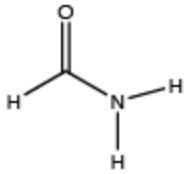
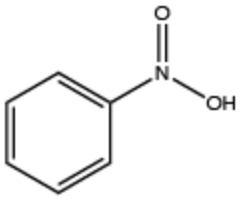
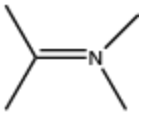
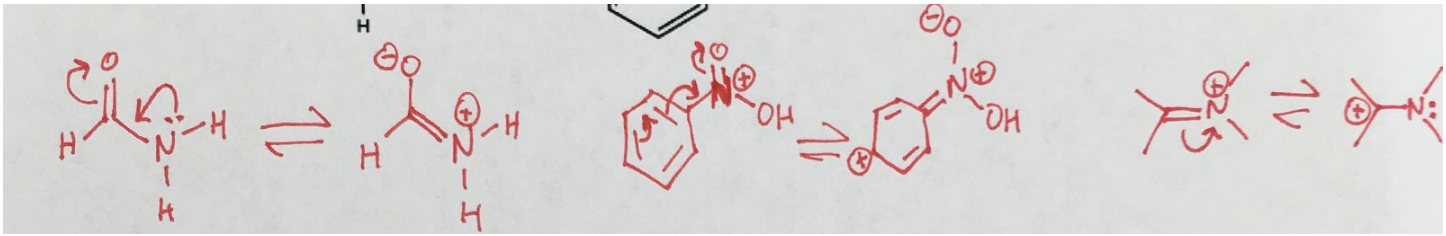
Name:_____ S17BioE11 Orgo Midterm February 16, 2017

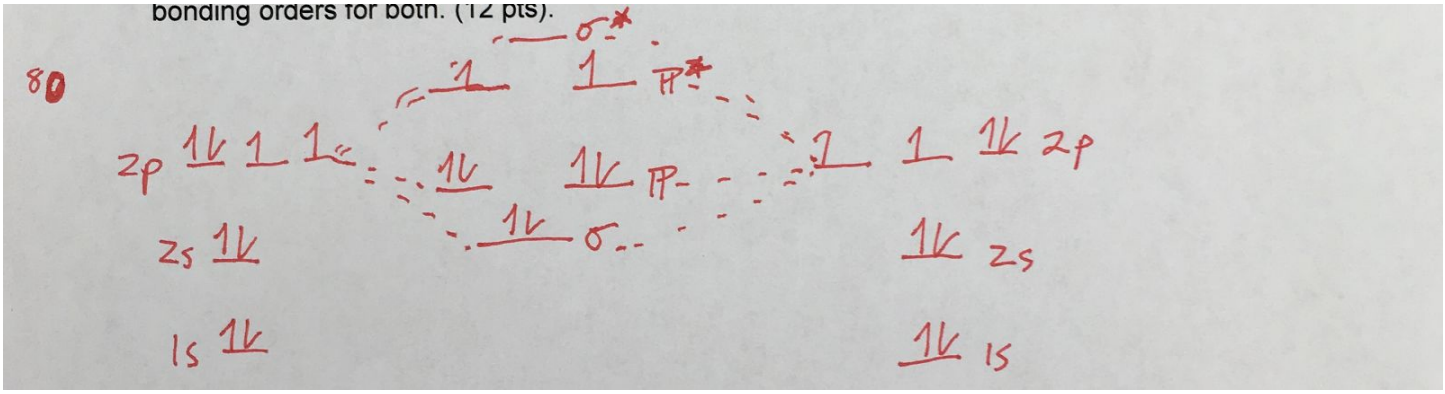
Warning: formal charges not always indicated/drawn, but you should in your answers!

1. Draw resonance forms for the following structures. (9 pts).



2. Which is more stable, O_2 or O_2^+? Explain your rationales using molecular orbitals and calculations of the bonding orders for both. (12 pts).



O_2^+ is more stable because O_2 has 2 pi antibonding electrons and O_2^+ only has 1. Bonding orders are 2 for O_2 and 2.5 for O_2^+.

