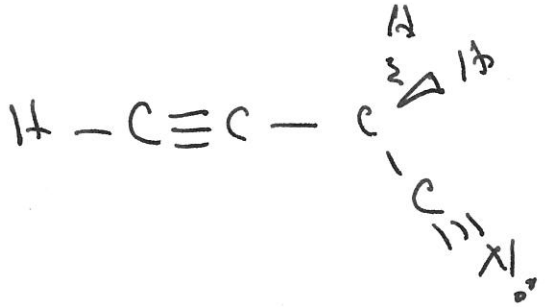
Chemistry 3311-100
Organic Chemistry/Dr. Barney Ellison
Tuesday: Feb. 12th @ **7:00pm → 9:00**/1st Exam/Hellems 252)

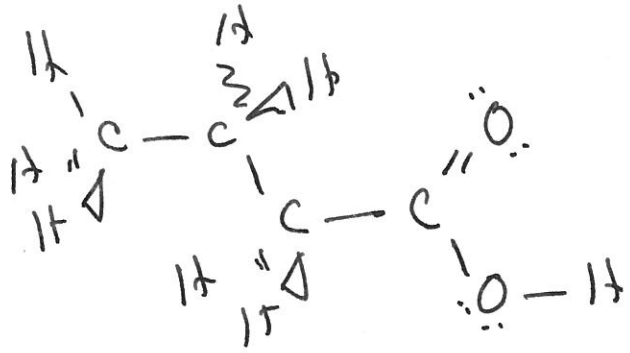
Name: Key (please print)

1. (10 pts) Draw a proper 3 dimensional structure for the following compounds. Be sure to include any lone pair electrons.

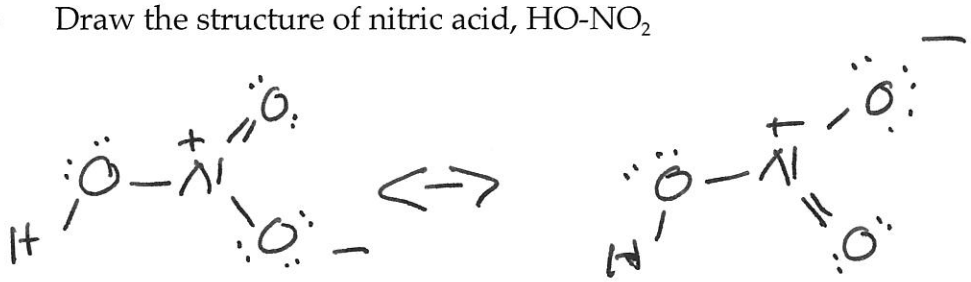
a) propargyl nitrile, $HCCCH_2CN$



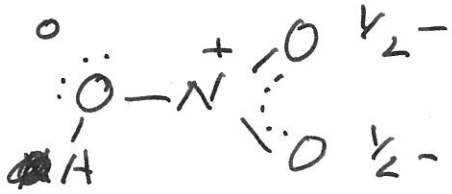
b) methyl butanoate, $CH_3CH_2CH_2COOCH_3$



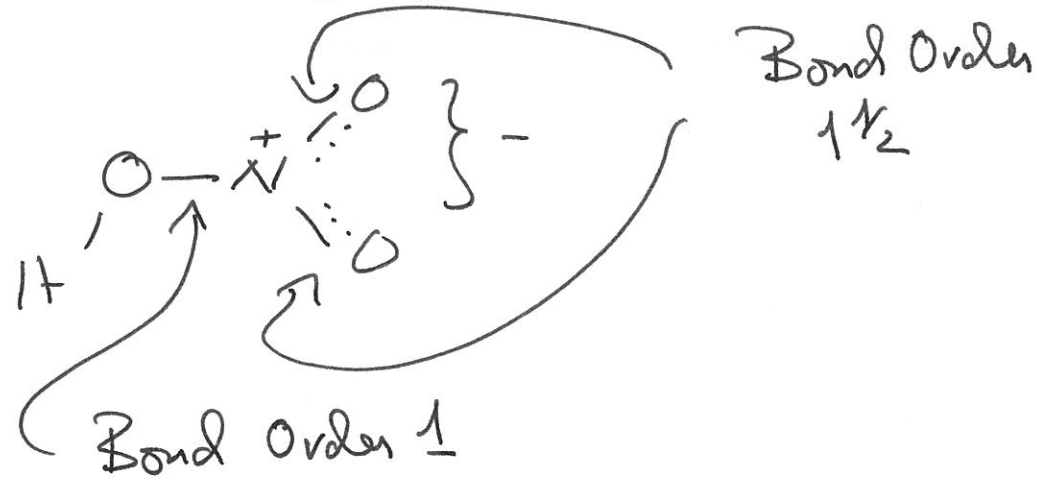
2. (10 pts) Draw the structure of nitric acid, $HO\text{-}NO_2$



a) How much negative charge is on each oxygen atom?



