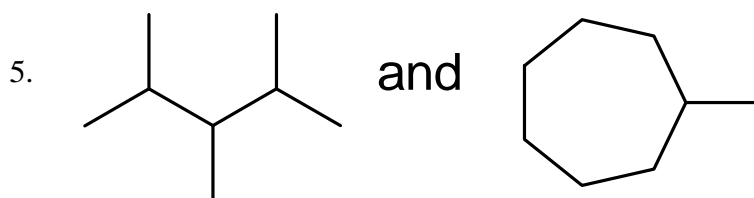
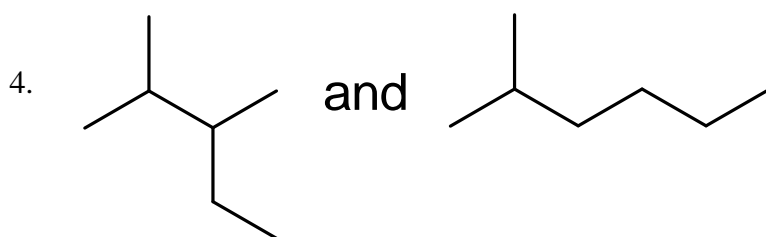
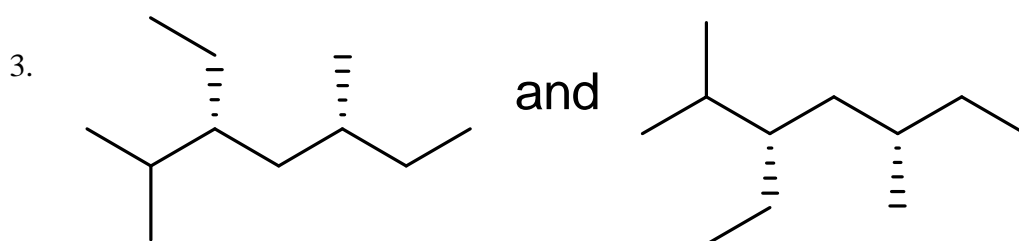
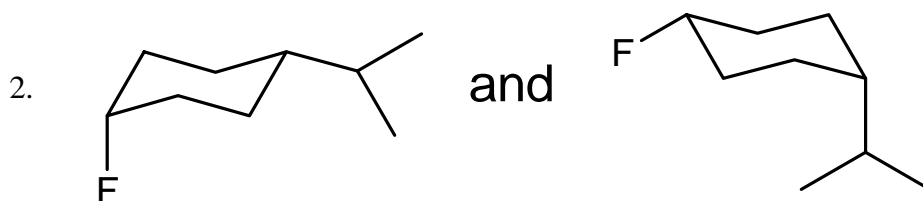
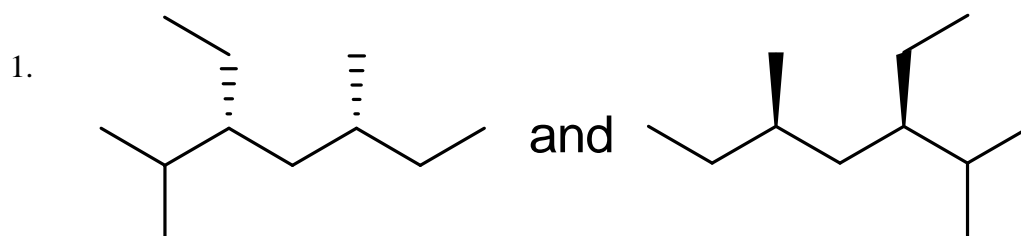


Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

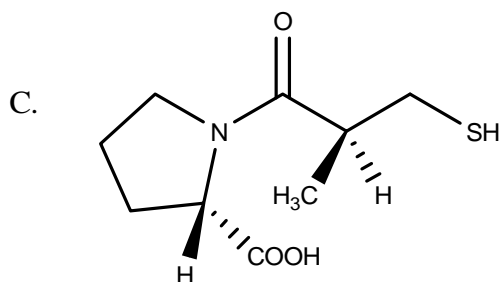
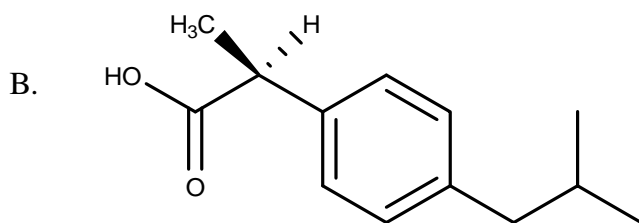
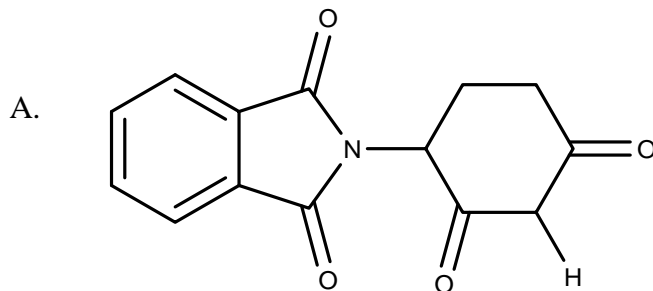
For Questions 1 – 5, determine the relationship (if any) that exists between the pair of molecules listed below by selecting one of the following answer choices:

- A. Identical structures **#1 below**
- B. Constitutional isomers **#4 below**
- C. Enantiomers **#3 below**
- D. Conformational isomers **#2 below**
- E. Unrelated structures **#5 below**



Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

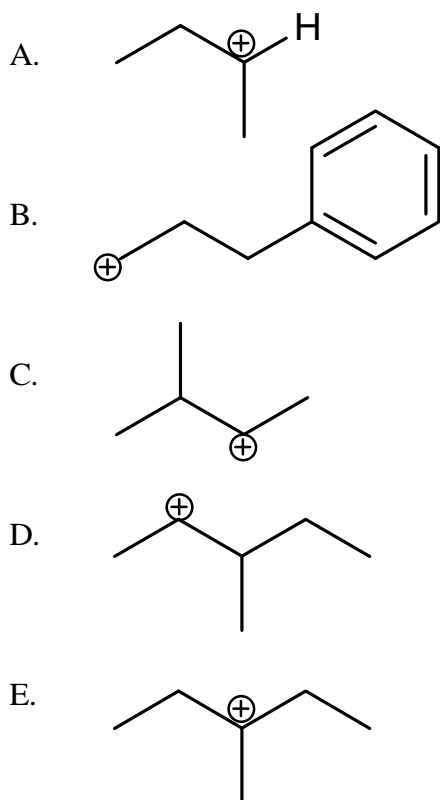
For Questions 6 – 10, consider the structures below of the three drugs discussed in this section:



- This enantiomer is teratogenic and led to abnormally large number of birth defects in women during their first trimester of pregnancy. **A**
- This drug is sold as a racemic mixture; the R-enantiomer is biologically inactive in our bodies. **B**
- There is a resurgence of interest in this drug because it has been found to be useful in the treatment of leprosy and may also be useful in the treatment of AIDS. **A**
- Patients suffering from high blood pressure and congestive heart failure may be prescribed this drug. **C**
- This drug is active as a pain and fever reliever. **B**

Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

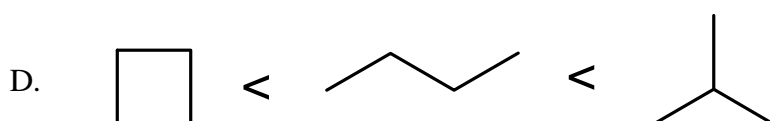
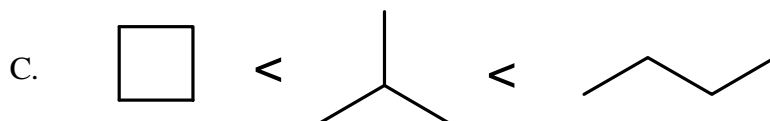
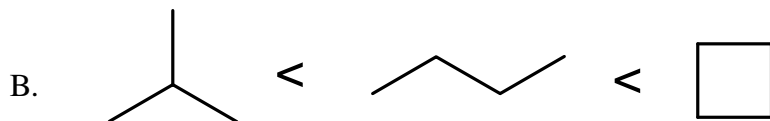
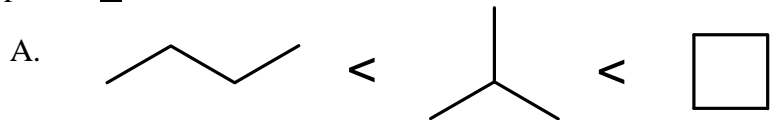
11. Which of the following organic reactions involves converting an alkene into an alcohol?
- A. combustion
 - B. hydrohalogenation
 - C. **hydration**
 - D. halogenation
 - E. hydrogenation
12. Consider the carbocation intermediates below. Which is the most stable (as written)? **E**



13. Determine the FALSE statement:
- A. **A racemic mixture is an equimolar mixture of two enantiomers that rotates plane polarized light.**
 - B. Enantiomers rotate plane polarized light by equal amounts in opposite directions.
 - C. Diastereomers are not mirror images of one another.
 - D. Enantiomers have identical melting points, boiling points, solubilities, heats of formation, and standard free energies.
 - E. All R-enantiomers do not necessarily rotate plane polarized light in the dextrorotatory direction.

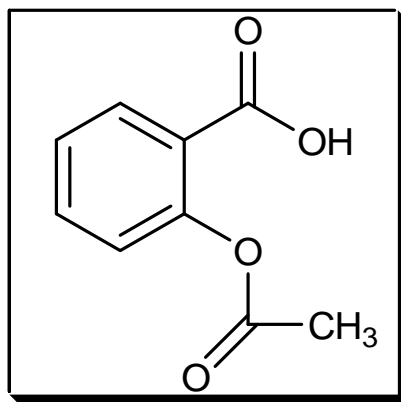
Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

14. Which of the following is arranged in order of INCREASING expected boiling point? **B**



- E. All of the above exhibit the same boiling point.

15. Consider the structure of acetylsalicylic acid (i.e., aspirin) shown below:



Which of the following INCORRECTLY describes aspirin?

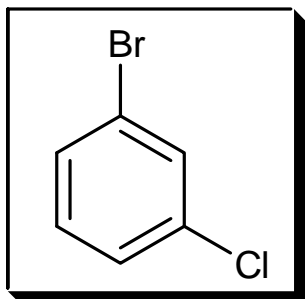
- A. *ortho*
B. polar
C. **chiral**
D. aromatic
E. planar

END OF MULTIPLE CHOICE

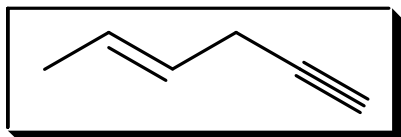
Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

16. (15 pts. total; 3 pts. each) **NOMENCLATURE!** Use the appropriate IUPAC notation to name/draw each of the organic structures below:

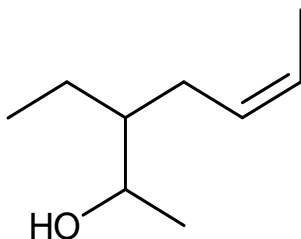
A. *m*-bromochlorobenzene



B. **Figure It Out!** *trans*-4-hexen-1-yne

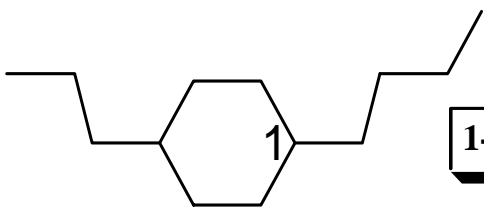


C.



