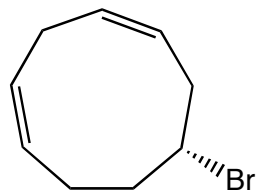


- 1) Provide an unambiguous name for each of the following molecules. For each structure, indicate whether it is chiral, achiral, or meso by circling the correct description. (12 pts)



**(R,1Z,4Z)-7-bromocyclonona-1,4-diene**

circle one

chiral

achiral

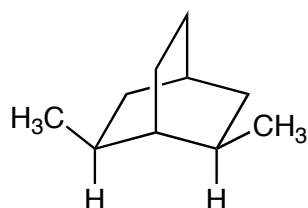
meso

circle one

chiral

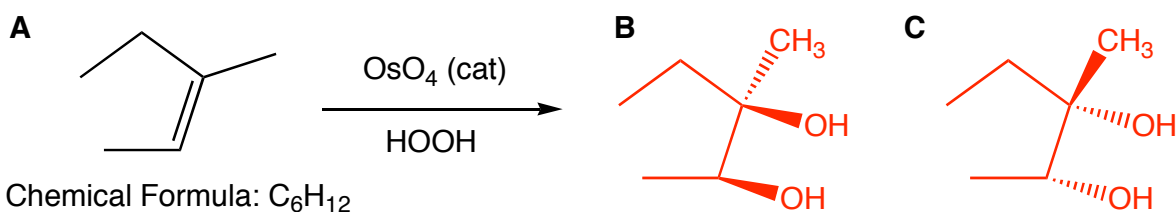
achiral

meso

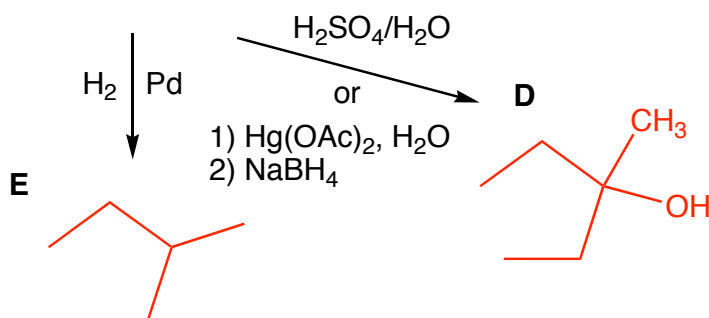


**(R,S)-2,6-dimethylbicyclo[2.2.2]octane**

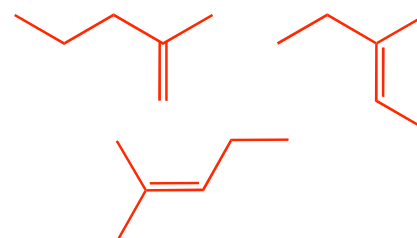
- 2) Compound **A** ( $C_6H_{12}$ ) reacts with  $OsO_4/HOOH$  to give **B** & **C** as a mixture that does not rotate plane polarized light. **A** reacts with either  $H_2SO_4/H_2O$  or the sequence of 1)  $Hg(OAc)_2/H_2O$  2)  $NaBH_4$  to give the same product, **D**. Finally, when **A** is hydrogenated with  $H_2/Pd$ , only one compound, **E**, is formed. Provide structures & label them **A-E**. Be sure to jot down your thoughts and guesses for partial credit. (10 pts)