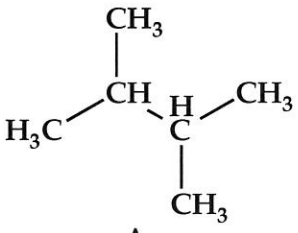
b) What is the bond order for each nitrogen-oxygen in nitric acid?



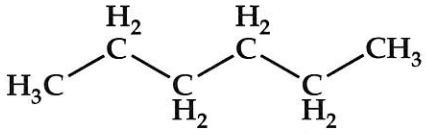
3. (10 pts) What are the names of compounds (A and B). Are they isomers or are they the same species?

A. 2,3-dimethyl butane
B. n-hexane
} isomers

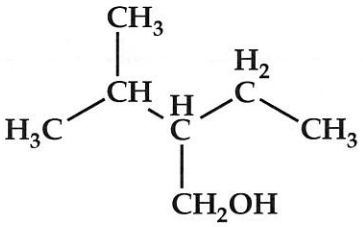
What are the names of compounds (C, D, and E). Are they isomers or are they the same species??



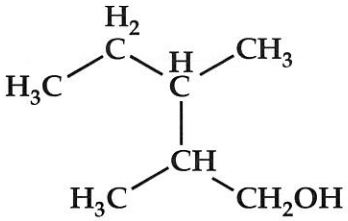
A.



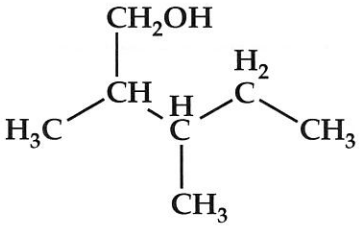
B.



C.



D.



E.