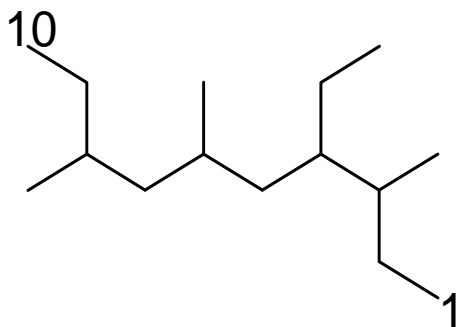
***cis*-3-ethyl-5-hepten-2-ol**

D.



1-butyl-4-propylcyclohexane

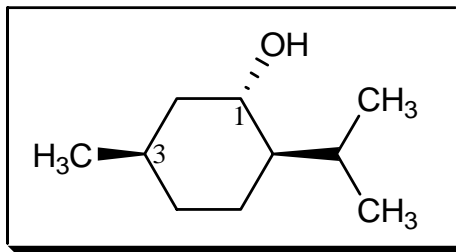
E.



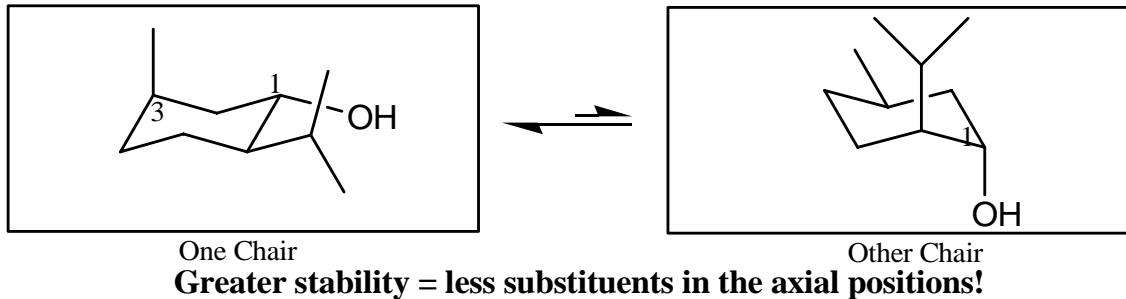
4-ethyl-3, 6, 8-trimethyldecane

Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

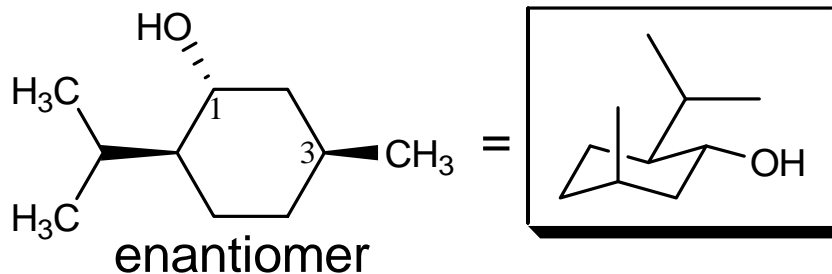
(22 pts. total) For Questions 17 - 22, consider one of the isomers of isomenthol shown to the right, a compound responsible for mint flavoring. Note the numbering of the ring atoms.



17. (4 pts.) In the box below labeled 'One Chair', complete the drawing of isomenthol's chair conformation. Note the numbering of the ring atoms.
18. (4 pts.) In the box below labeled 'Other Chair', draw the other chair conformation of isomenthol. Note the numbering of the ring atoms.
19. (2 pts.) Between the boxes, circle the equilibrium arrow set that properly indicates the position of the isomenthol chair-flip equilibrium.

