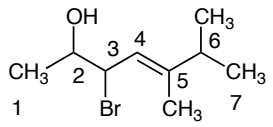
L. I. U.

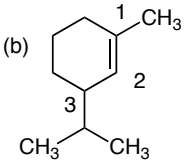
ANSWER KEY

Chem. 121, Sect 010, Exam II Fall, 2012, 150 points

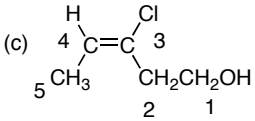
1. Name the following compounds. (15 pts)

(a) 

3-bromo-5,6-dimethyl-4-hepten-2-ol

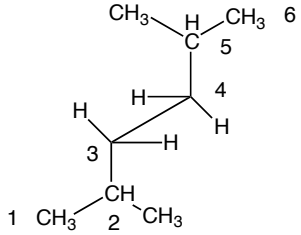
(b) 

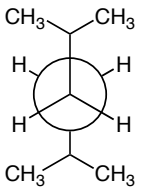
3-isopropyl-1-methylcyclohexene

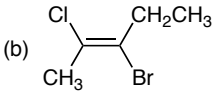
(c) 

(E)-3-chloro-3-penten-1-ol

2. Draw the following molecules. (a) The Neumann projection looking down the C3-C4 bond for 2,5-dimethylhexane. (b) (E)-3-bromo-2-chloro-2-pentene. (10 pts)

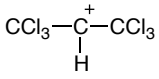
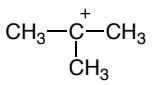
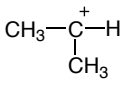
(a) 



(b) 

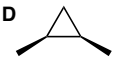
3. Answer the following questions and in each case briefly justify your answer.

(a) Which carbocation is most stable? Least stable? (10 pts)

A  **B**  **C** 

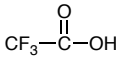
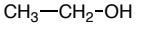
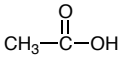
B is most stable since it is a tertiary carbocation with three electron-donating methyl groups. **A** is the least stable. Like **C**, it is secondary, but it has two electron-withdrawing CCl_3 groups, which destabilize the carbocation.

(b) Which molecule would have the highest heat of combustion? The lowest? (10 pts)

D  **E**  **F** 

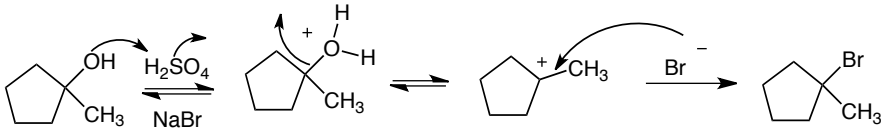
Both **D** and **E** are higher in energy than the five-membered ring F, so **F** has the lowest heat of combustion, since it does not have much ring strain. **D** is *cis*, which means the two methyl groups are eclipsed and therefore higher in energy than the *trans*-isomer.

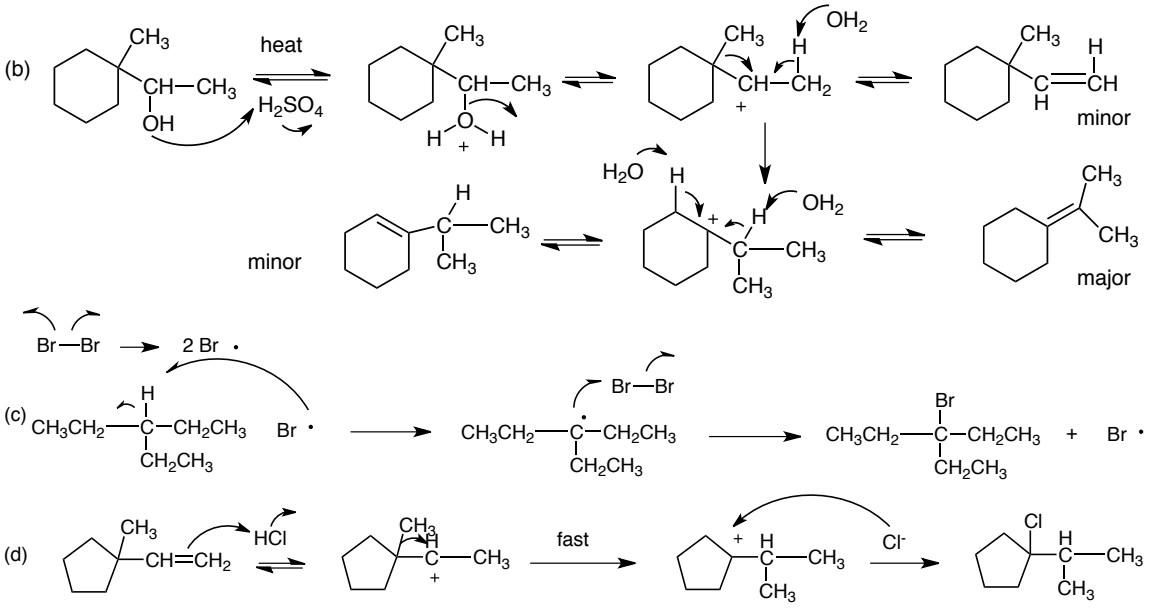
(c) Which molecule is the strong acid? Weakest? (10 pts)

