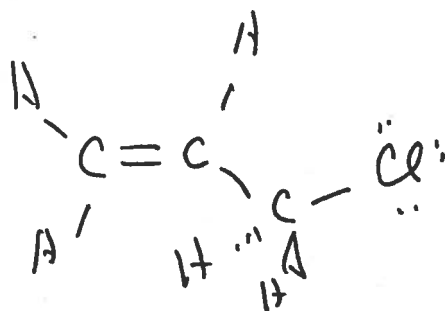


Chemistry 3311-100
 Organic Chemistry / Dr. Barney Ellison
 Thursday: Feb. 14th @ 7:00pm → 9:00 / 1st Exam / Math 100)

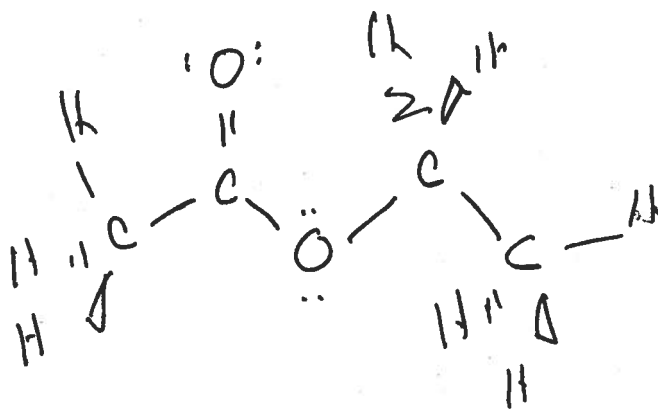
Name: Key (please print)

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

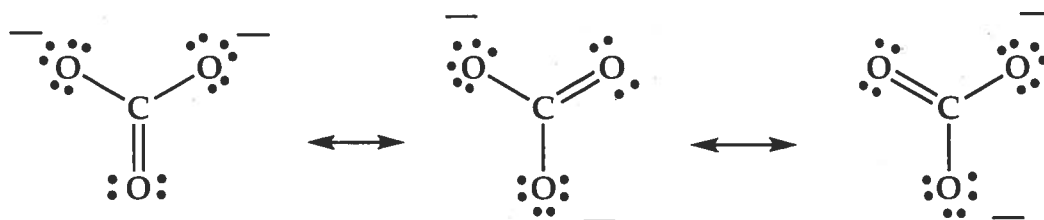
a) allyl chloride, $\text{CH}_2\text{CHCH}_2\text{Cl}$



b) ethyl acetate, $\text{CH}_3\text{COOCH}_2\text{CH}_3$



2. (10 pts) Consider the resonance structure for carbonate anion, CO_3^{-2}



- How much negative charge is on each oxygen atom?
- What is the bond order for each carbon-oxygen in the carbonate ion?

a) There are 2 charges spread over 3 oxygen atoms. So each oxygen has $\frac{2}{3}$ charges.

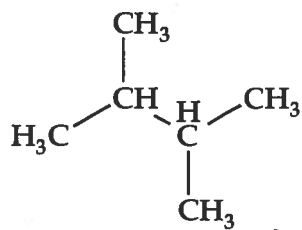
b) There are 4 bonds between C atom & the 3 oxygens. So the bond order is $\frac{4}{3}$ or 1.3

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

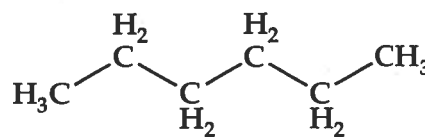
A & B are isomers

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

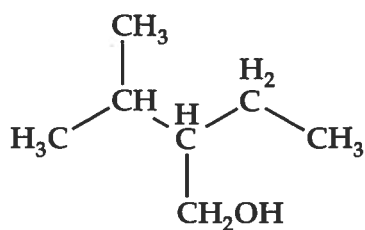
D and E are the same but C is an isomer



A. *2,3 dimethyl butane*

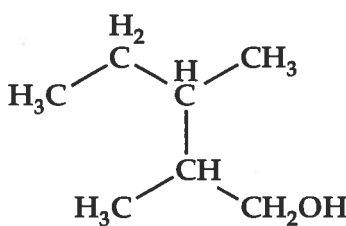


B. *n-hexane*



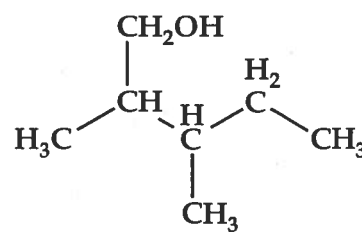
C.

