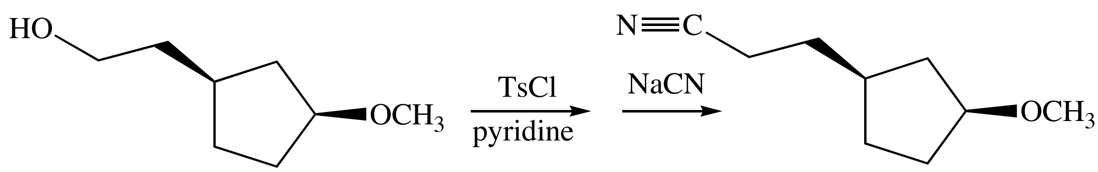
Chemistry 250 -- Exam #2 Answer Key -- October 17, 2008

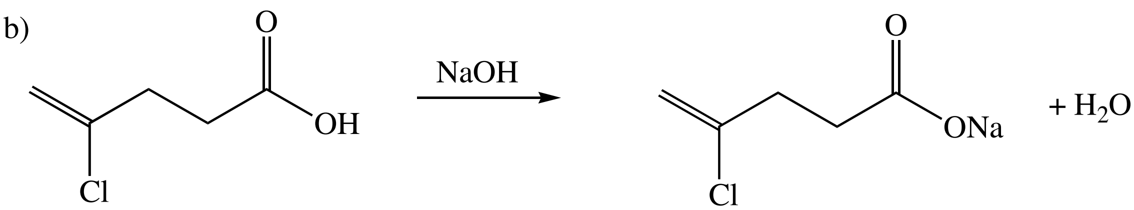
There are 5 pages.

1. (21 pts) Complete the following reactions. If the stereochemistry of the reactants is shown, show the stereochemistry of the products. If two compounds are shown as products, I will assume that they are formed in approximately equal amounts unless you label them "major" and "minor".

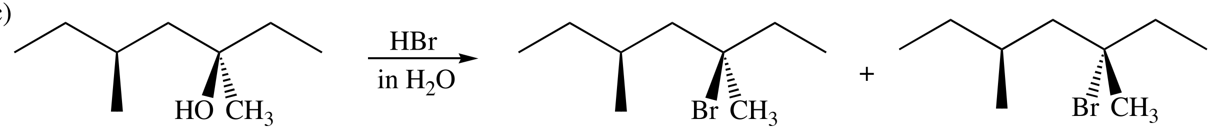
a)



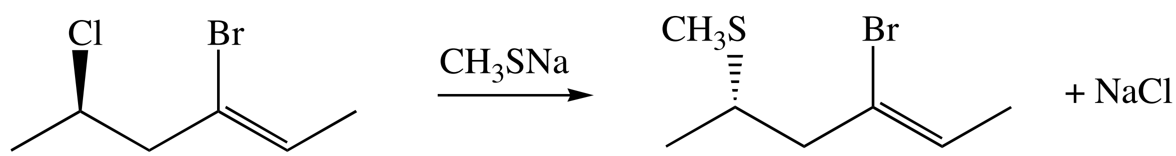
b)



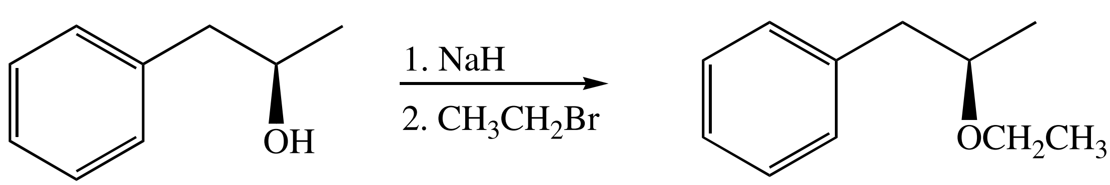
c)



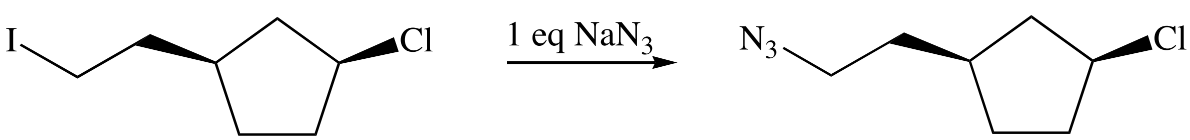
d)