G  **H**  **I** 

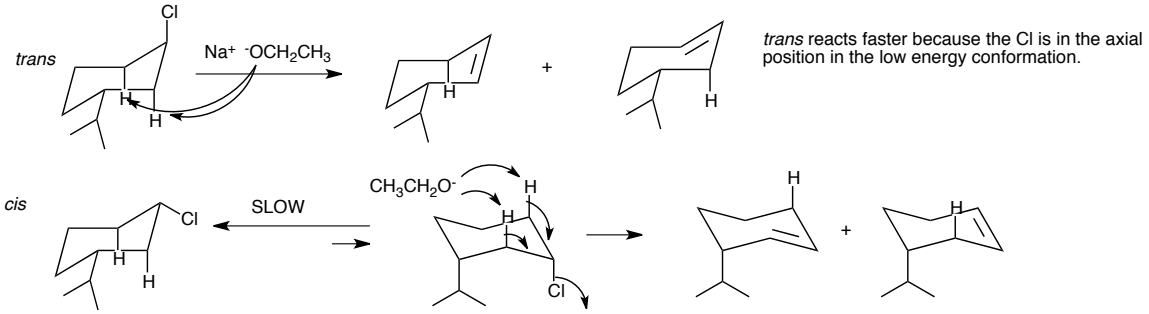
The weakest acid is **H** since it does not have a carbonyl group, like **G** and **I** to help stablize the anion resulting from deprotonation. **G** is a stronger acid than **I** because it has the CF_3 group, which withdraws electrons from the carbonyl and helps to stabilize the resulting anion.

4. Give the product for each of the following reactions and show all of the steps of the mechanism. (60 pts)

(a) 



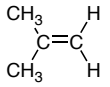
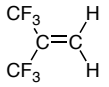
5. (a) Draw both chair conformations of *cis*- and *trans*-1-chloro-3-isopropylcylcohexane and indicate which is lower in energy. Briefly explain why. (b) Which molecule would react faster with sodium ethoxide in ethanol ($NaOCH_2CH_3/HOCH_2CH_3$)? Explain by showing the complete reaction that occurs for each molecule, giving the reaction mechanism and the products that are formed. (20 pts).

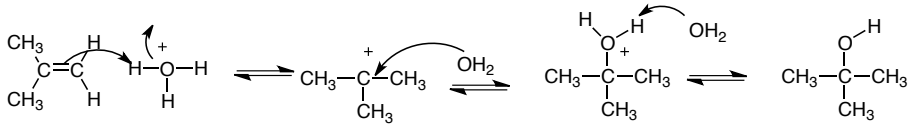


trans reacts faster because the Cl is in the axial position in the low energy conformation.

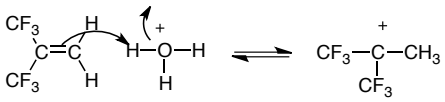
Cis reacts more slowly than *cis* because the low energy conformation cannot undergo elimination. It must first undergo a ring flip to put the Cl in the axial position, but this also puts the large isopropyl group axial and this is a very high energy conformation. Therefore, the concentration of this conformation is very low.

6. Which molecule would react faster in an acid catalyzed hydration reaction using H_3O^+, H_2O? Briefly explain your choice and show the reaction that occurs, including the full reaction mechanism, for the molecule that you choose. (15 pts)

J  **K**  **J** will react faster because it forms the more stable carbocation



More stable carbocation; alkyl groups donate electrons.

 Less stable carbocation, due to the strongly electron withdrawing CF_3 groups.

BONUS: show how the following transformation occurs. (10 pts)