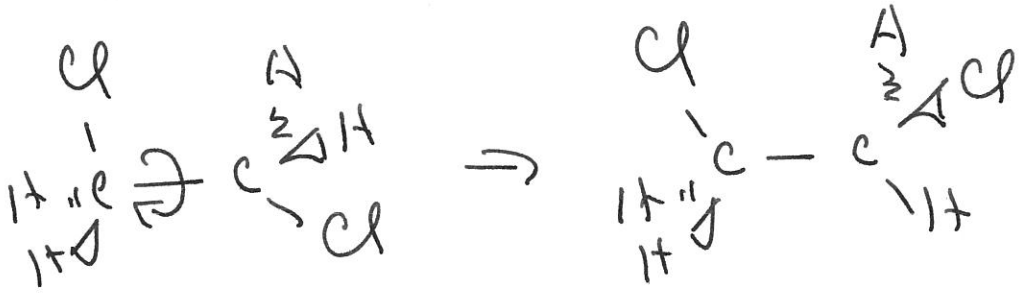
2,3-dimethyl pentanal

same

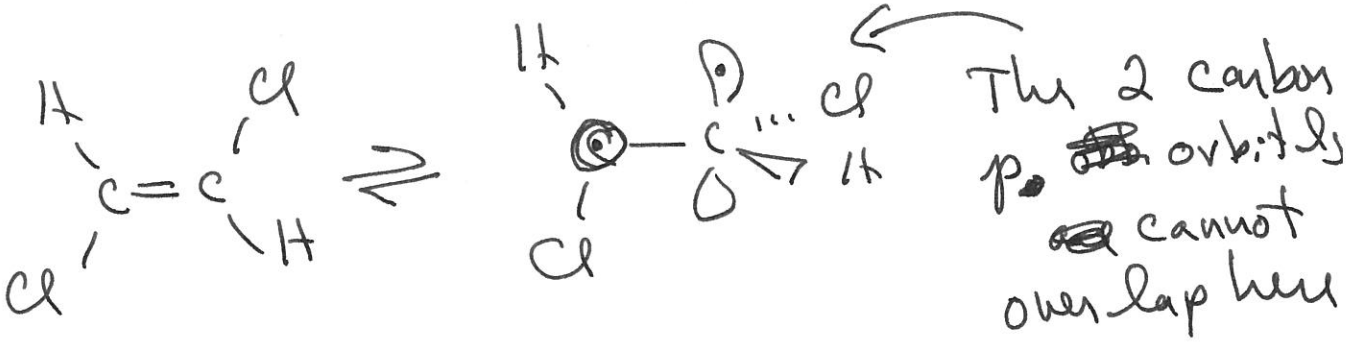
2(isopropyl)-butanal

isomers

4. (10 pts) The energy required to rotate about the CC bond in $C\ell CH_2$-$CH_2C\ell$ is only 3 kcal mol^{-1} while that to rotate about the CC bond in $CHC\ell$=$CHC\ell$ is 60 kcal mol^{-1}. Why is this?

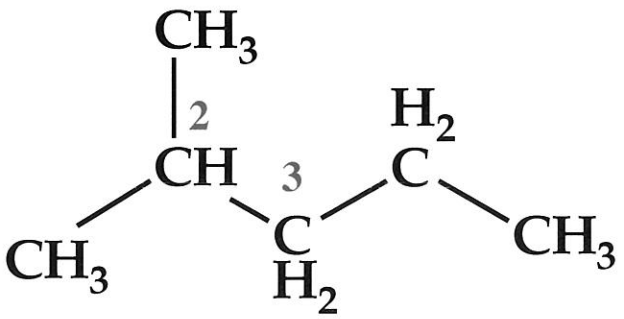


There is nearly free rotation about a single C – C bond. In contrast, rotation of a double bond requires the π bond to be broken.

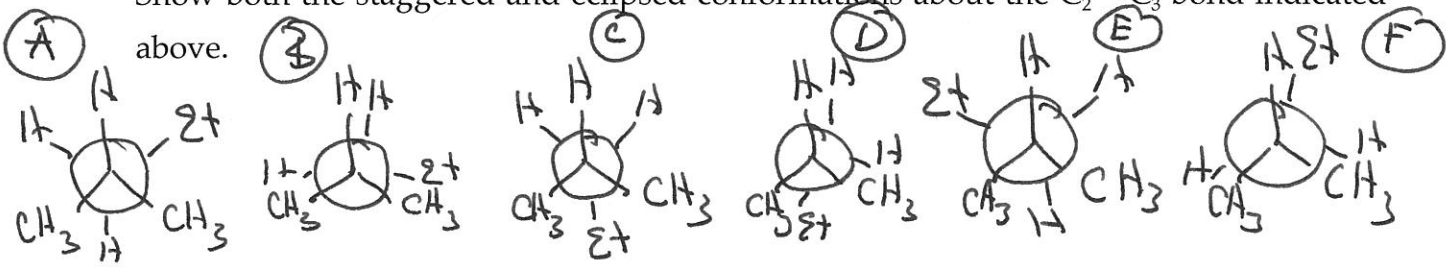


5. (15 pts)

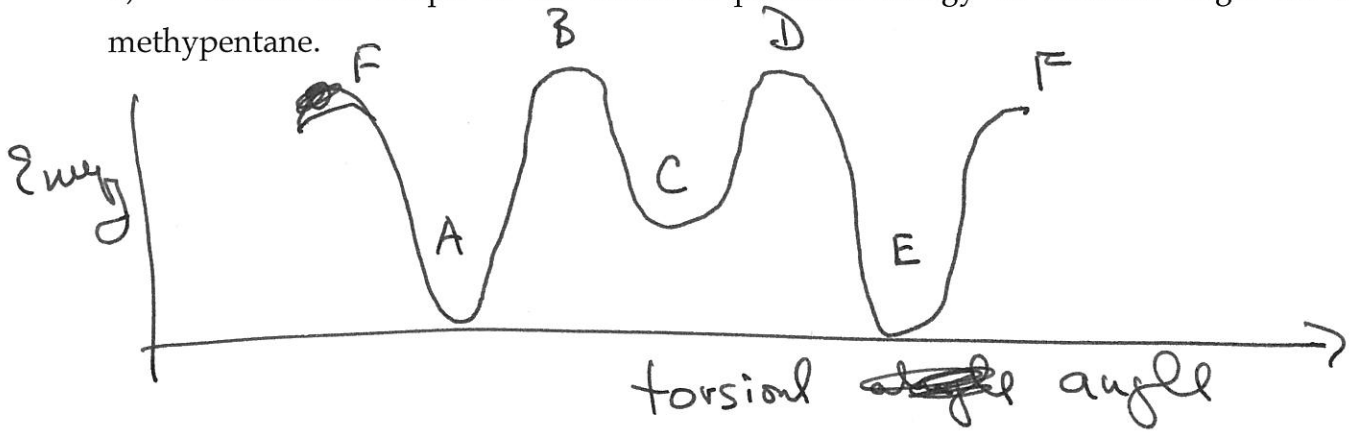
a) Draw a Newman projection for each conformation of 2-methypentane:



Show both the staggered and eclipsed conformations about the $C_2 - C_3$ bond indicated above.



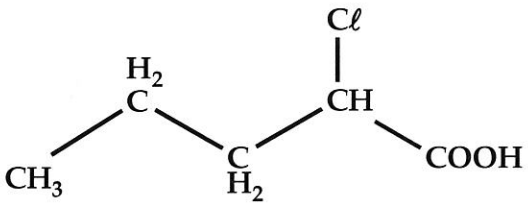
b) Sketch the shape of the curve of potential energy *vs* dihedral angle for 2-methypentane.



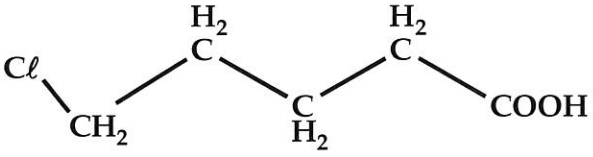
c) Which conformations are likely to be present in greatest amount at room temperature?

A & E are lowest in energy

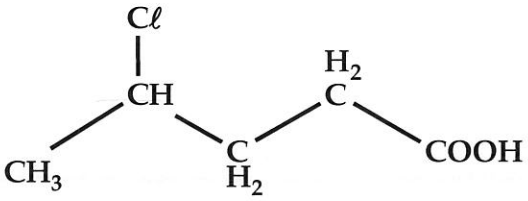
6. (15 pts) Consider the compounds and their pK_as.



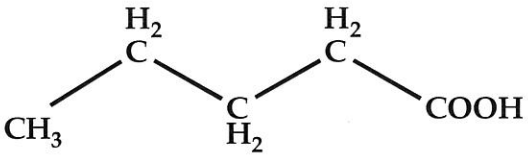
$pK_a = 2.84$ $K_a = 10^{-2.84}$



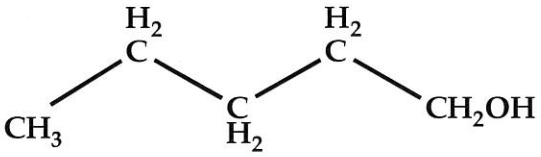
$pK_a = 4.52$ $K_a = 10^{-4.52}$



$pK_a = 4.06$ $K_a = 10^{-4.06}$



$pK_a = 4.82$ $K_a = 10^{-4.82}$

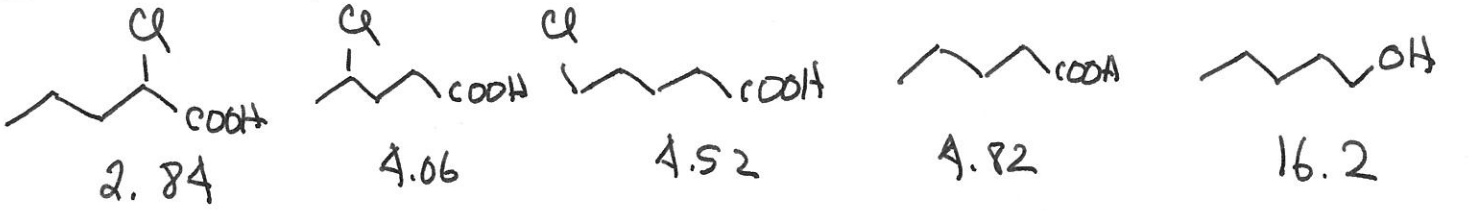


$pK_a = 16.2$ $K_a = 10^{-16.2}$

1) For each species, what is the dissociation constant, K_a ?

