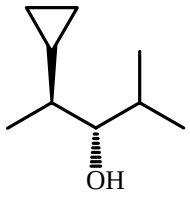
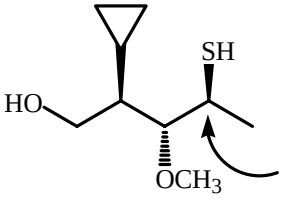
1. Name the following compounds

a. 

(2*S*,3*S*)-2-cyclopropyl-4-methylpentan-3-ol

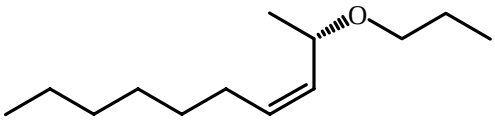
b. 

(2*R*,3*R*,4*S*)-2-cyclopropyl-4-mercapto-3-methoxypentan-1-ol

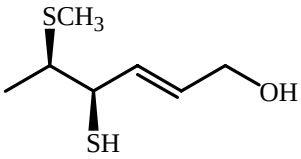
compound originally shown did not have any stereochemistry here

2. Provide structures for the following compounds

a. (2*S*,3*Z*)-2-(propyloxy)dec-3-ene

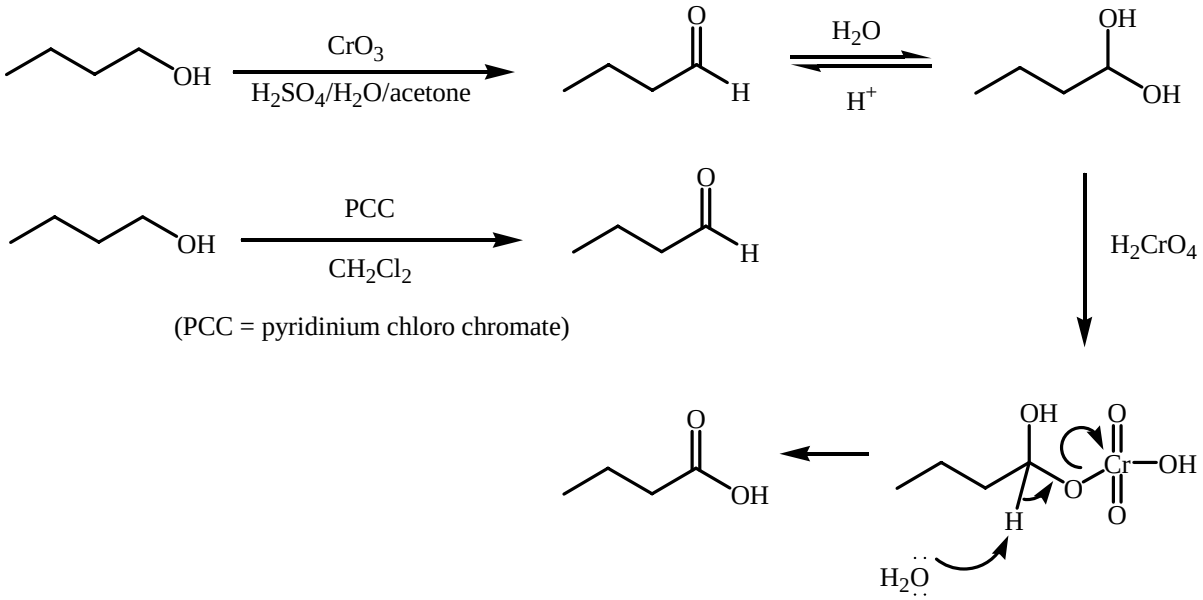


b. (2*E*,4*R*,5*R*)-4-mercapto-5-(methylthio)hex-2-en-1-ol



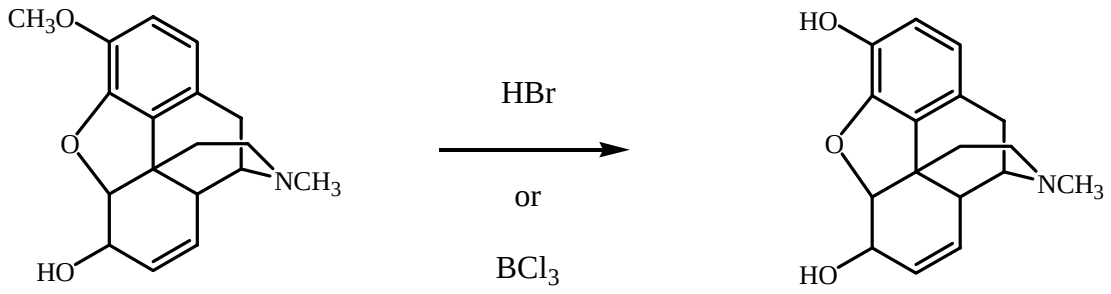
3. Primary alcohols can be oxidized to the corresponding carboxylic acid or aldehyde by choosing the appropriate oxidizing agent. Both reagents below use chromium(VI), but explain why the outcomes are different. (10 points)

See below.