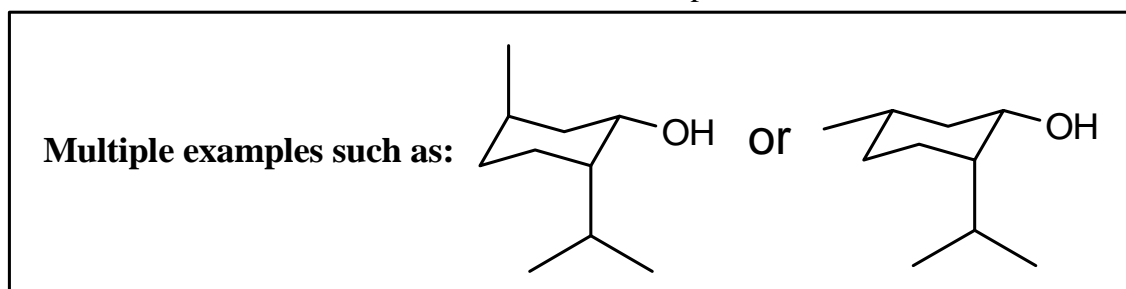


20. (4 pts.) Fill-in-the-blanks: There is/are ONE enantiomer(s) and SIX diastereomer(s) of the structure in the 'One Chair' box.
21. (4 pts.) In the box below, complete the drawing of an enantiomer of the structure in the 'One Chair' box. If this is not possible, write 'NOT POSSIBLE'.

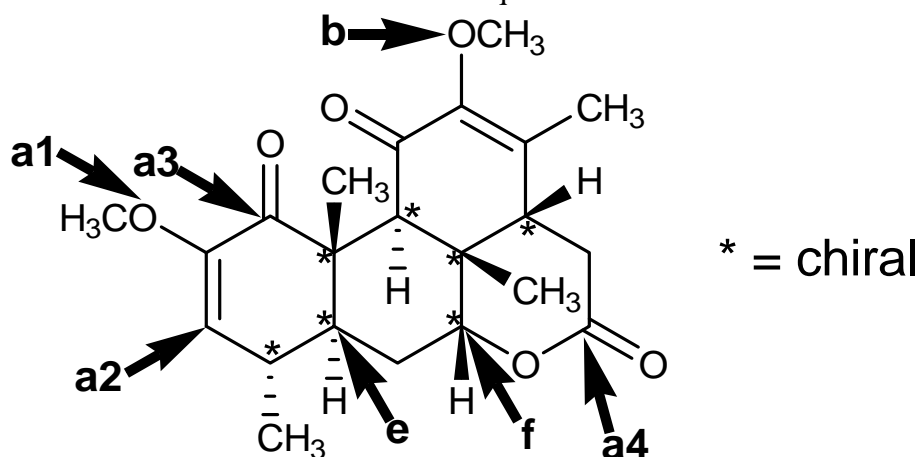


Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

22. (4 pts.) In the final box below, complete the drawing of a diastereomer of the structure in the 'One Chair' box. If this is not possible, write 'NOT POSSIBLE'.



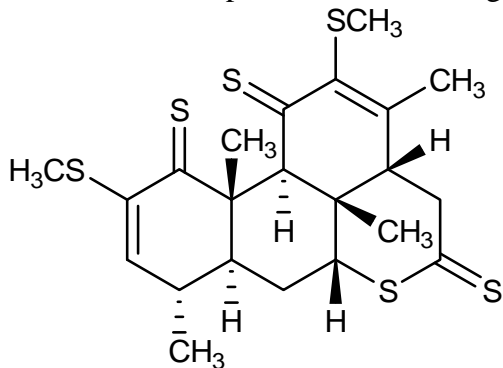
23. (21 pts. total) Behold the structure of **Quassin**, a white, bitter, and crystalline substance extracted from the quassia tree that is known to be the bitterest substance found in nature. Answer the questions related to its structure.