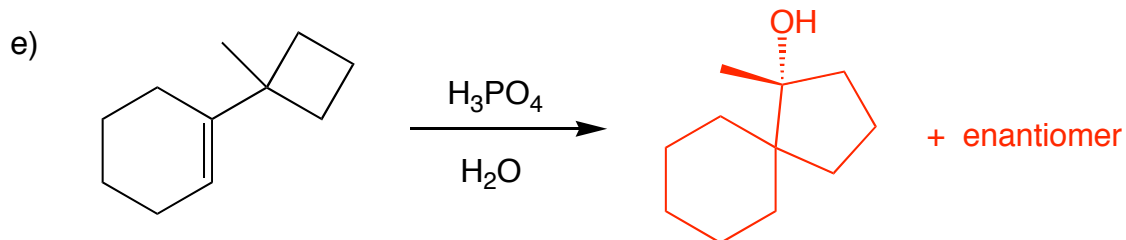
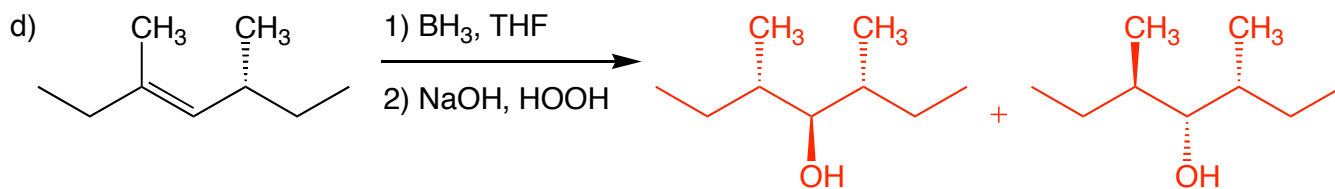
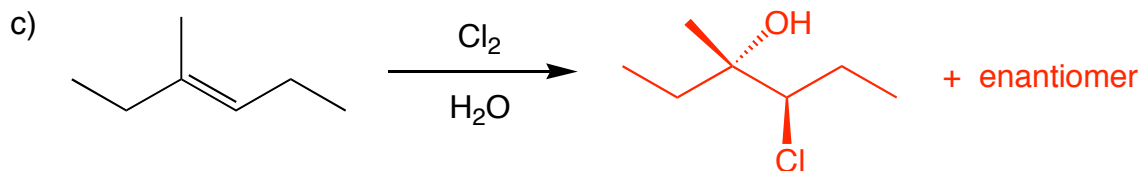
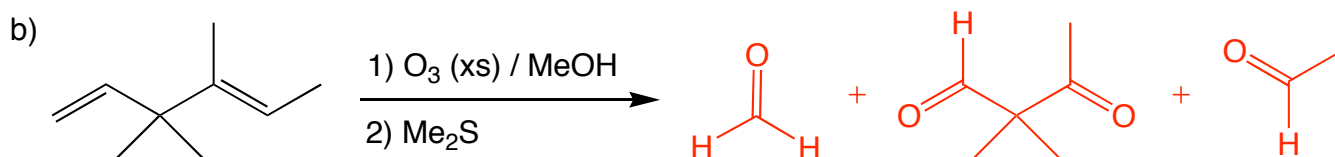
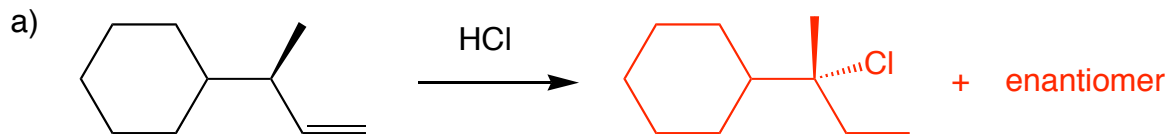
racemic



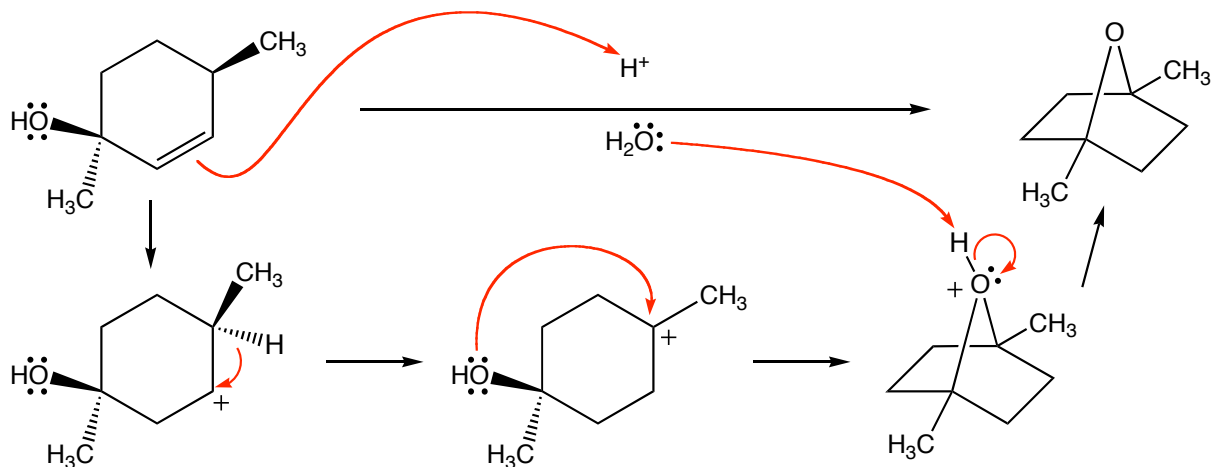
These also work for **A**:



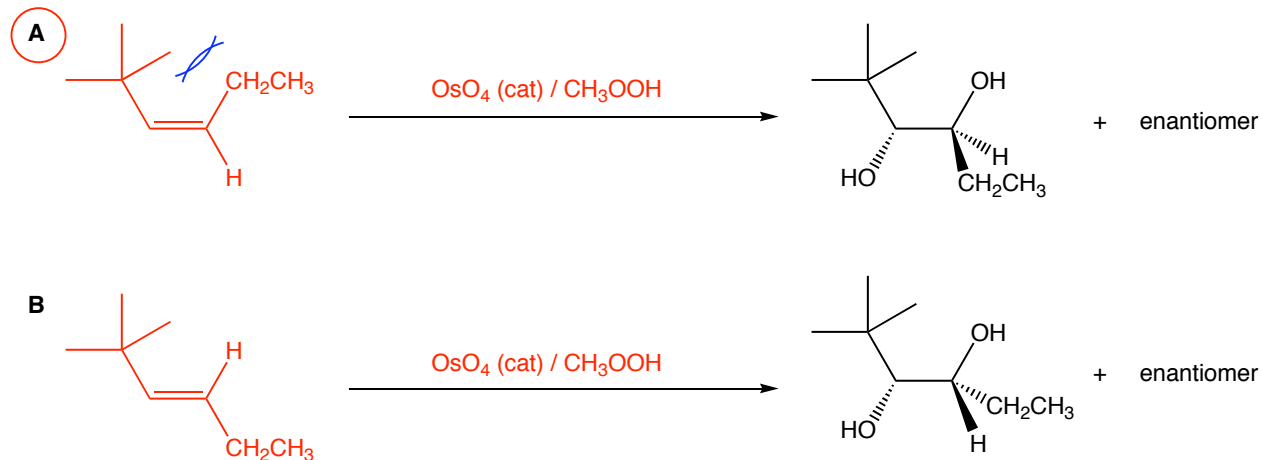
3) Predict the *major* organic product of each of the following reactions. If more than one product are equally favored, draw each product. (35 pts)



- 4) The compound below reacts with strong aqueous acid to give the bicyclic shown. From your knowledge of alkene addition reactions, provide a mechanism for this transformation. For full credit, you need to show all intermediates, formal charges, & electron pairs in your mechanism. (12 pts)

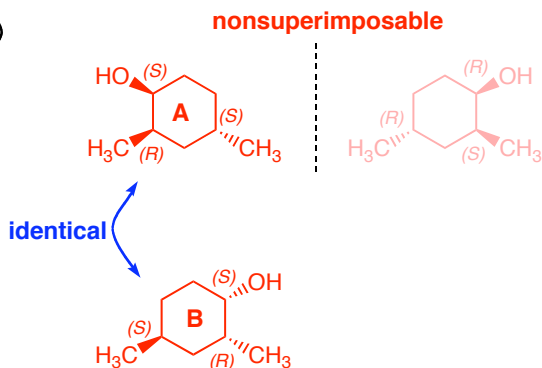
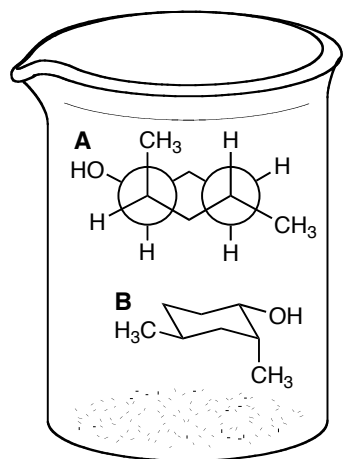


- 5) Propose reagents and starting materials that would achieve the following transformations. Then explain which reaction, **A** or **B**, would be more exothermic (circle the faster reaction)? Provide a concise but thorough explanation for your choice in the box provided. (12 pts)



**Explanation:** The alkene in **A** is less stable than the alkene in **B** because the large *t*-butyl group is *cis* to the ethyl group. The steric strain presented by this alkene will make it more reactive. Addition of  $\text{OsO}_4$  to the double bond will produce a single bond that can then rotate and allow the ethyl group to move away from the *t*-butyl group.

