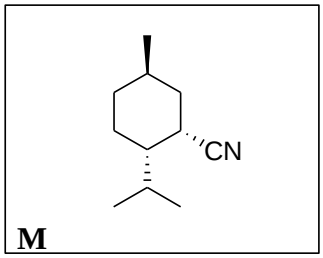
c) Complete the structures of the compounds formed in the following reactions of menthol:



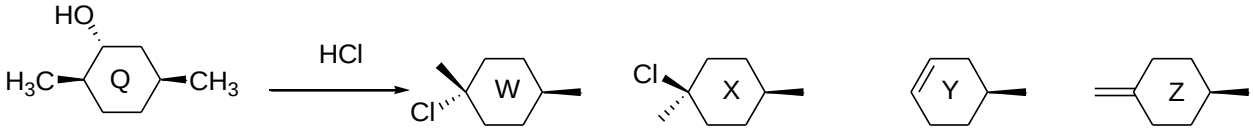








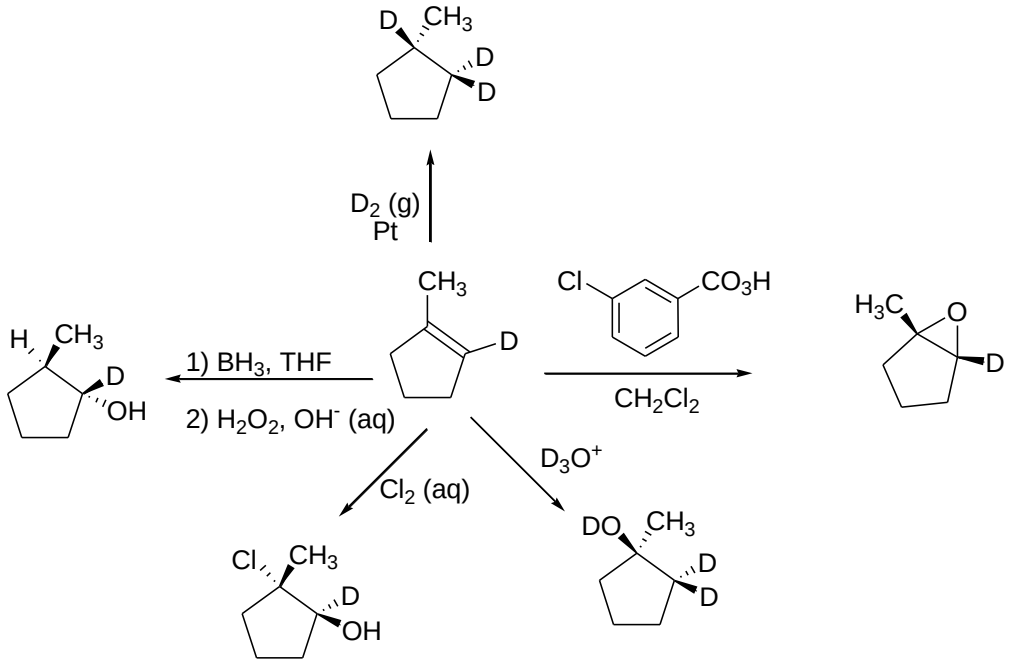
7) Complete the structures of the major and minor products **W**, **X**, **Y** and **Z** expected from the reaction of compound **Q** with HCl. Compounds **W** and **X** are both formed via the S_N1 pathway and **are not stereoisomers of one another**. Compounds **Y** and **Z** are both formed via the E_1 pathway and **are not stereoisomers of each other.**



carbocation undergoes 1,2-hydride shift

8)

a) Propose the structure of the major product formed in each of the following reactions. Note that all of the reactions occur on the same starting material. Include stereochemistry of products.