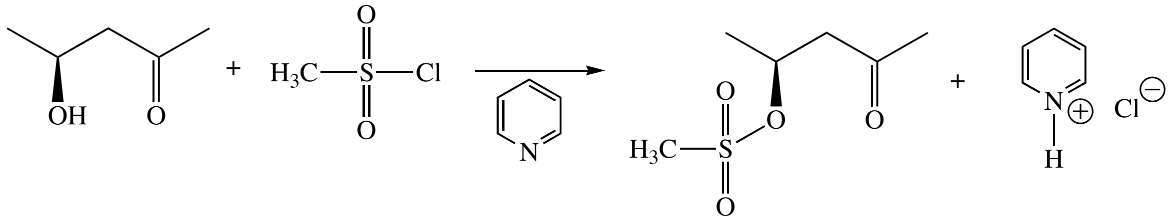
e)



f)

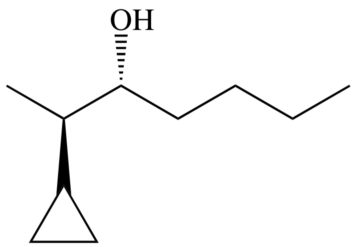


g)



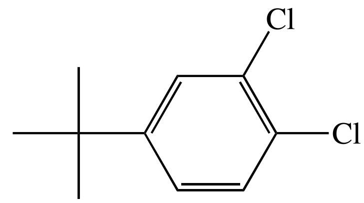
2. (10 pts) Name the following compounds. If the stereochemistry is shown, include appropriate stereochemical descriptors in the name.

a)



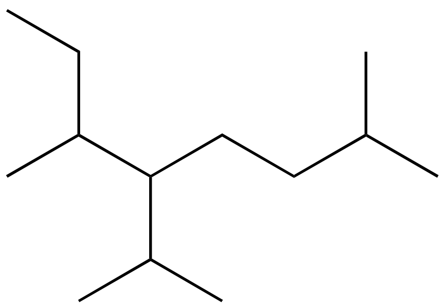
***(2R, 3R)*-2-cyclopropyl-3-heptanol**

b)



1-*tert*-butyl-3,4-dichlorobenzene

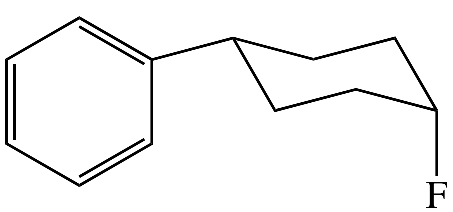
c)



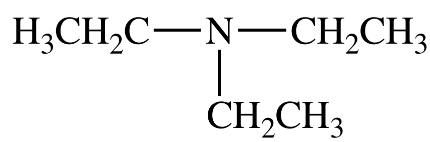
5-isopropyl-2,6-dimethyloctane

3. (12 pts) Draw structures for the following compounds. If a stereochemical descriptor is used, be sure to show the stereochemistry.

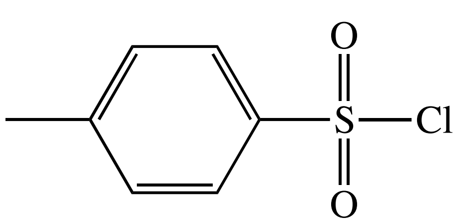
a) *cis*-1-phenyl-4-fluorocyclohexane (most stable conformer)



b) triethylamine

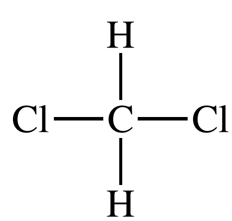


c) TsCl (+ 2 pts extra credit for giving the name)

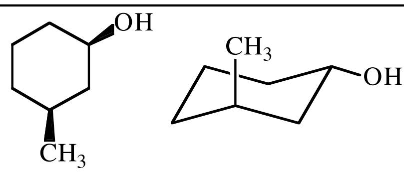


p-toluenesulfonyl chloride

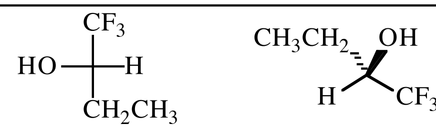
d) methylene chloride



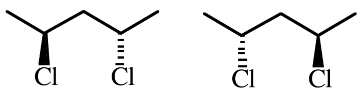
4. (12 pts) Label each of the following pairs of compounds as either: constitutional (structural) isomers, enantiomers, diastereomers, conformers, resonance forms, or identical. **Circle any meso compounds**.