2-ethyl-3-methyl-1-butanol



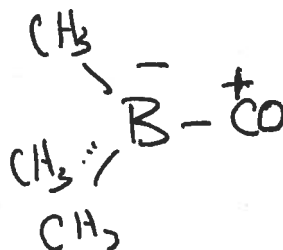
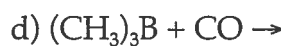
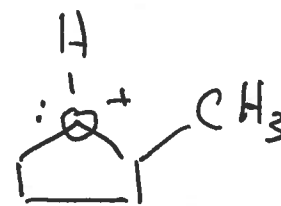
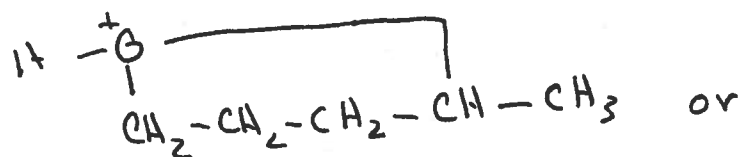
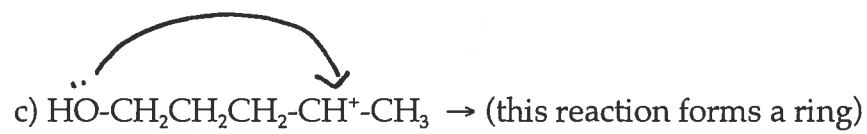
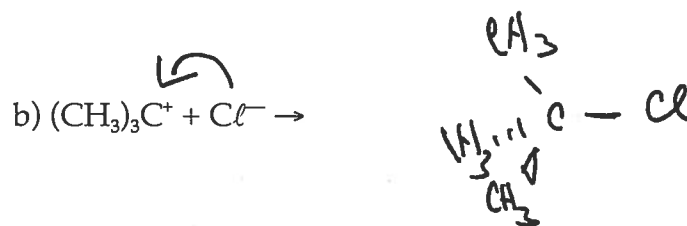
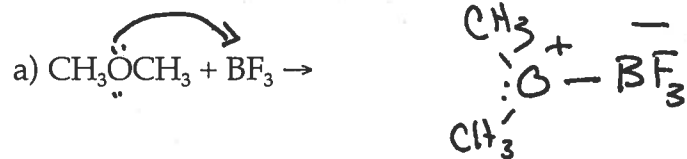
D.

2,3 dimethyl-1-butanol



E.

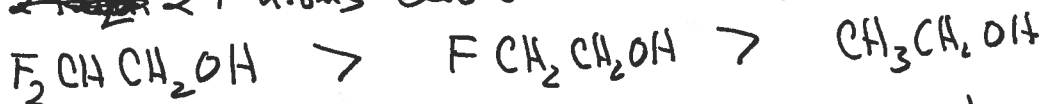
4. (10 pts) What are the products of the resulting adducts. Give a curved-arrow notation for each reaction.



5. (12 pts) Arrange the compounds in each of the following sets in order of decreasing pK_a , highest first. Explain your reasoning.

