

Practice Exam 1 Spring 2014

Name Key Room _____

Student ID _____ Seat Number _____

The exam consists of 10 questions on a total of 10 pages, including periodic table.

1. _____/10

2. _____/10

3. _____/10

4. _____/10

~~5. _____/10~~

6. _____/10

7. _____/10

8. _____/10

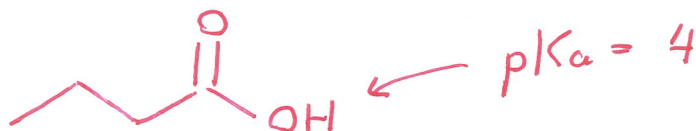
9. _____/10

10. _____/10

Regrading: All requests for regrades must be submitted in writing within 48 hours of the return of the exam. You must explicitly state what has been misgraded and why it is an error. The entire exam will be regraded, which could result in points being added or deducted overall.

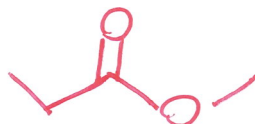
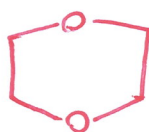
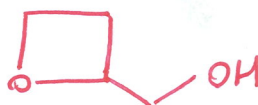
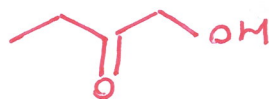
1. (10 points)

a) (5 points) Please draw a constitutional isomer of $C_4H_8O_2$ that has a pK_a of about 4.



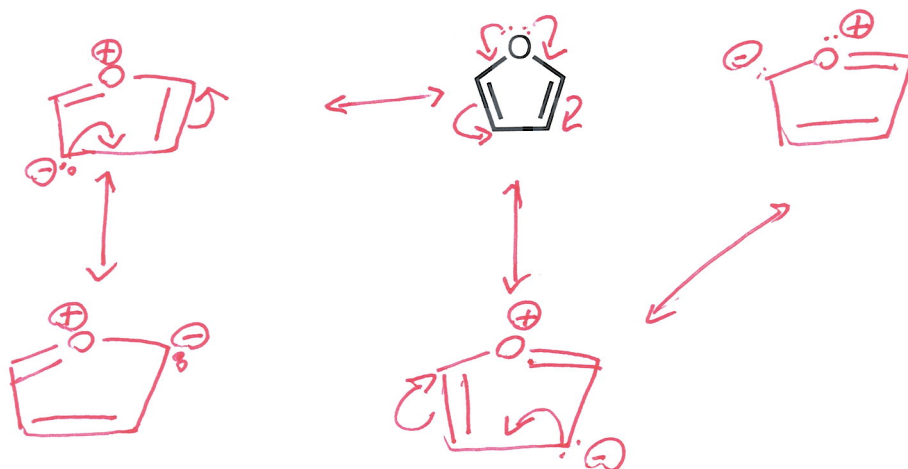
b) (5 points) Please draw a different constitutional isomer of $C_4H_8O_2$ that is less acidic than the structure provided above.

- several of many possibilities

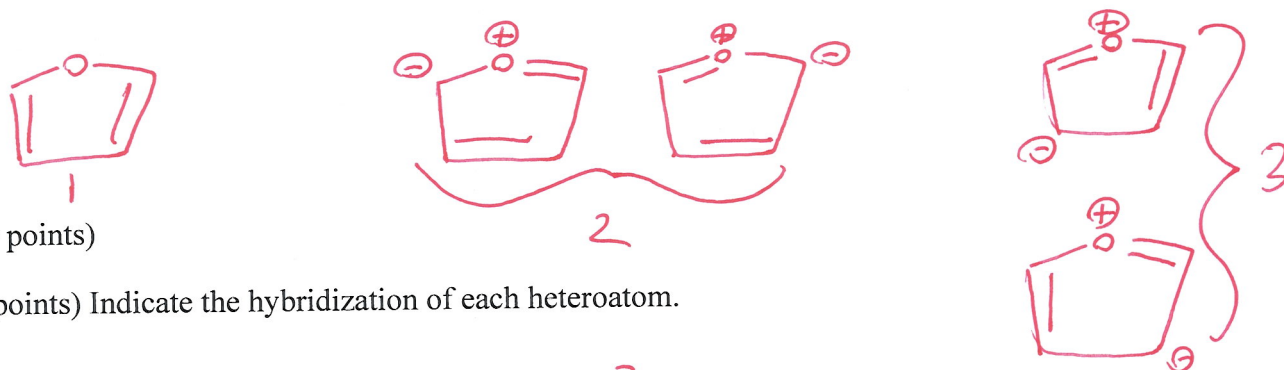


2. (10 points)

a) (6 points) Draw all **significant** resonance structures for the molecule illustrated below.

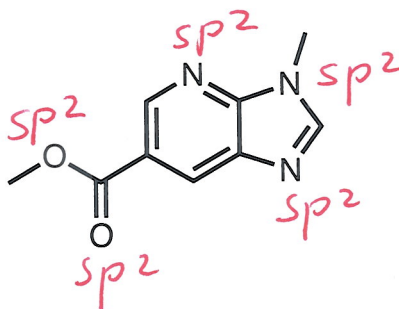


b) (4 points) Rank the relative importance of each resonance structure to the resonance hybrid.