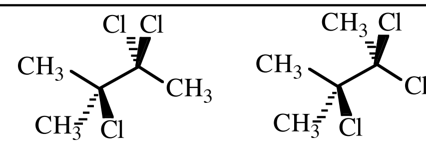
Diastereomers



Identical

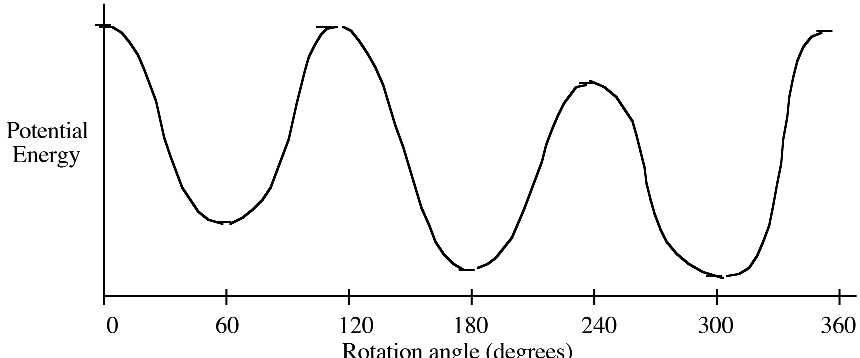


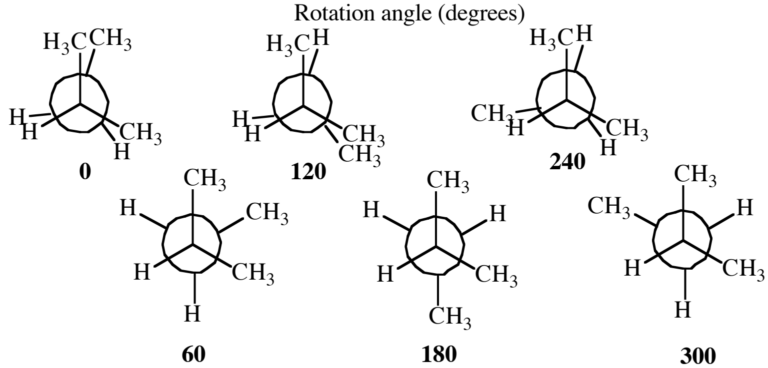
Enantiomers



Conformers

5. (10 pts) On the graph below, sketch an approximate energy diagram for rotation about the C2-C3 bond in **2-methylbutane.** Start in a conformation with the C1 and the C4 methyl's eclipsed. Draw Newman projections for the conformations at 0, 60, 120, 180, 240, and 300 degrees. (I recommend drawing the Newman projections first to help you determine the appropriate energies.)





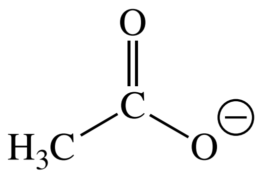
b) What is the approximate energy difference (kcal/mole) between the lowest energy and highest energy position on your diagram above? (Circle the best answer). (1 kcal/mole = 4.184 kJ/mole)

1 5 25 50 100 (kcal/mol)

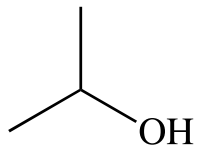
Name:_______________________________

6. (5 pts) Rank the following compounds according to the indicated property:

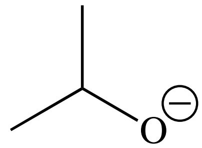
a) Rate of reaction with ethyl iodide



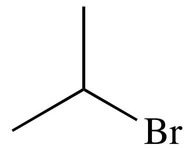
A



B



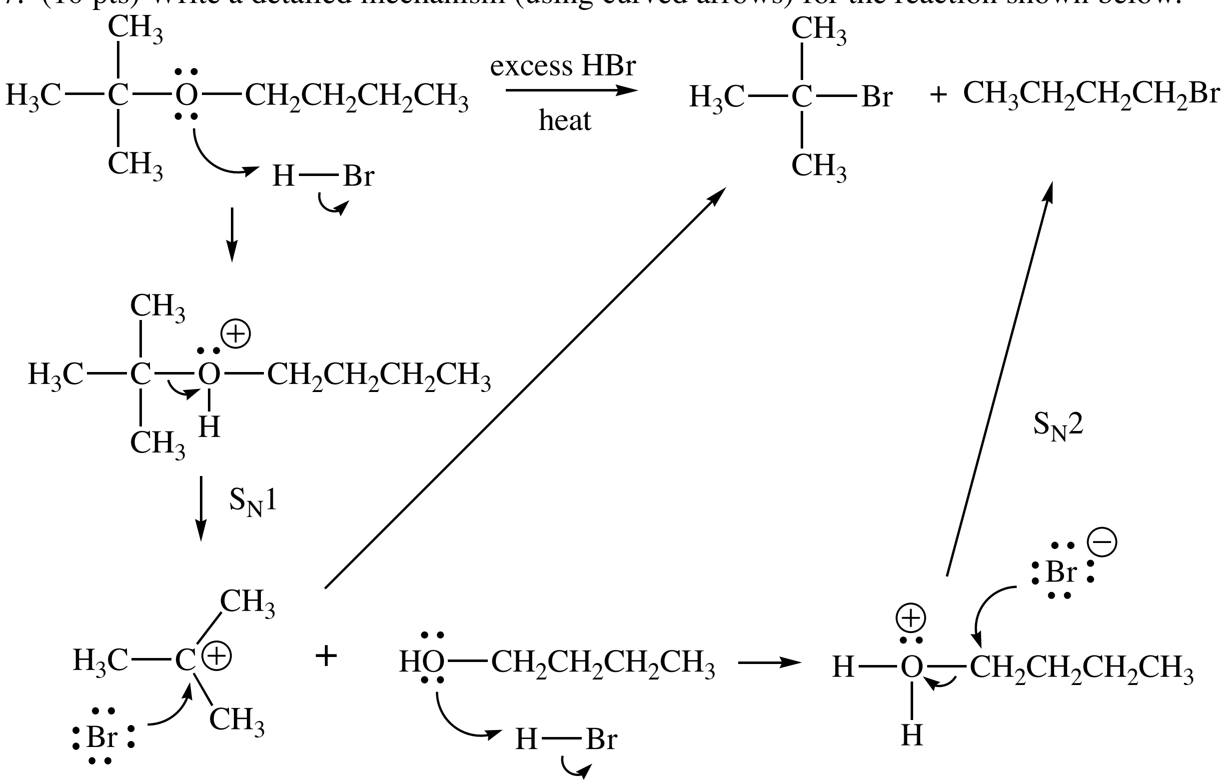
C



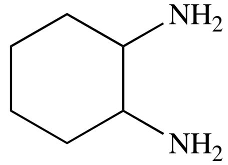
D

C (fastest reaction) > **A** > **B** > D (slowest reaction)

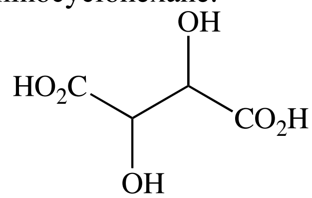
7. (10 pts) Write a detailed mechanism (using curved arrows) for the reaction shown below.



8. (20 pts) In lab this semester you began the synthesis of Jacobsen's catalyst by purifying a mixture of 1,2-diaminocyclohexane isomers (shown below). The mixture we purchased contained all possible stereoisomers of 1,2-diaminocyclohexane.

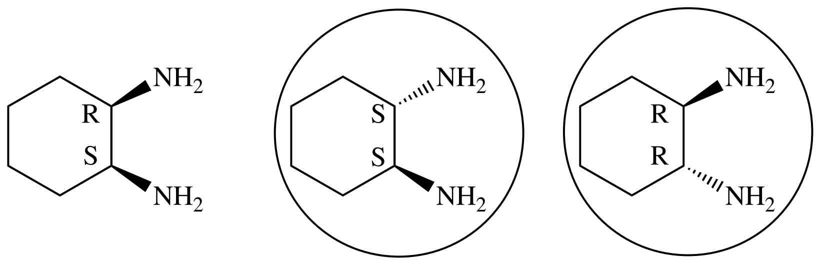


1,2-Diaminocyclohexane



Tartaric Acid

a) Draw structures for all the stereoisomers of 1,2-diaminocyclohexane. (You do not need to show chair conformers for this part of the problem.)

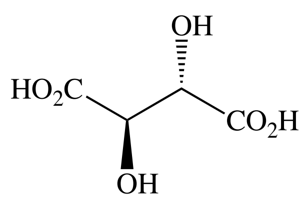


b) Assign *R* and *S* configuration to each of the stererocenters in your structures.

c) Circle all the isomers that are optically active. The mixture that we purchased had no optical activity. Explain what this implies about the composition of the mixture.

It must contain equal amounts of the *R,R* and *S,S* isomers plus an undetermined amount of the R,S isomer. (The R,S isomer is achiral and thus has no optical activity.)

d) One of the stereoisomers of tartaric acid was used to selectively remove only the *R*,*R* isomer of 1,2-diaminocyclohexane from the mixture. Draw the structure of the isomer of tartaric acid that could **NOT** have been used to do this and briefly explain how you know that this isomer wouldn't have worked.



***meso*-Tartaric Acid**

This isomer of tartaric acid is achiral. Therefore it can not be used to separate ("resolve") a mixture of enantiomers.

e) Draw the two chair conformers for the *R*,*R* isomer of 1,2-diaminocyclohexane and circle the most stable one.