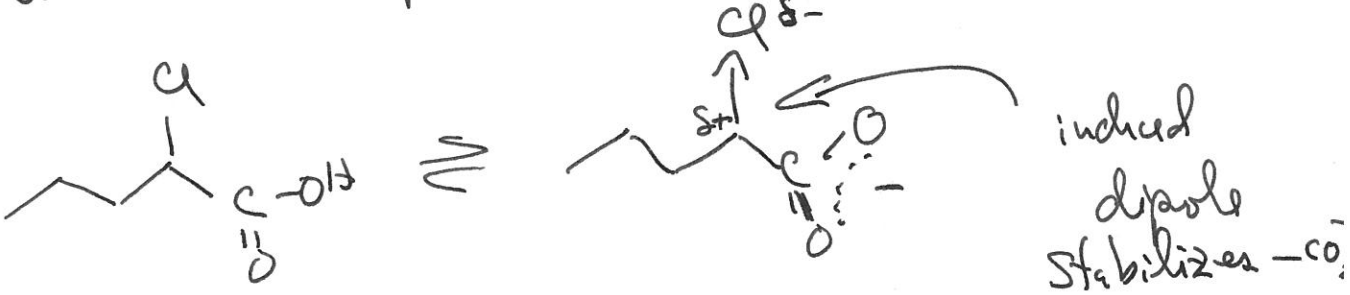
2) Rank these compounds by their acidity. Which is most acidic?

most acidic ← → least acidic



3) What is the structural basis for this variation in acidty ?

The C–Cl dipole stabilizes $-CO_2^-$ anion

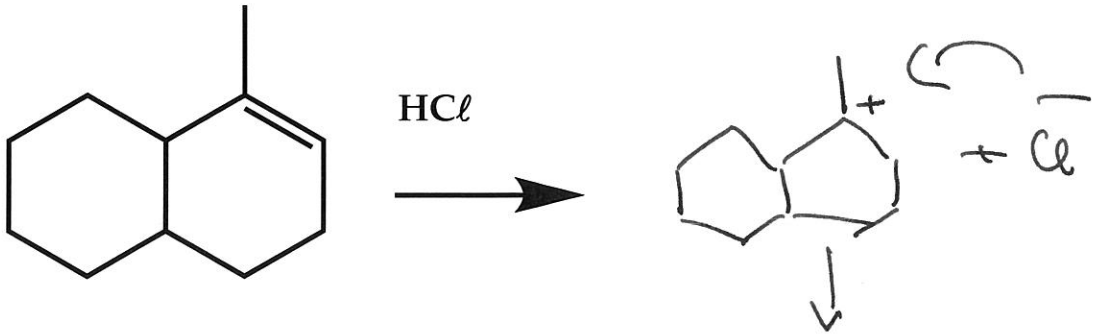


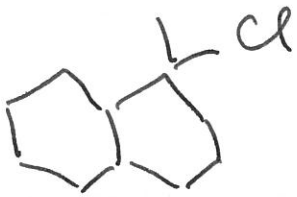
As Cl–C dipole gets, further from $-CO_2^-$ the stabilization diminishes.

The least acidic species is the pentanol. This is not an acid & the anion, $CH_3CH_2CH_2CH_2CH_2O^-$ is not resonant stabilized.