- A. (8 pts.) Name each of the functional groups labeled above.
a1 ether **a2 alkene** **a3 ketone** **a4 ester**
- B. (2 pts.) Consider the oxygen labeled "b". What is the geometry and approximate bond angle around the central atom? **bent; 109.5 degrees**
- C. (2 pts.) How many total stereocenters (if any) are in **Quassin**? Clearly label them in the structure above with an asterisk (*). **7**
- D. (1 pt.) What is the maximum number of possible stereoisomers for this molecule? *Formula is sufficient; no need to calculate!* **$2^7 = 128$**
- E. (2 pts.) Determine the absolute configuration at the carbon atom labeled "e". **S**
- F. (2 pts.) What is the absolute configuration at the carbon atom labeled "f"? **R**

Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

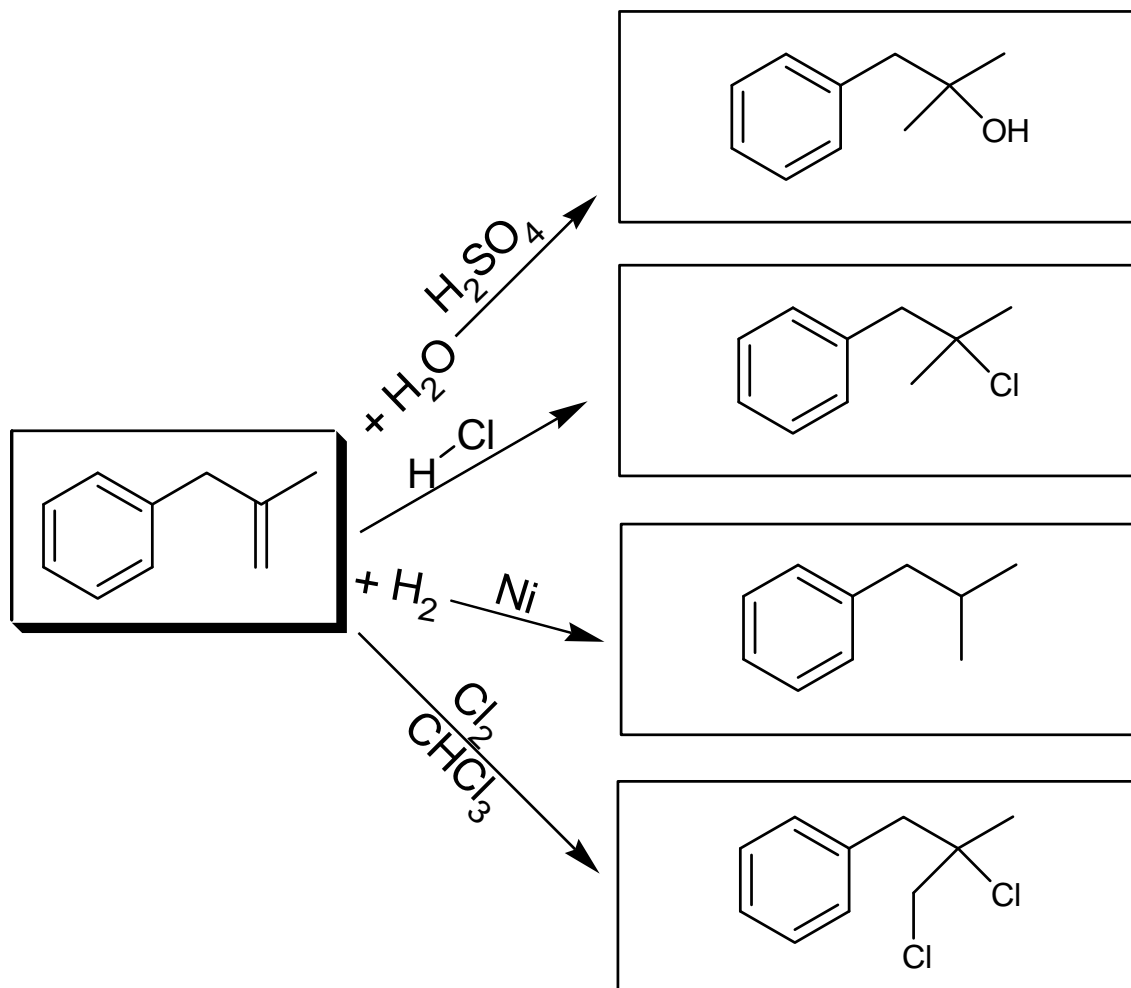
- G. (4 pts.) Finally, consider a derivative of **Quassin** below. Is this molecule expected to boil at a higher or lower temperature? Briefly explain.



would have a (CIRCLE ONE) higher **lower** boiling point than **Quassin**.