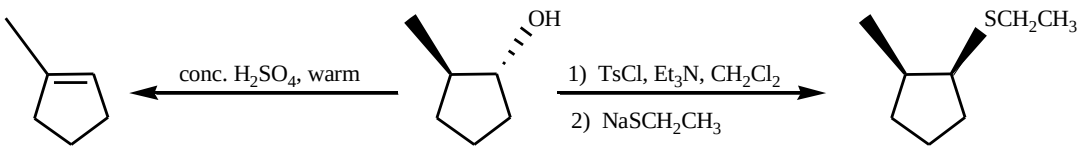


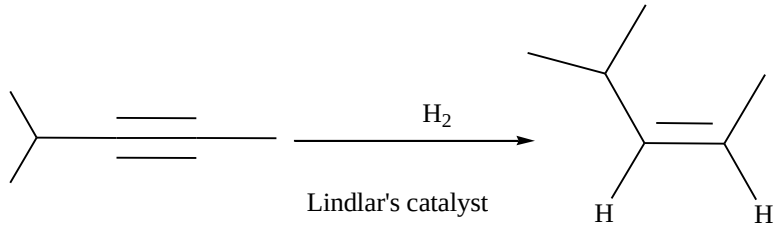
b) Circle the appropriate terms to complete the sentence.

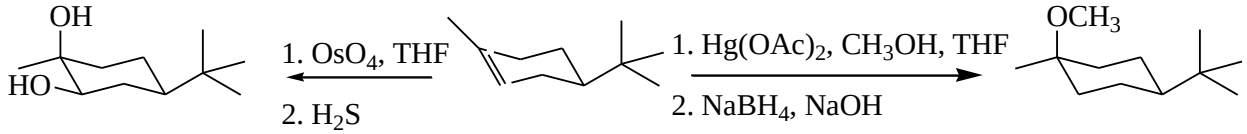
The D_3O^+ reaction is a **{ concerted / non-concerted }, { stereoselective / regioselective }** reaction best described as **{ an electrophilic / a nucleophilic } { addition / substitution }**.

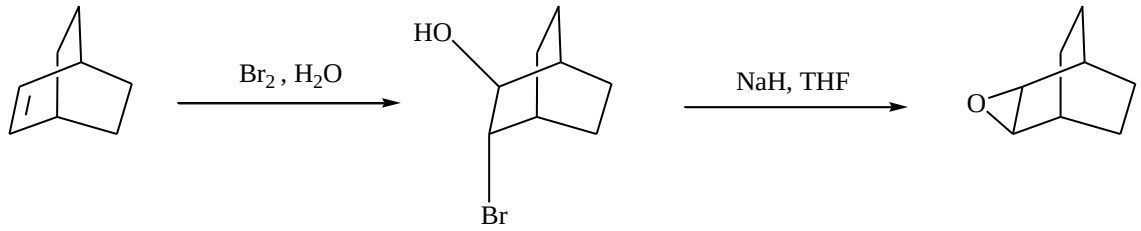
The BH_3 reaction is **{ a syn / an anti } { Markovnikov / anti-Markovnikov }** process.

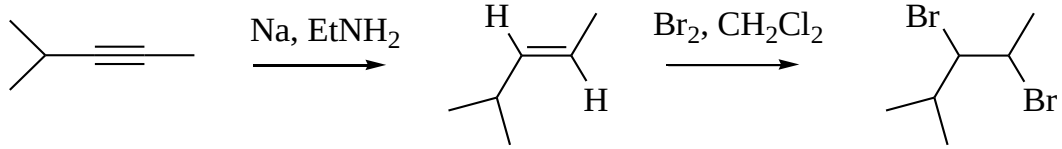
9) Provide the structure of the **major product** expected in each of the following reactions. You may assume that the reagents are in excess unless otherwise indicated. Stereochemistry must be **clearly shown** where required.