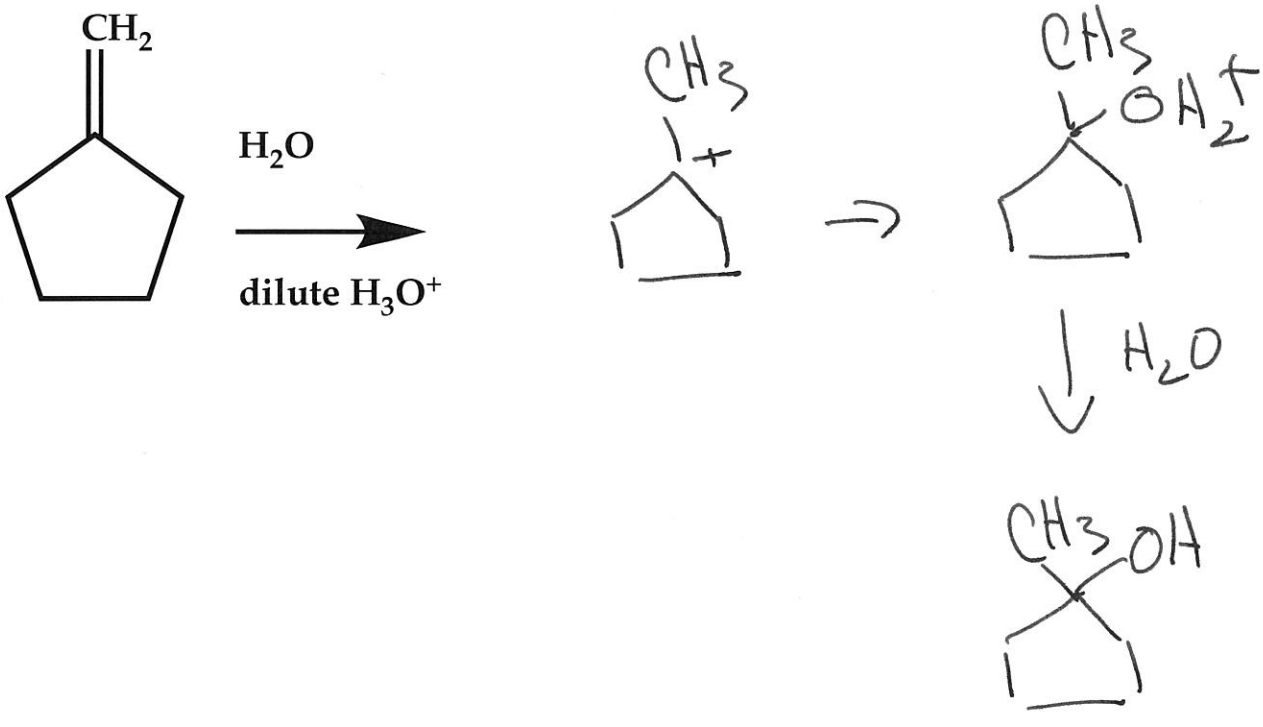
7. (10 pts) What are the products of the following reactions? Provide a mechanism for the reaction.

a)