3. Identify if the below molecules are nucleophilic or electrophilic and where the electrons would originate or attack. (5 pts).

H_2S

CH_2O

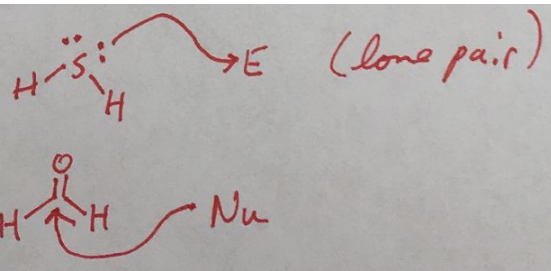
H_2S nucleophilic (lone pair)

CH_2O electrophilic (carbonyl carbon)

or attack. (5 pts).

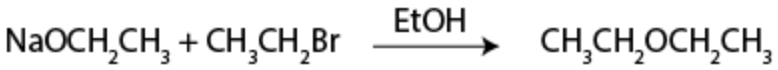
H_2S

CH_2O



H_2S nucleophilic (lone pair)
CH_2O electrophilic (carbonyl carbon)

4. For the following SN2 reaction: (6 pts).



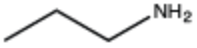
a) Replace bromoethane with bromomethane. Will the reaction happen slower, faster, or at the same rate?

Reaction is faster, less sterically hindered.

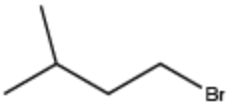
b) Replace EtBr with $EtNH_3$? Will the reaction happen slower, faster, or at the same rate?

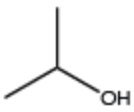
Reaction is faster, NH3 is a better leaving group.

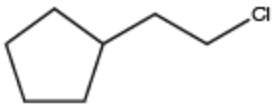
5. Which of the following compounds would be expected to react in an SN2 manner at a reasonable rate with sodium azide (NaN_3) under basic conditions in an aprotic solvent? For those that do not react at a reasonable rate, explain why not. (12 pts).

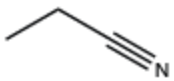
a) 

b) 

c) 

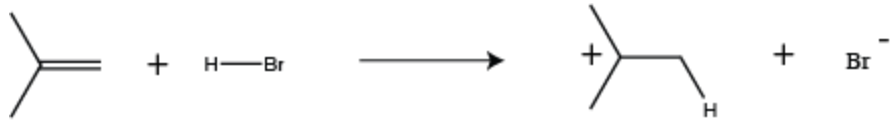
d) 

e) 

f) 

a) NH2 not a good LG, b) tertiary carbon, c) YES, d) OH not a good LG, e) YES, f) not a good LG.

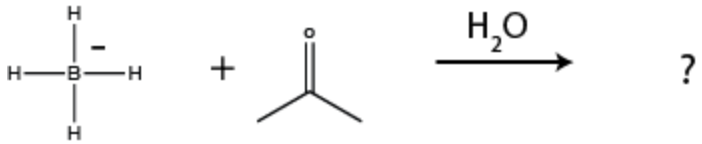
6. For the following reaction, identify the HOMO and LUMO: (8 pts).