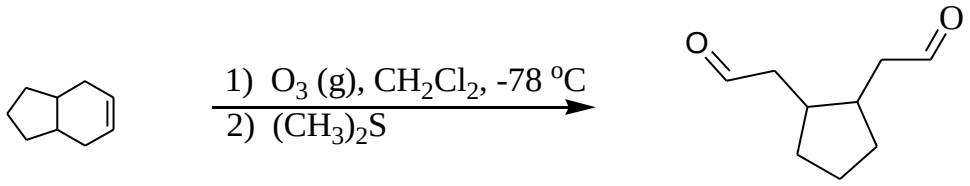


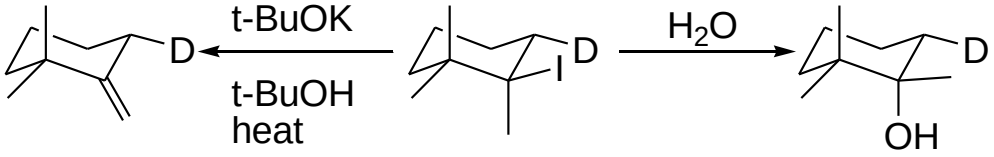

H2
Lindlar's catalyst
H
H


OH
HO
1. OsO4, THF
2. H2S
1. Hg(OAc)2, CH3OH, THF
2. NaBH4, NaOH
OCH3

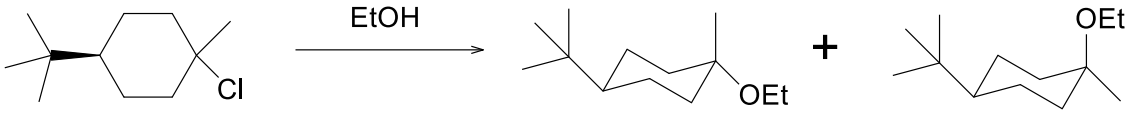

Br2 , H2O
HO
Br
NaH, THF
O

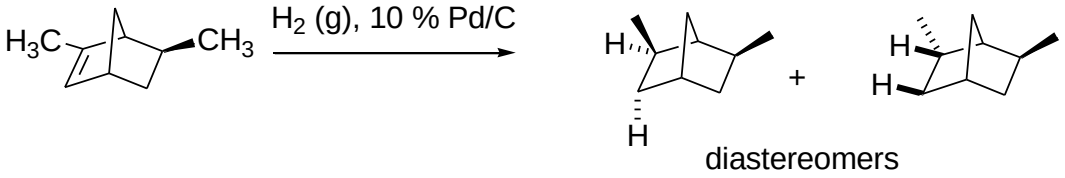

Na, EtNH2
H
H
Br2, CH2Cl2
Br
Br


1) O3 (g), CH2Cl2, -78 °C
2) (CH3)2S
O
O

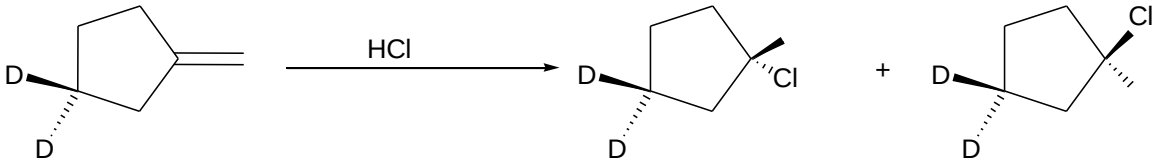

t-BuOK
t-BuOH
heat
D
D
I
H2O
D
OH

10) Each of the following reactions produces **2 major products**. Complete the structure of each product (clearly showing any pertinent stereochemistry) and indicate the relationship between the two compounds (i.e., enantiomers, diastereomers, tautomers, positional isomers, functional isomers, skeletal isomers, or not isomers)