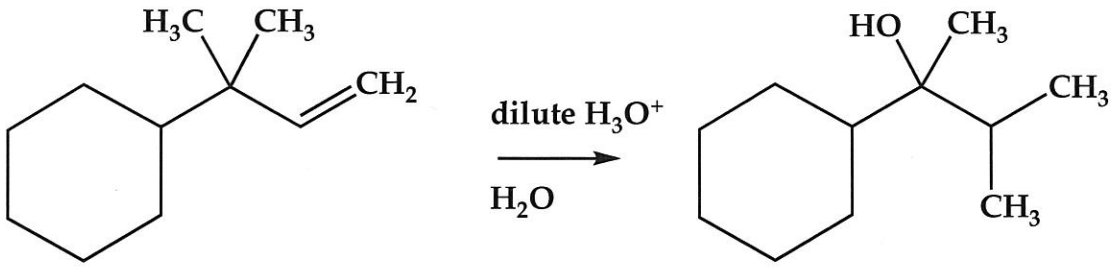


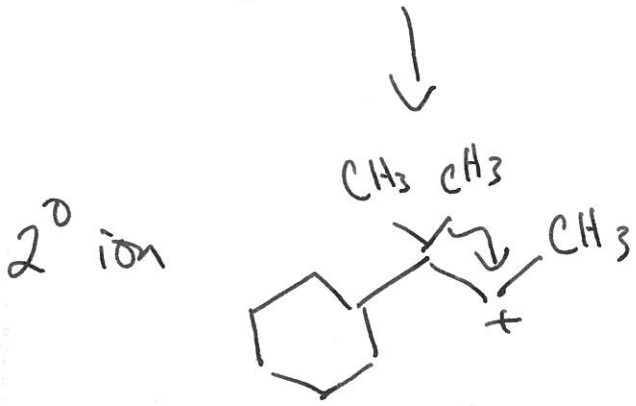


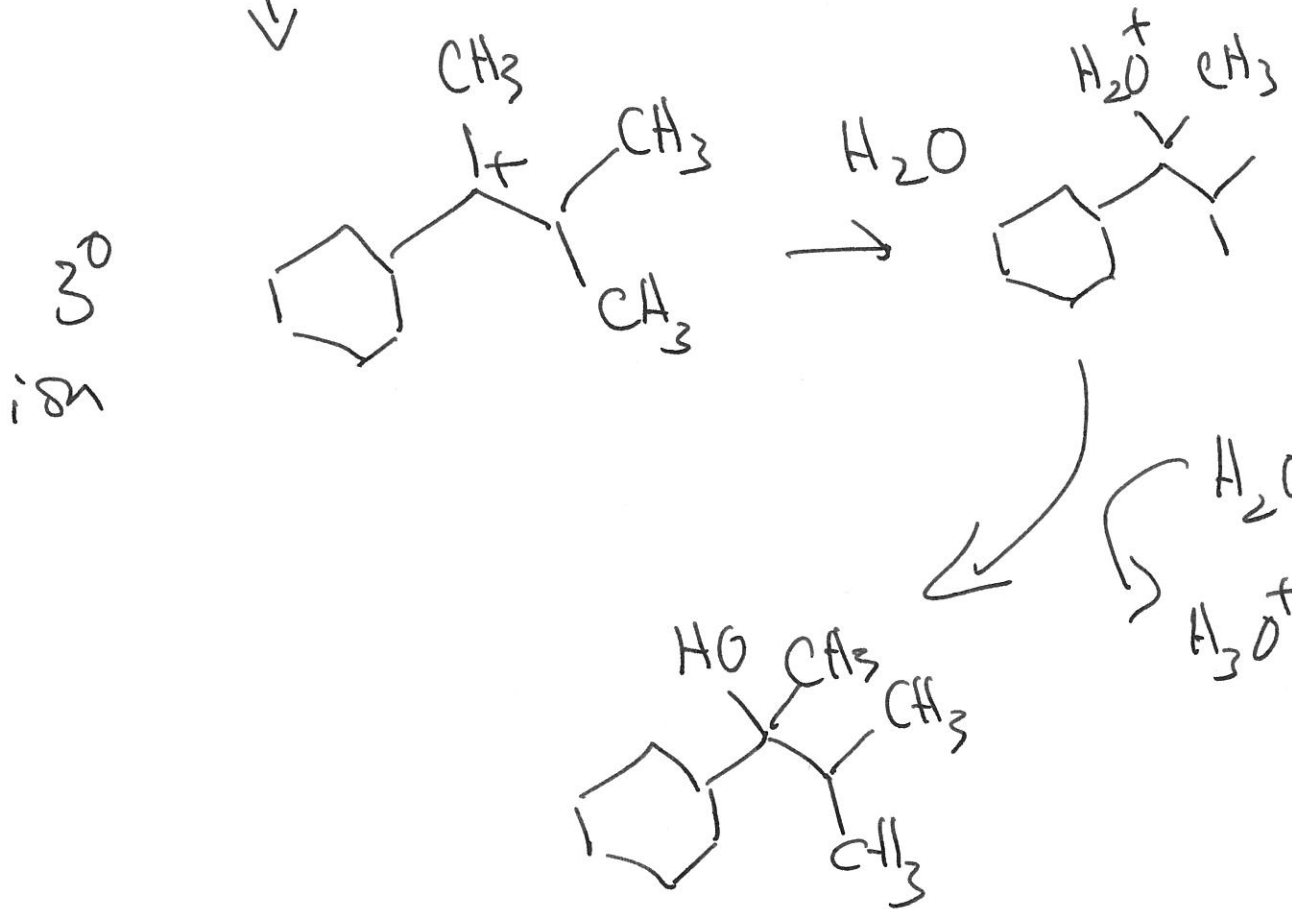
b)



8. (10 pts) Propose a mechanism for the following reaction?







9. (10 pts) Consider the alkenes below. Write the name of each compound below the structure. Recall that the more negative the heat of formation ($\Delta_f H_{298}$) is, the more stable the alkene is. Arrange the alkenes in order of stability.

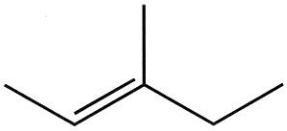
A < D < C < B < E

less stable, higher in energy → **more stable, lower in energy**

1-hexene

A highest

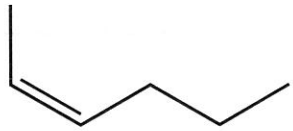
3-methyl-2-pentene



B

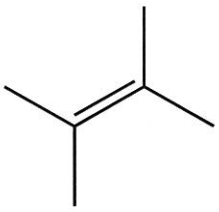
E-2-hexene

C



Z-2-hexene

D



E lowest

2,3-dimethyl-2-pentene