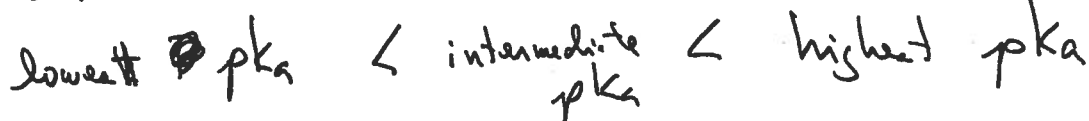


~~2 F atoms~~ 2 F atoms electron withdrawing



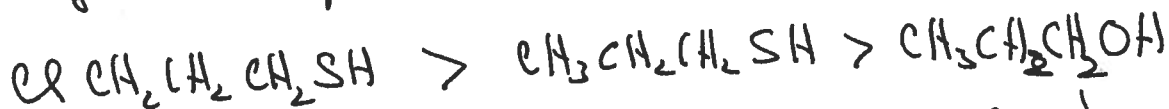
most acidic

least acidic



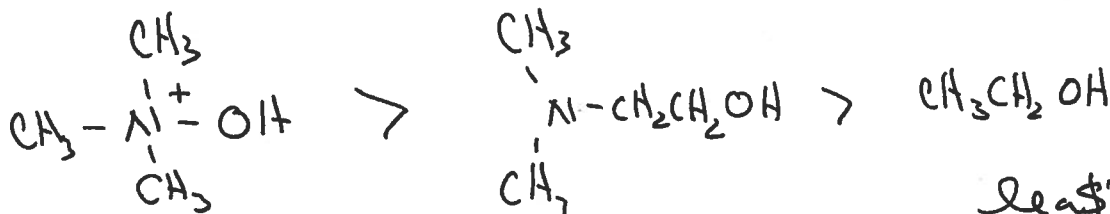
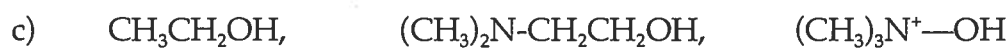
The thiols, RSH , are more acidic than ROH

And the chloro thiol is more acidic than thiol because of the Cl -polar effect.



more acidic

least acidic



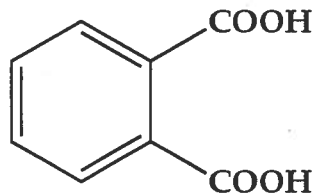
more acidic

least acidic

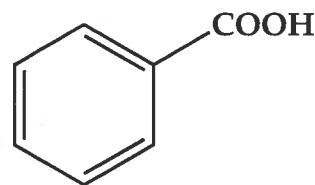
polar effect of N atom

$-\text{N}^+$ cation is stabilizing OH

6. (18 pts) Phthalic acid has two carboxylic acid groups and consequently undergoes two ionization reactions. The pK_a for the first ionization is 2.95, the pK_a for the second ionization is 5.41. The pK_a for benzoic acid is 4.18.

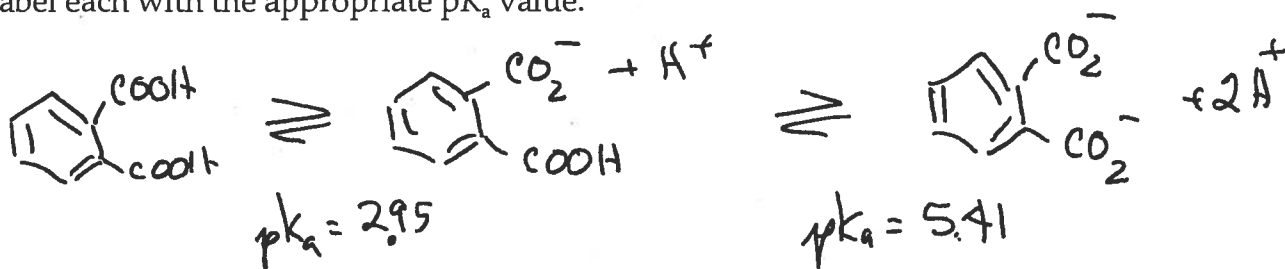


phthalic acid

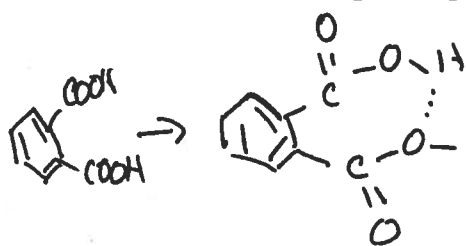


benzoic acid

a) Write out the equations for the first and second ionizations of phthalic acid, and label each with the appropriate pK_a value.



b) Why is the first pK_a of phthalic acid much lower than the pK_a of benzoic acid but the second pK_a of phthalic acid is much higher than the pK_a of benzoic acid?