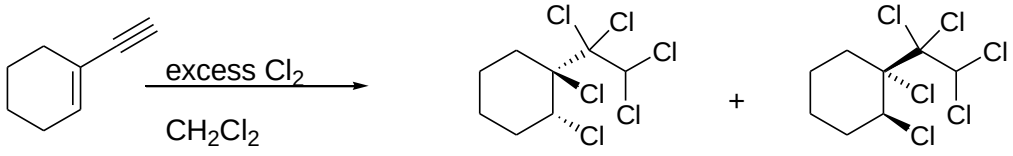




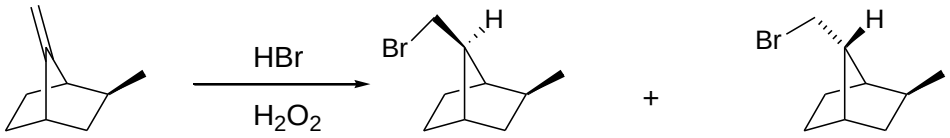
diastereomers



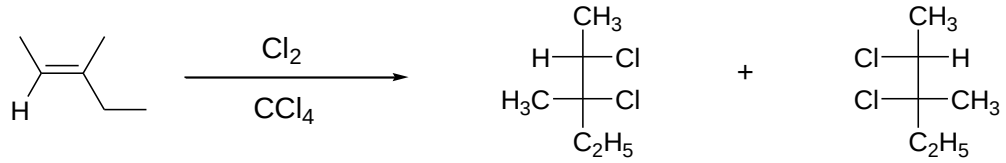
enantiomers



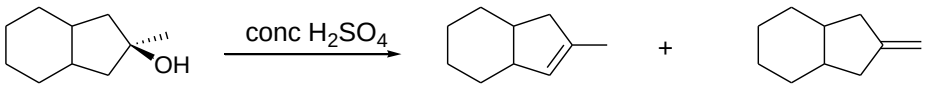
enantiomers



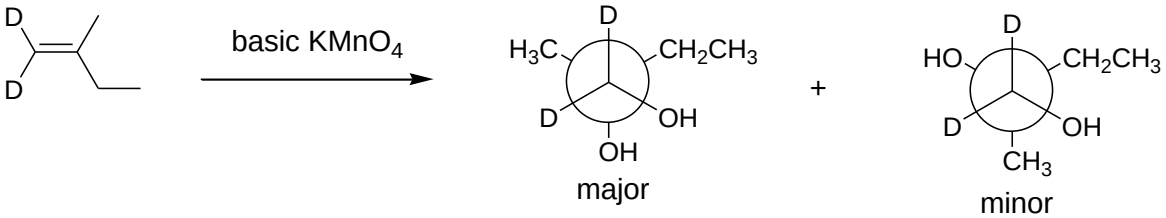
diastereomers



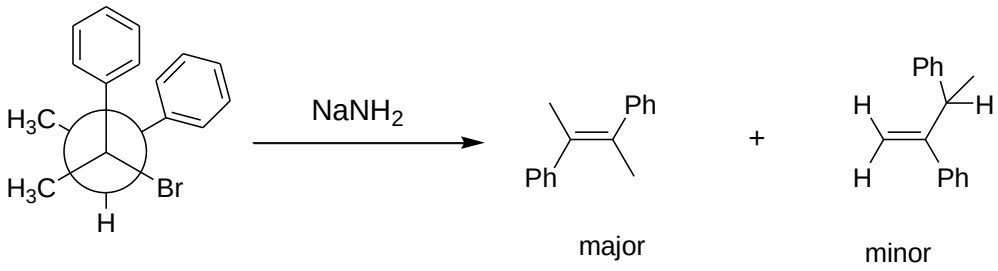
enantiomers



positional isomers



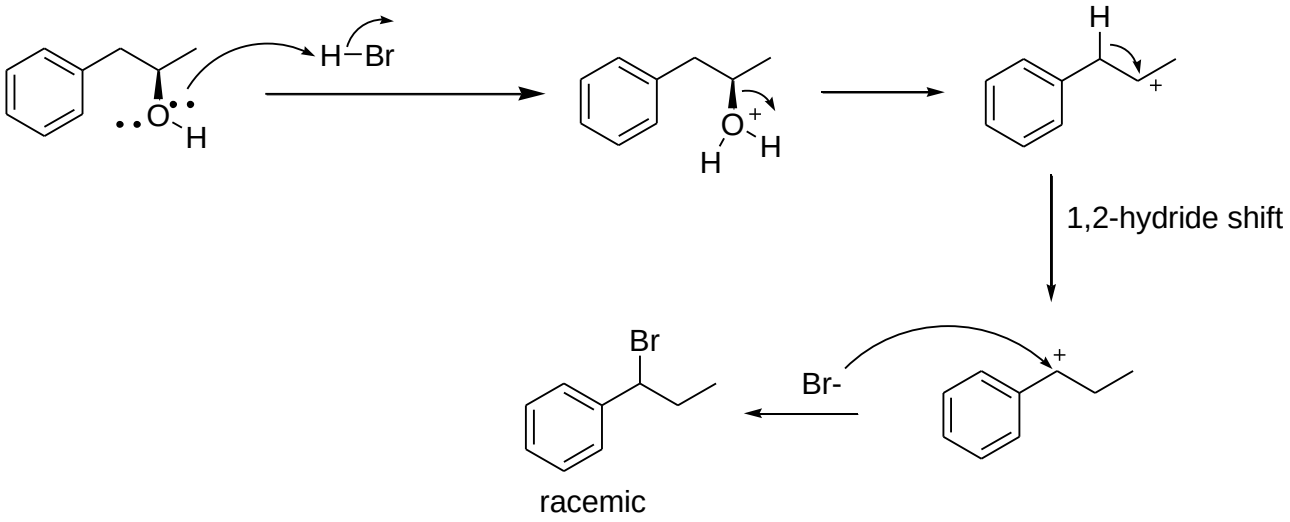
enantiomers



positional isomers

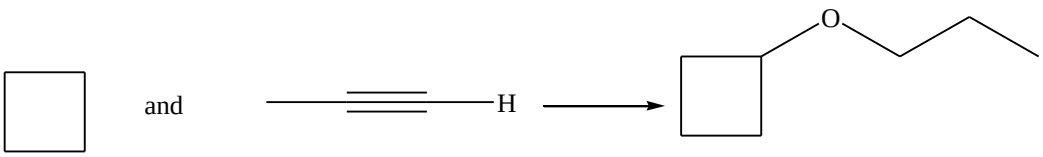
11) The reaction of the optically pure alcohol **A** below with concentrated HBr produces the final product **B** (as a racemic mixture).

a) Briefly sketch the mechanistic steps involved in this conversion, including the correct direction for any arrows representing the movement of electrons. The boxes should contain the three reactive intermediates involved in the process.



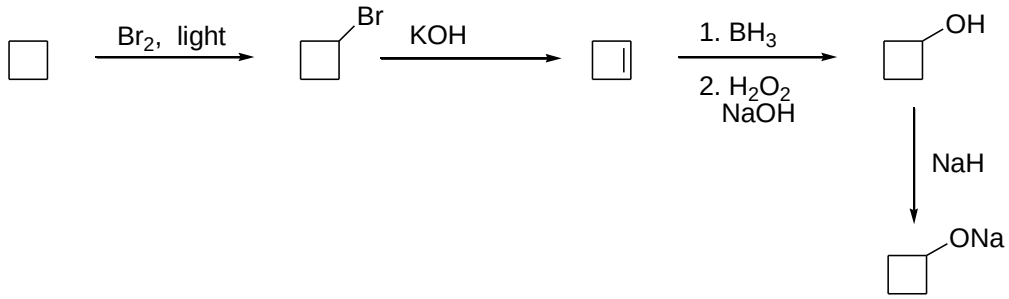
12) Show how the following conversion could be accomplished by providing reagents and conditions (solvent, temperature, concentration, etc.) so that the product shown will be the major one.