The presence of water in the top reaction allow for the formation of the hydrate in equilibrium with the aldehyde. The hydrate can undergo further oxidation which can oxidize further. The A

4. Show how to convert codeine into morphine. (10 points)

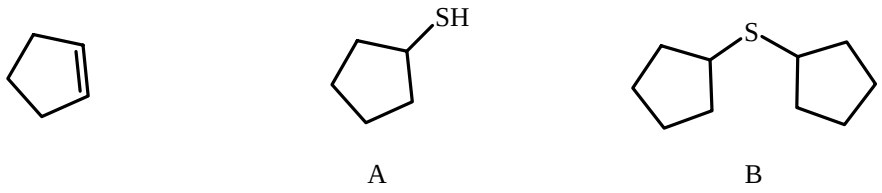


5. Using cyclopentene as the ONLY source of carbon, show a synthesis of product B. Compound A is a very likely intermediate.

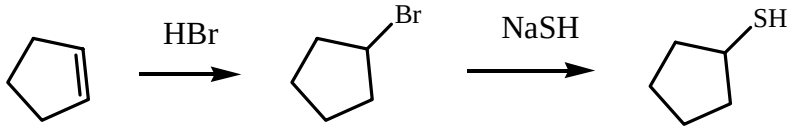
Also, provide the common and IUPAC names for compounds A and B.

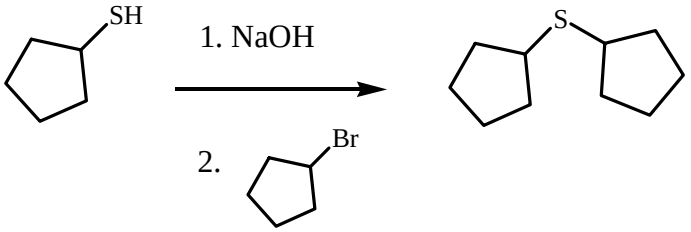
(15 points)

See below



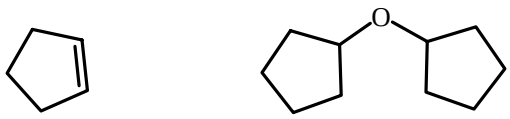
A B



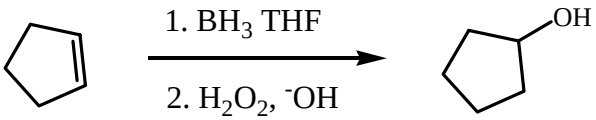


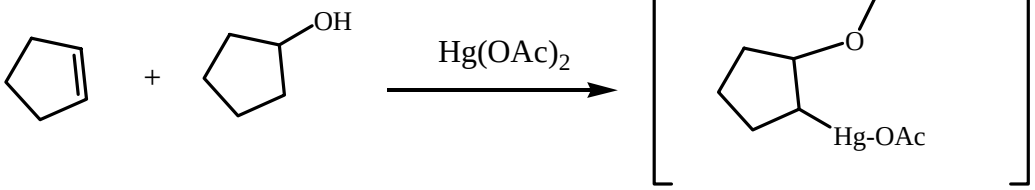
6. Consider how to prepare A from cyclopentene. Note that using the same approach as above will result in no formation of A. (15 points)