- 6) Decide whether the mixture of structures in each beaker would rotate plane polarized light & provide a concise & valid reason for your decision. Also, indicate whether the contents of each beaker can be separated by distillation (a process that differentiates compounds by boiling point). (12 pts)



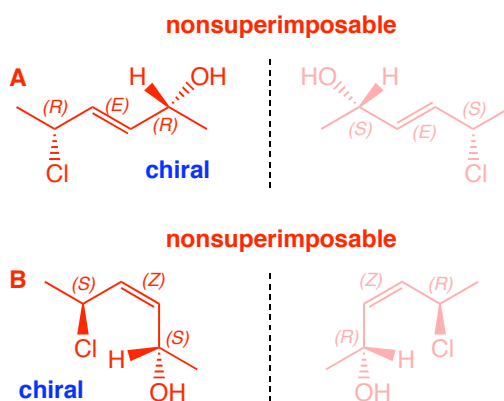
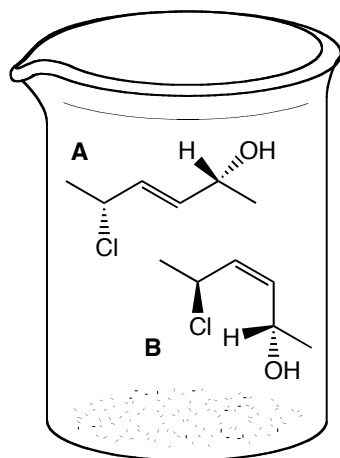
Rotates plane polarized light?

yes or  no

Reason: **The beaker contains only one compound which is chiral. Chiral compounds rotate plane polarized light.**

Separable by distillation?

yes or  no



Rotates plane polarized light?

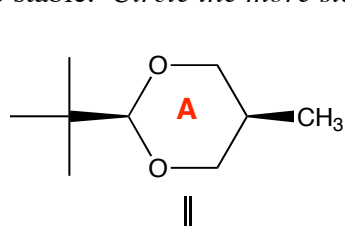
yes or  no

Reason: **The beaker contains a pair of diastereomers, both which are chiral. Chiral molecules rotate plane polarized light and the chance that two diastereomers will have exactly opposite specific rotations is extremely low.**

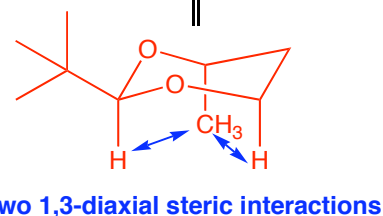
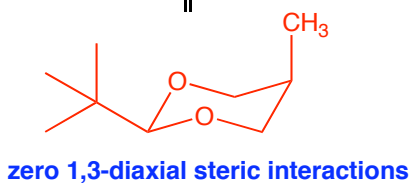
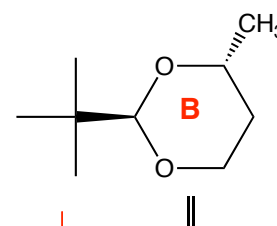
Separable by distillation?

yes or  no

- 7) Use conformational analysis to determine (i.e. explain using pictures and words) which compound is more stable. *Circle the more stable compound.* (7 points)



versus



Since *t*-butyl is such a large group, it will always be equatorial in cyclohexane (or analogous structure) to avoid steric strain. In both A and B, this forces the methyl group to be axial. The methyl group experiences two 1,3-diaxial interactions with hydrogen atoms in B, but there are no axial hydrogens in A for the methyl to interact with, since oxygens occupy those positions. Therefore, A has less steric strain than B and is thus more stable.