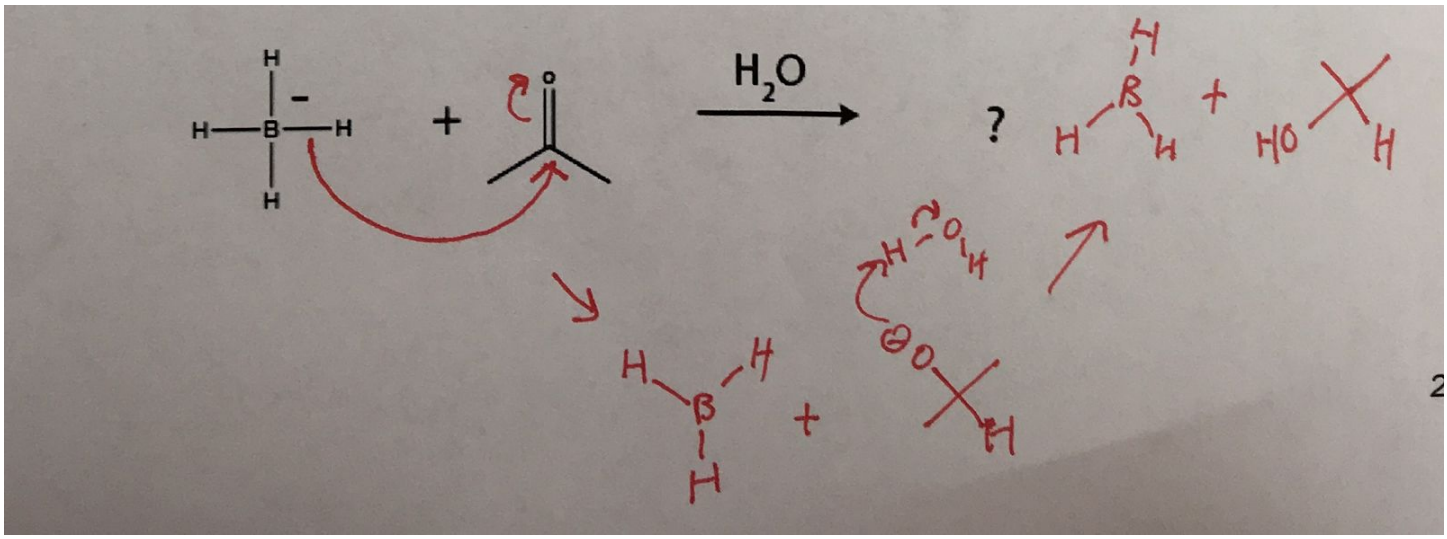


HOMO: pi bond

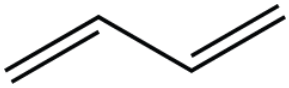
LUMO: H-Br anti-sigma bond

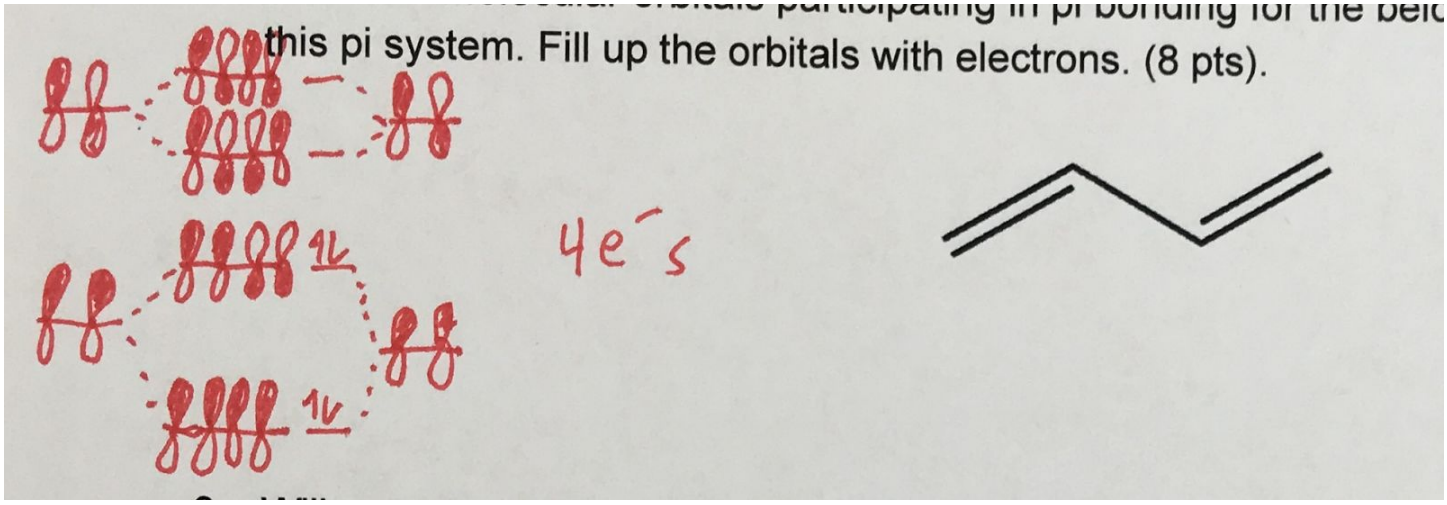
7. Draw a mechanism with an arrow-pushing mechanism for the following reaction: (5 pts).