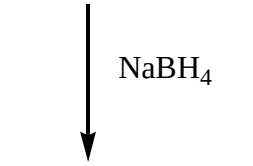
See below

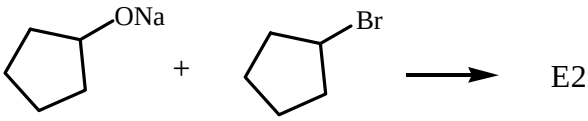


A

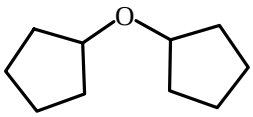






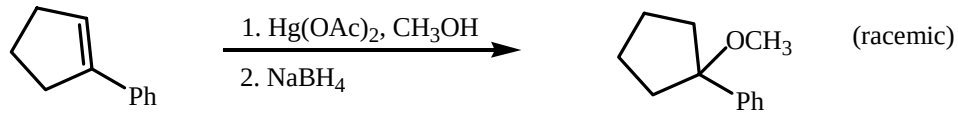


Note this approach would lead to elimination

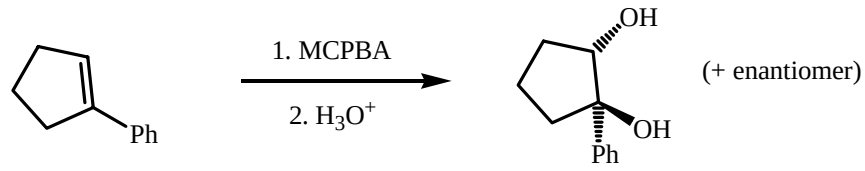


7. Fill in the blanks. Show the necessary reagents or the products from each of the reactions shown below.

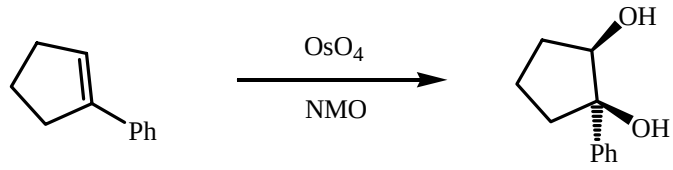
(30 points)

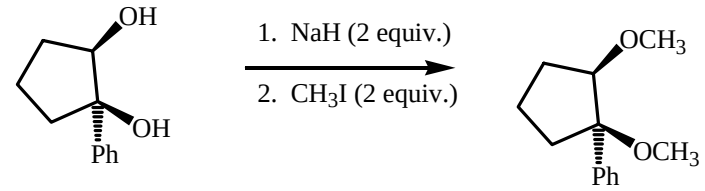
a. 

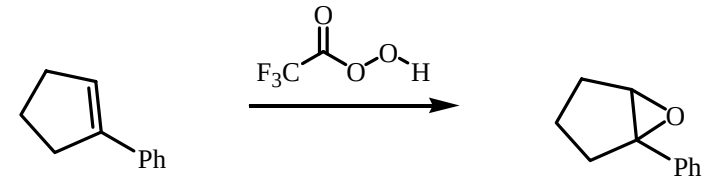
(racemic)

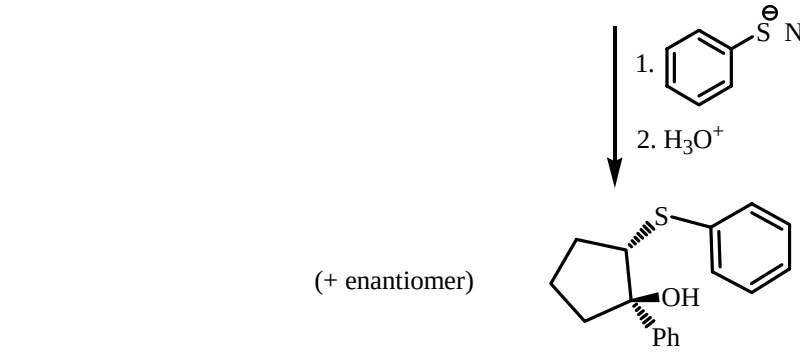
b. 

(+ enantiomer)

c. 