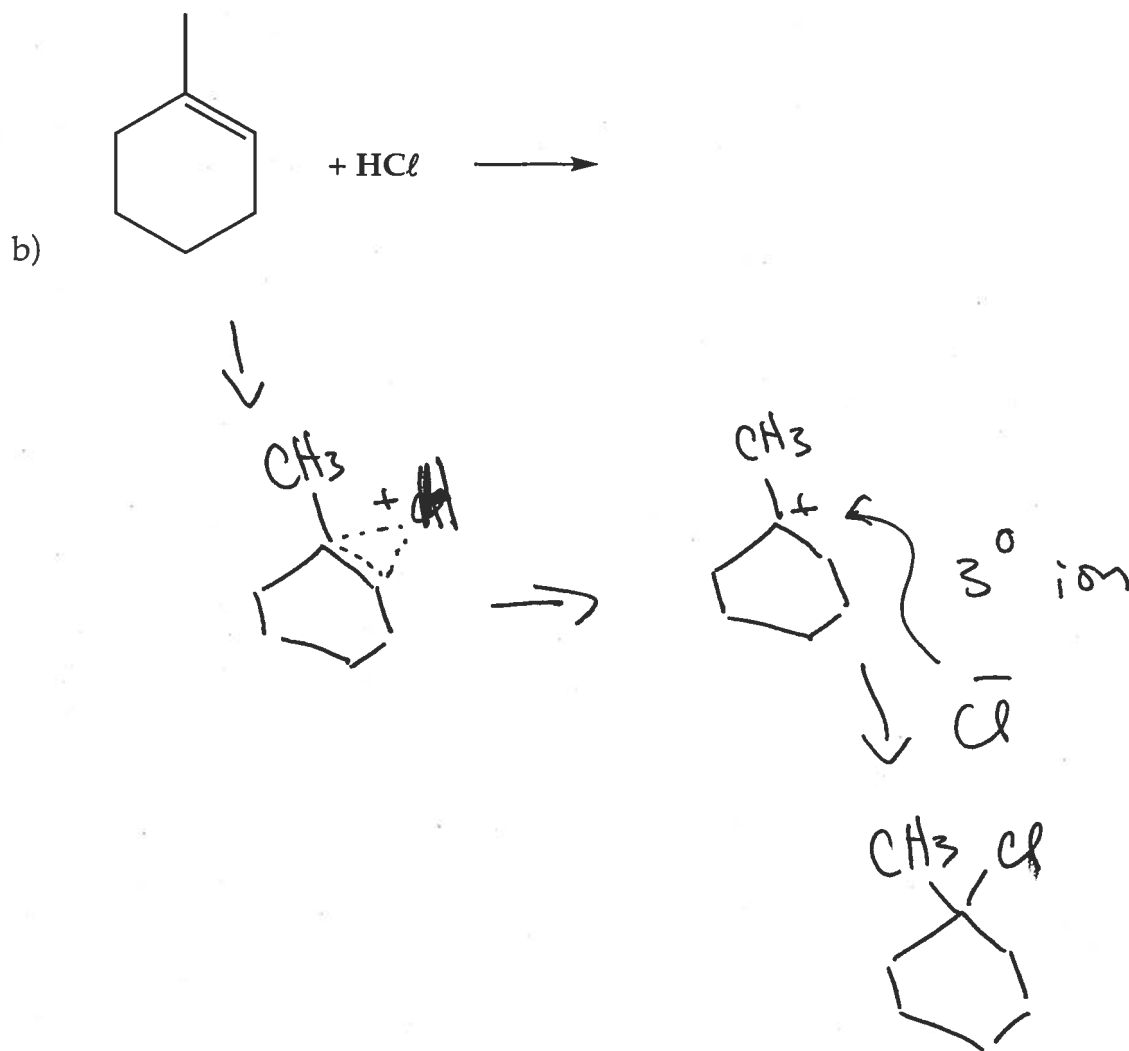