You may use any inorganic reagents in addition to the original starting materials (which you can use as many times as you need to). Show the structure of the **major product** formed after each reaction.

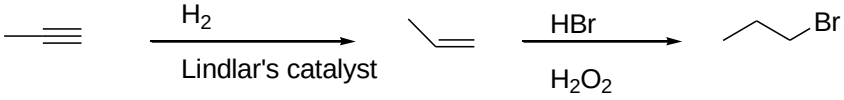


as the only sources of carbon

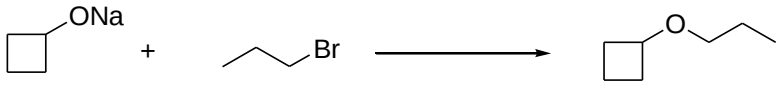
STEP 1



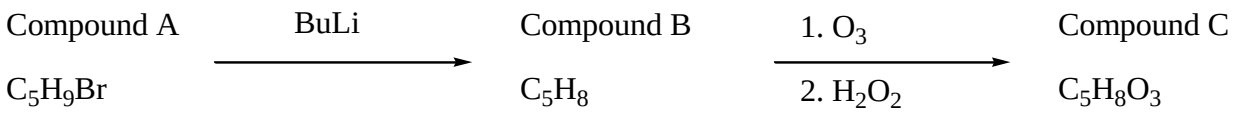
STEP 2



STEP 3



13) When chiral compound **A** (C_5H_9Br) was treated with BuLi, the achiral compound **B** (C_5H_8) was produced. Treatment of compound **B** with O_3 followed by H_2O_2, led to the formation of the achiral compound **C** ($C_5H_8O_3$). The IR spectrum of compound **C** showed two strong bands around 1700 cm^{-1} and a broad band from ~ 2500 cm^{-1} to 3400 cm^{-1}. The ^{1}H-NMR spectrum of compound **C** is provided below. Provide structures for compounds **A, B and C**.



HNMR of compound C