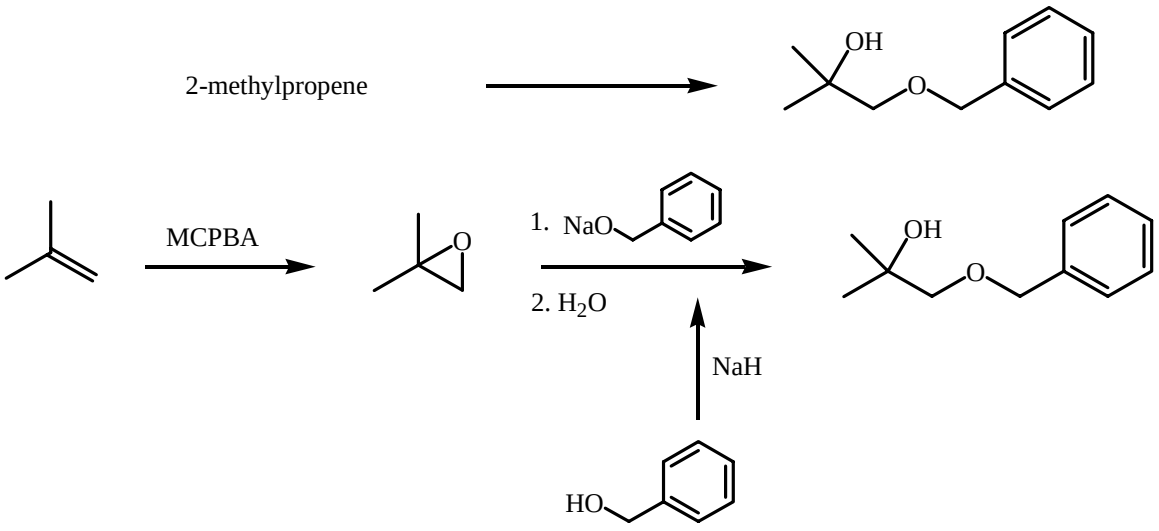
d. 

e. 

f. 

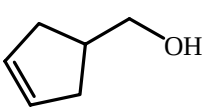
(+ enantiomer)

8. Show which reagents and conditions are required to prepare the product shown starting from 2-methylpropene. (The overall transformation requires more than one step!)

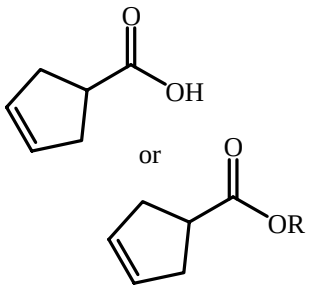


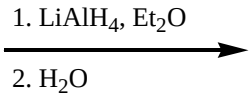
9. Plan syntheses of the following starting from the indicated functional group. You can use any other reagents. (Note in c. only the relative stereochemistry is shown)

a.

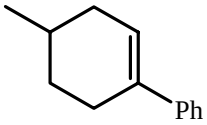


from a carboxylic acid

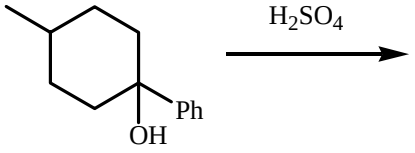




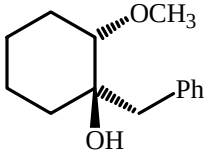
b.



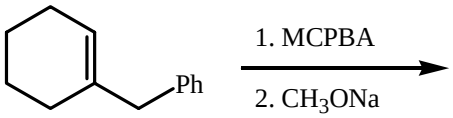
from an alcohol



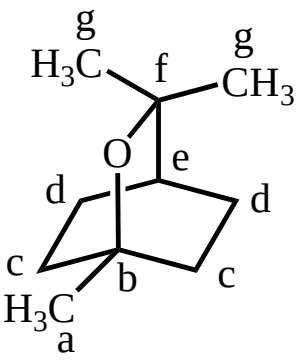
c.



