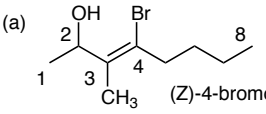
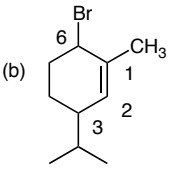
L. I. U.

Chem. 121, Sect 012, Exam II Fall, 2012, 150 points

1. Name the following compounds. Specify E or Z where appropriate. (10 pts)

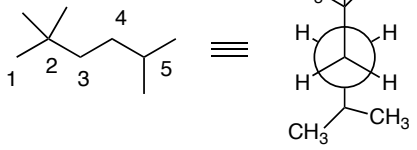
(a) 

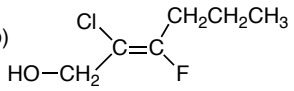
(Z)-4-bromo-3-methyl-3-octen-2-ol

(b) 

6-bromo-3-isopropyl-1-methylcyclohexene

2. Draw the following molecules: (a) The Neumann projection for the low energy conformation of 2,2,5-trimethylhexane looking down the C3-C4 bond. (b) (E)-2-chloro-3-fluoro-2-hexen-1-ol. (10 pts)

(a) 

(b) 

3. Give the product of the following acid-base reactions and indicate in each case whether or not the reaction is favorable as drawn by calculating the equilibrium constant. If the equilibrium is very unfavorable, you can simply write "No Reaction". (20 pts)

(a) $CH_3CH_2-C\equiv C-H$ + KNH_2 ⟶ $CH_3CH_2-C\equiv C:$ + $H-N(H)-H$ Keq = 10^{10}

pKa 26 pKaH 36

(b) $CH_3CH_2CH_2-O-H$ + $Na^+ {}^-O-C(=O)-CH_3$ ⟵ $CH_3CH_2CH_2-O:^-$ + $HO-C(=O)-CH_3$ Keq = 10^{-11}

pKa 15.8 pKaH 4.8 (or NO REACTION)

4. Answer the following questions. I**n each case briefly explain your answer**. (20 pts)

(a) Which compound is the strongest acid? The weakest acid?

A $Cl_3C-C(=O)-O-H$ **B** $H_3C-C(=O)-O-H$ **C** CH_3CH_2-O-H

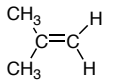
A is the strongest acid due to the inductive effect of the Cl's; they remove electron density from the O-H bond, making it a stronger acid. **C** is the wekest acid for 2 reasons: (1) it does not have the inductive effect of the carbonyl, pulling electron density from the O-H bond and (2) it does not have the resonance stabilization of the anion that both **A** abd **B** have.

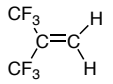
(b) Which radical is the most stable? The least stable?

D $CH_3-\dot{C}H-H$ **E** $CF_3-\dot{C}H-H$ **F** $CH_3-\dot{C}(CH_3)-H$

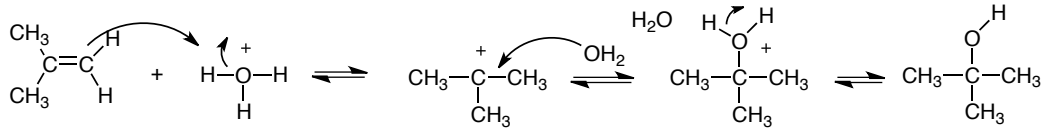
F is the most stable radical because it is secondary and the others are primary. Alkyl groups are electron donating groups and help to stabilize the electron deficient radical. **E** is the least stable since it is primary and the CF_3 group withdraws electrons from the radical, making it less stable.

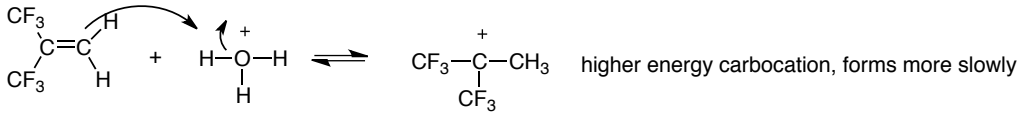
5. Which molecule would react faster with H_3O^+/H_2O? Explain briefly and show the reaction and the complete mechanism for the molecule you chose. (15 pts)