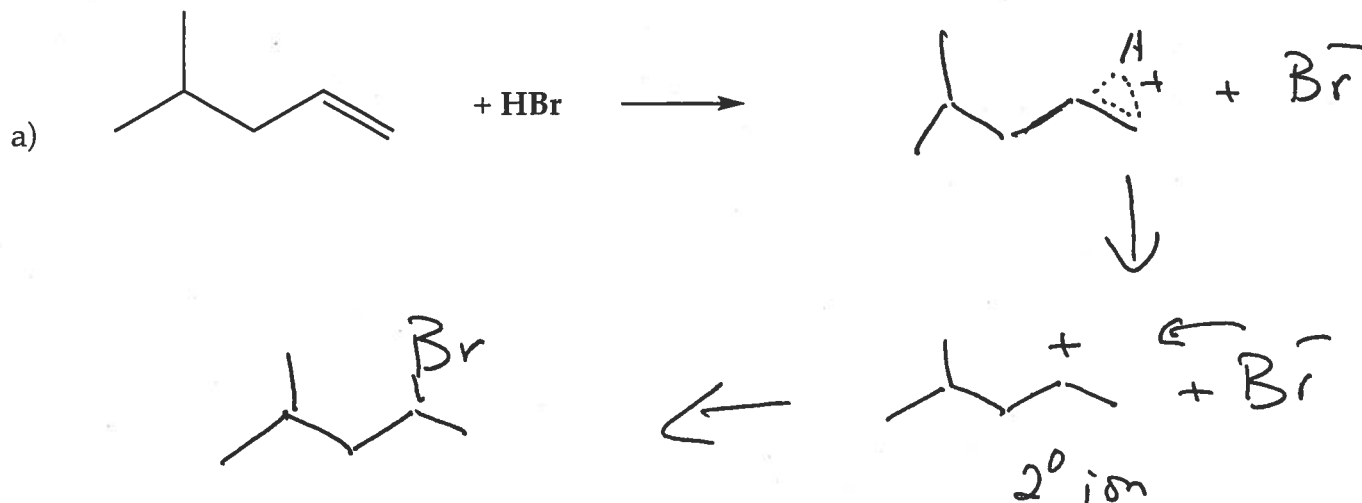