from an alkene
that doesn't contain any oxygen



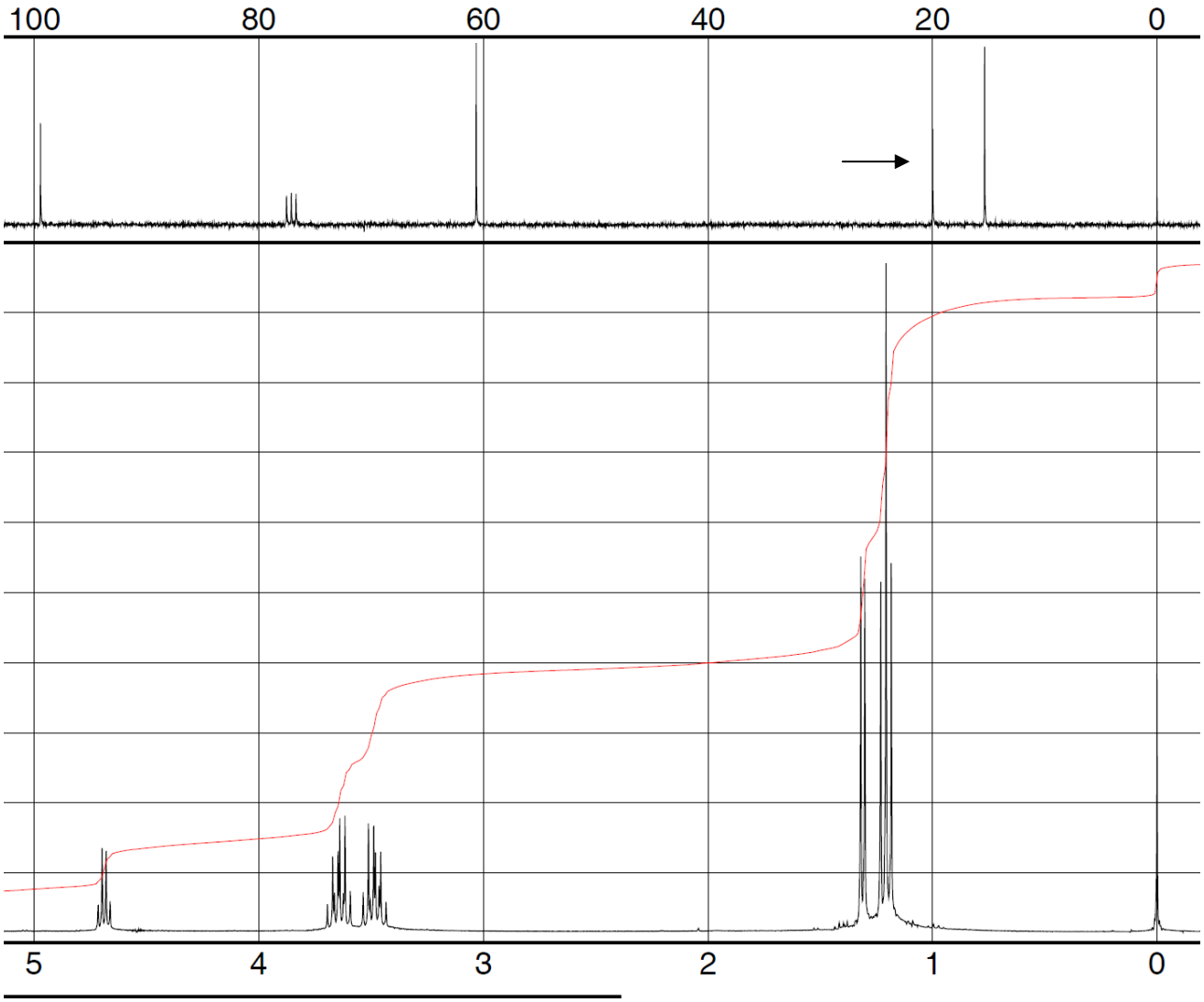
10. Cineole is a natural product found in eucalyptus oil. How many peaks would you expect in the ^{13}C NMR spectrum?

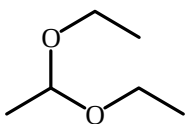


Seven peaks. All of the unique carbons are noted. There are three pairs of chemically equivalent carbons

11. The ^{1}H and ^{13}C NMR spectra for a molecule with formula $C_6H_{14}O_2$ has the following ^{1}H and ^{13}C NMR spectrum. Deduce the structure of the compound. (Note there is a peak at 20 ppm that is obscured by the graph line and ignore the solvent peaks centered at 77 ppm in the ^{13}C). (10 points)

EXTRA CREDIT describe the diastereotopic methylenes present in this molecule (5 EC points)





Note that the CH2 groups next to the oxygens are diastereo topic and give rise to the two patterns at ~3.5 and 3.7 ppm. Each of the CH2 protons should appear as a doublet of quartet since they couple to the CH3 and the adjacent proton on the CH2.