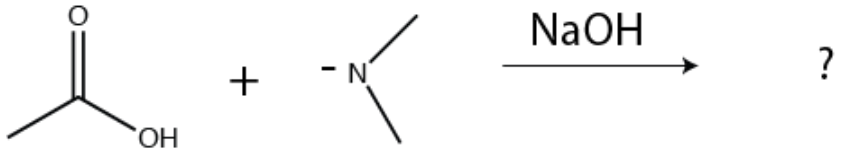


8. Draw the molecular orbitals participating in pi bonding for the below allyl. How many electrons are in this pi system. Fill up the orbitals with electrons. (8 pts).



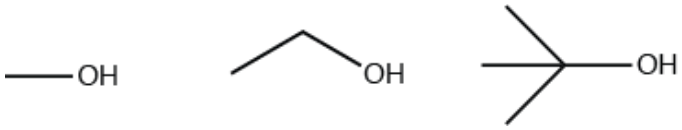


9. Will a product be formed? If yes, what product? If no, explain why not. (8 pts).



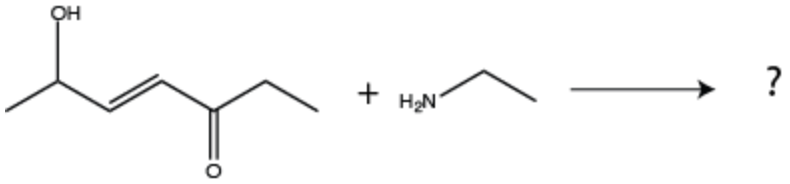
No product, carboxylate has negative charge distributed to make carbonyl carbon a poor electrophile.

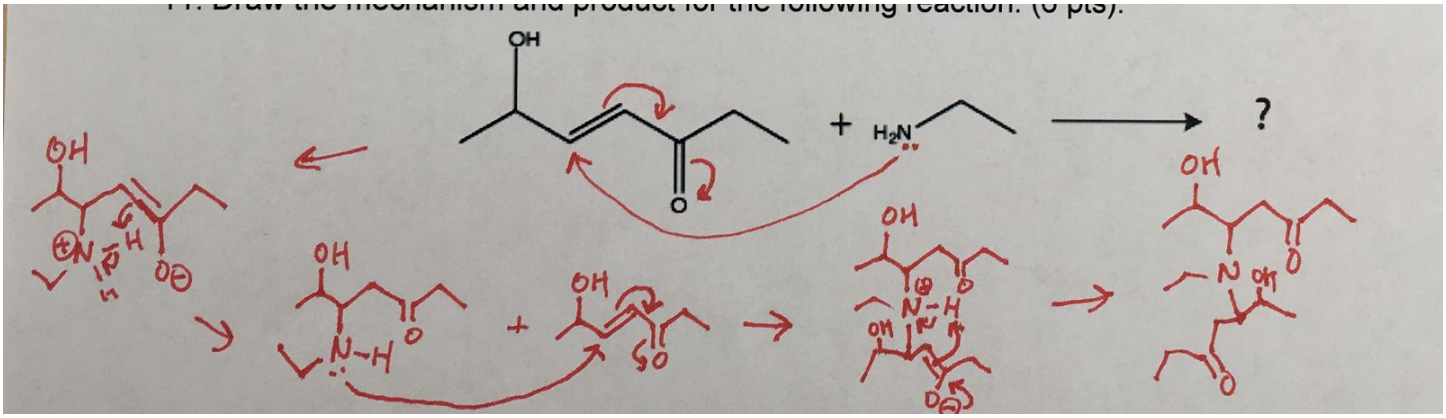
10. Which molecule is the best acid of those listed below? (6 pts).