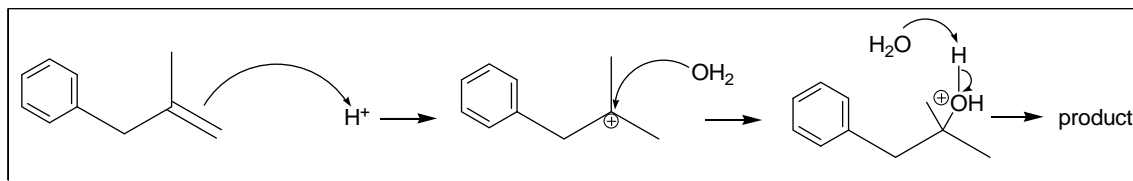
EXPLANATION: Replacing all the oxygen atoms with sulfur now eliminates the possibility for hydrogen bonding, hence lowering the boiling point of the derivative molecule.

24. (12 pts. total) **REACTIONS AND MECHANISMS!** Predict the expected MAJOR product(s) for the reactions listed below, and give the appropriate curved arrow notation for the first TWO listed reactions. Write NR if no reaction occurs.

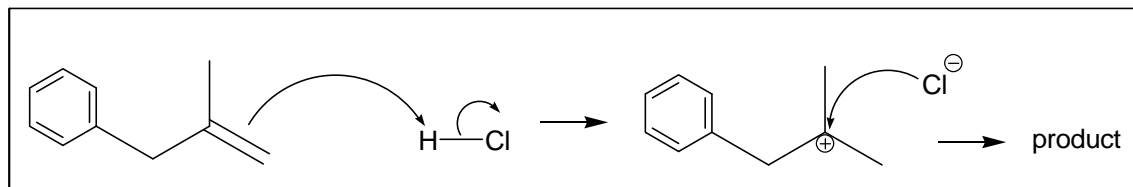


Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

Show mechanism for Reaction #1 above:

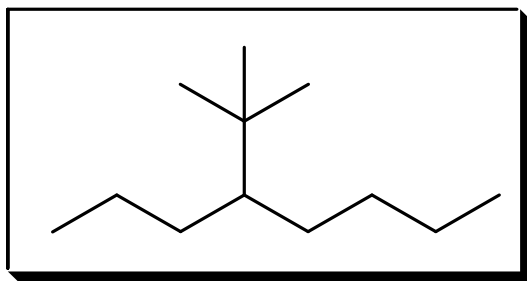


Show mechanism for Reaction #2 above:

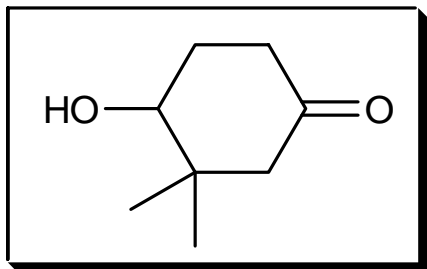


BONUS! Use your knowledge of IUPAC rules of nomenclature as well as functional groups and see if you can draw the following compounds using bond-line notation (6 pts. total; 2 pts. each). **GRADED ALL OR NONE!**

A. 4-(1,1-dimethylethyl)octane



B. 3,3-dimethyl-4-hydroxycyclohexanone (*hint: what functional group does the suffix of the parent chain resemble in terms of sound?*)



Fall 2009 Chemistry 11 Examination #3 ANSWER KEY

- C. 3-bromo-6-heptenal (*hint: what functional group does the suffix of the parent chain resemble in terms of sound?*)