The anion is stabilized by $-\text{COOH}$ in ring.

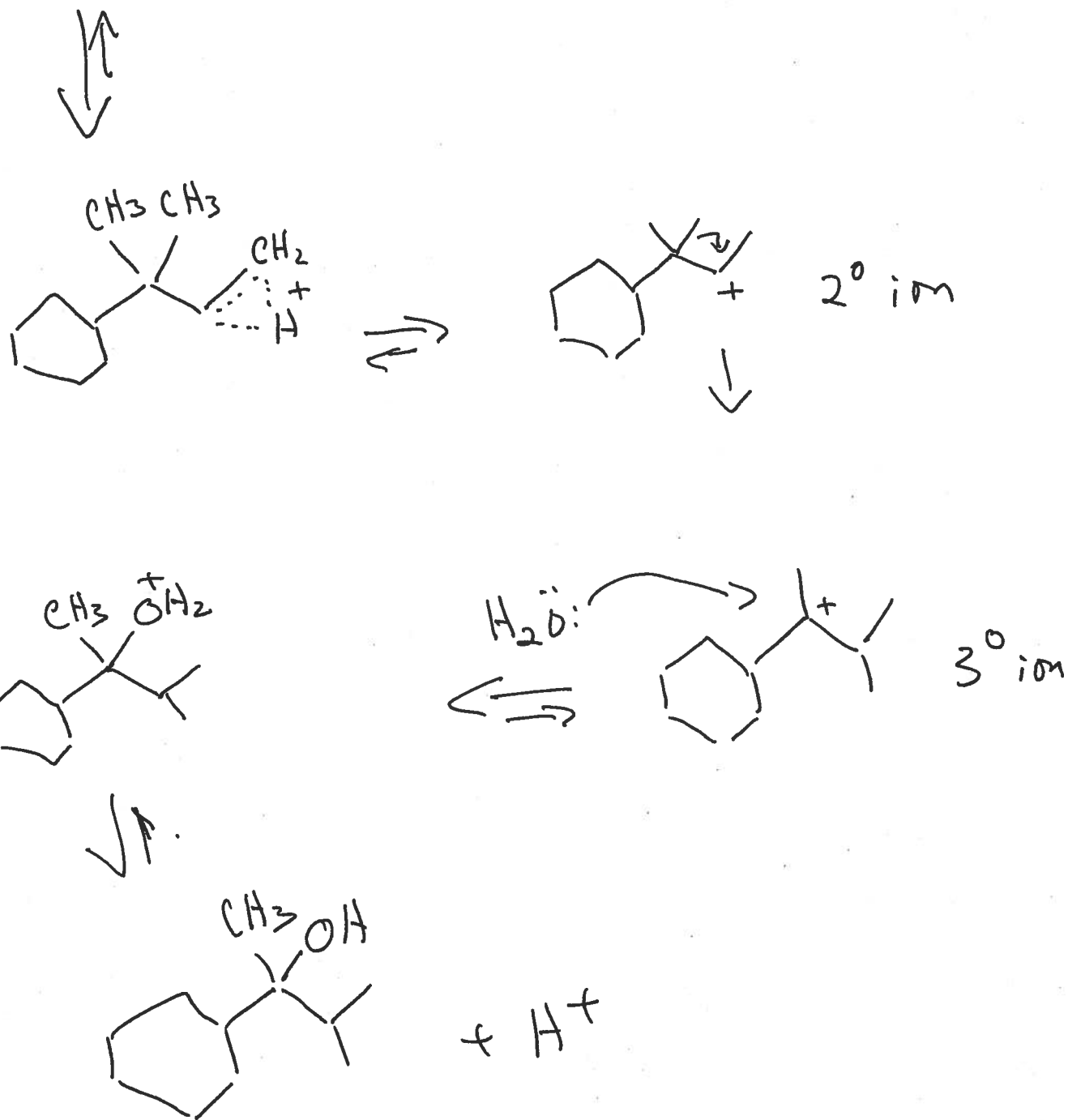
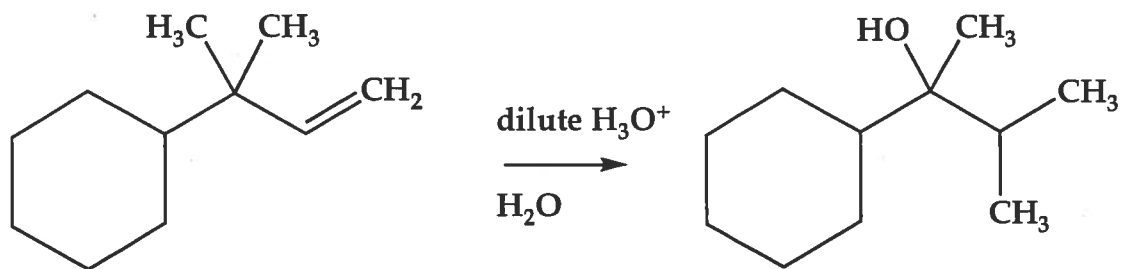
Consequently energy to remove 1st proton is lower than benzoic acid alone.

But 2nd proton is harder to remove because you get a doubly charged ion. $\text{C}_6\text{H}_4(\text{COO}^-)_2$ charges repel each other & destabilize anion

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



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.

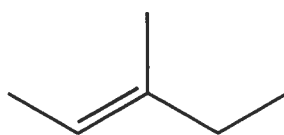
less stable, higher in energy

more stable, lower in energy

A ~~B~~ D C B E



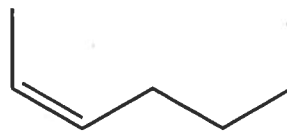
~~1-hexene~~ A
1-hexene



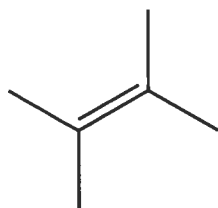
B
3-methyl-2-~~butene~~ pentene



C
trans-2-hexene
or E-2-hexene



D
cis-2-hexene
or Z-2-hexene



E
2,3-dimethyl-2-butene