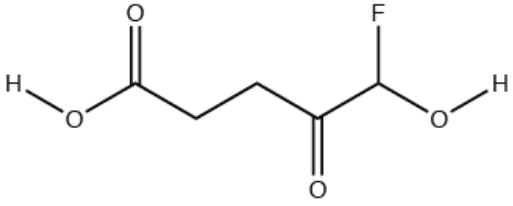
Primary carbon makes methanol more acidic (fewer electron donating carbons).

11. Draw the mechanism and product for the following reaction: (6 pts).



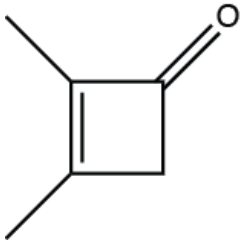


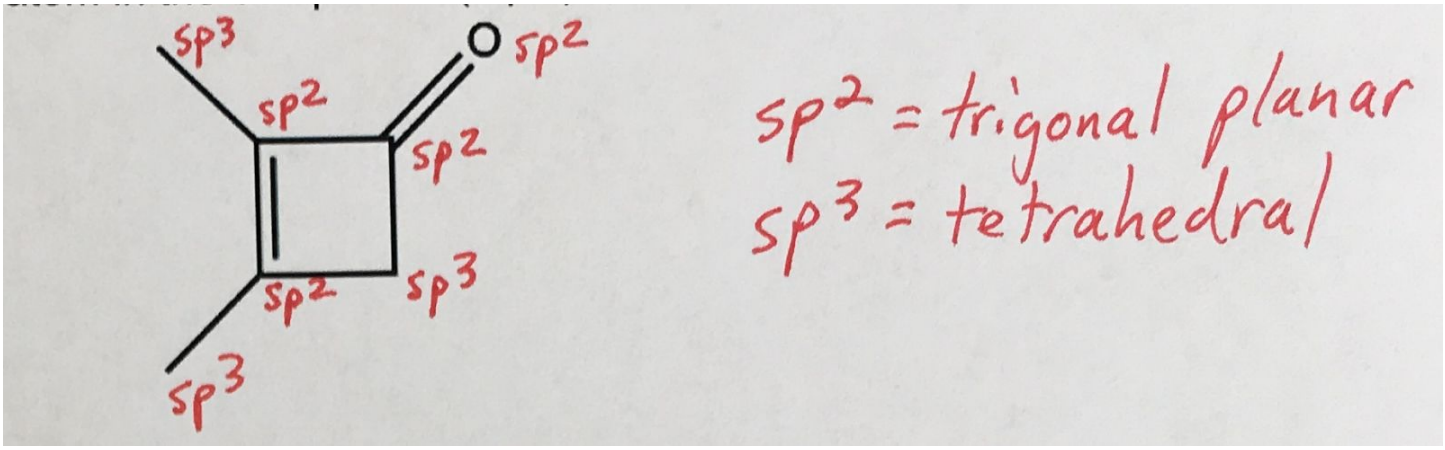
12. Compare the two protons identified below. Which proton is more acidic and explain why? (5 pts).



The Carboxyl proton is more acidic due to resonance

13. Identify the geometry for every atom in the compound. (5 pts).

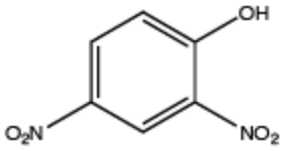




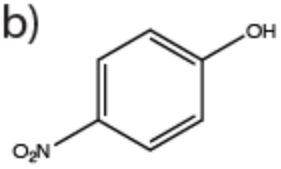
Sp2 = trigonal planar
Sp3 = tetrahedral

14. These phenols have approximate pK_a values of 4, 7,10, and 11. Suggest with explanations which pK_a value belongs to which phenol. (5 pts).

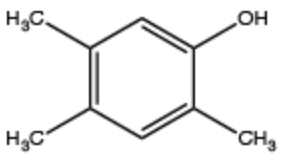
a)



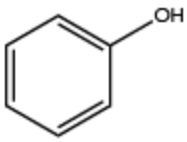
b)



c)



d)



a)
b)
c)

d)

a) 4
b) 7
c) 11
d) 10