G 

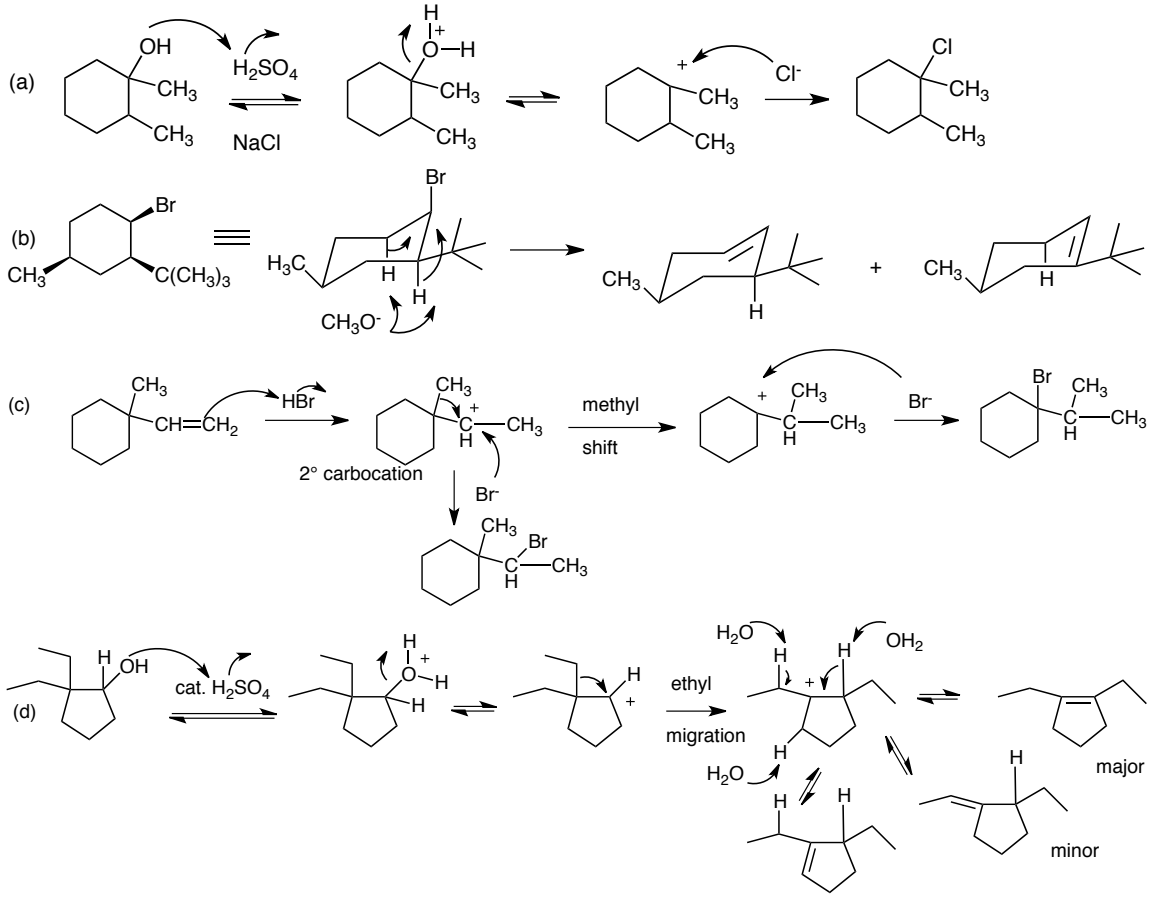
H 

G reacts much faster than **H** in a hydration reaction, since the carbocation that results from Markovnikov addition to the alkene double bond is much more stable. The CF_3 groups in **H** destabilize the carbocation, making it higher in energy and slower to form.

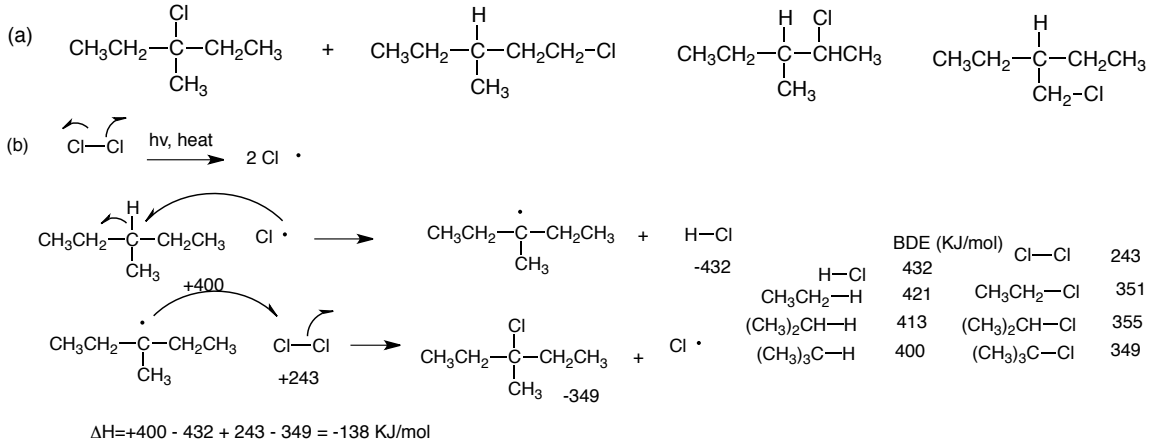
FAST 



6. Give the product of the following reactions and in each case show the complete reaction mechanism. Indicate major/minor products where appropriate. (60 pts, 15 each).



7. For the following reaction (a) first show all mono-chlorination products (b) show the reaction mechanism for reaction at the tertiary hydrogen and calculate ΔH for the overall reaction using the best match for the bond dissociation energies given. (15 pts)



ΔH=+400 - 432 + 243 - 349 = -138 KJ/mol

BONUS: Show how the following transformation occurs (10 pts)