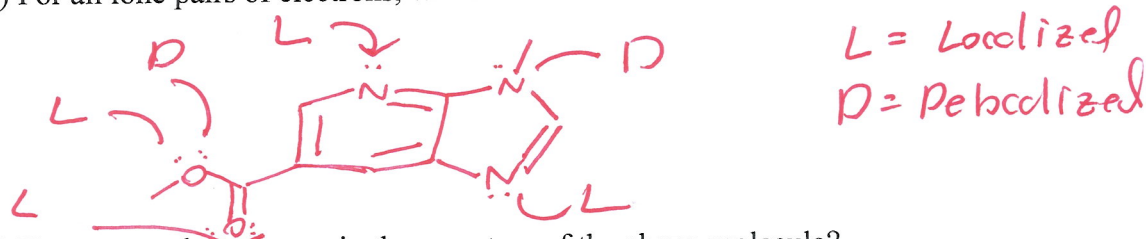


3. (10 points)

a) (4 points) Indicate the hybridization of each heteroatom.



b) (3 points) For all lone pairs of electrons, which are localized and which are delocalized?

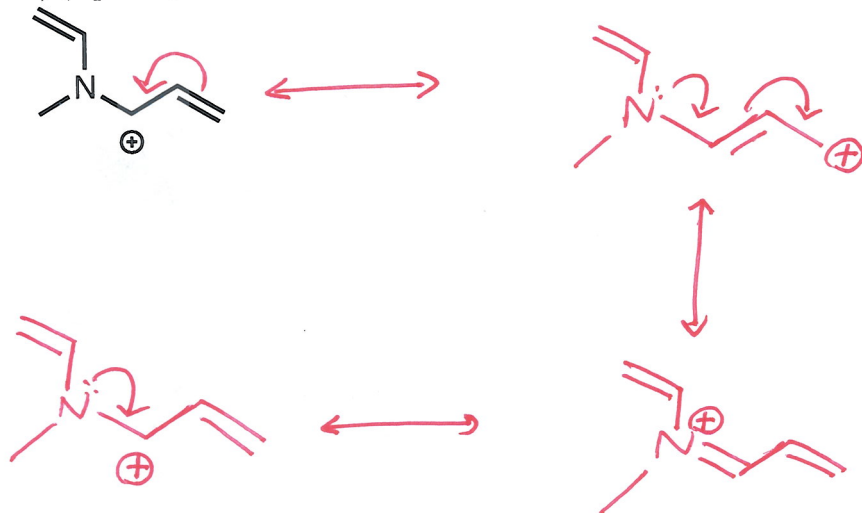


c) (3 points) How many electrons are in the π -system of the above molecule?

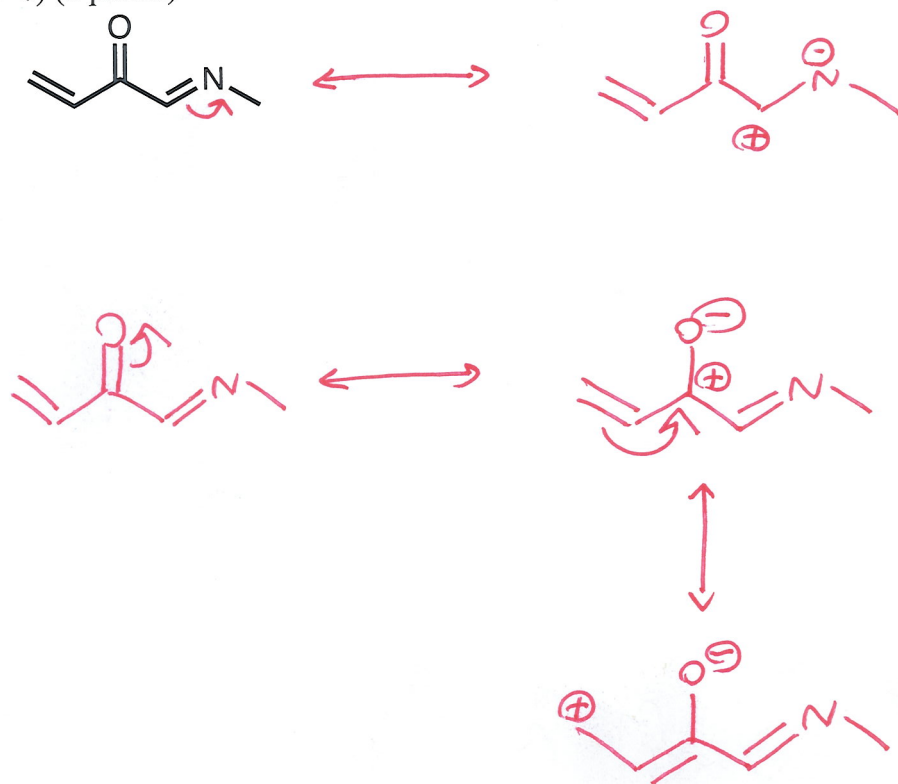
14e⁻

4. (10 points) Draw all **significant** resonance structures for the compounds illustrated below. Circle the most significant contributor in each case.

a) (5 points)

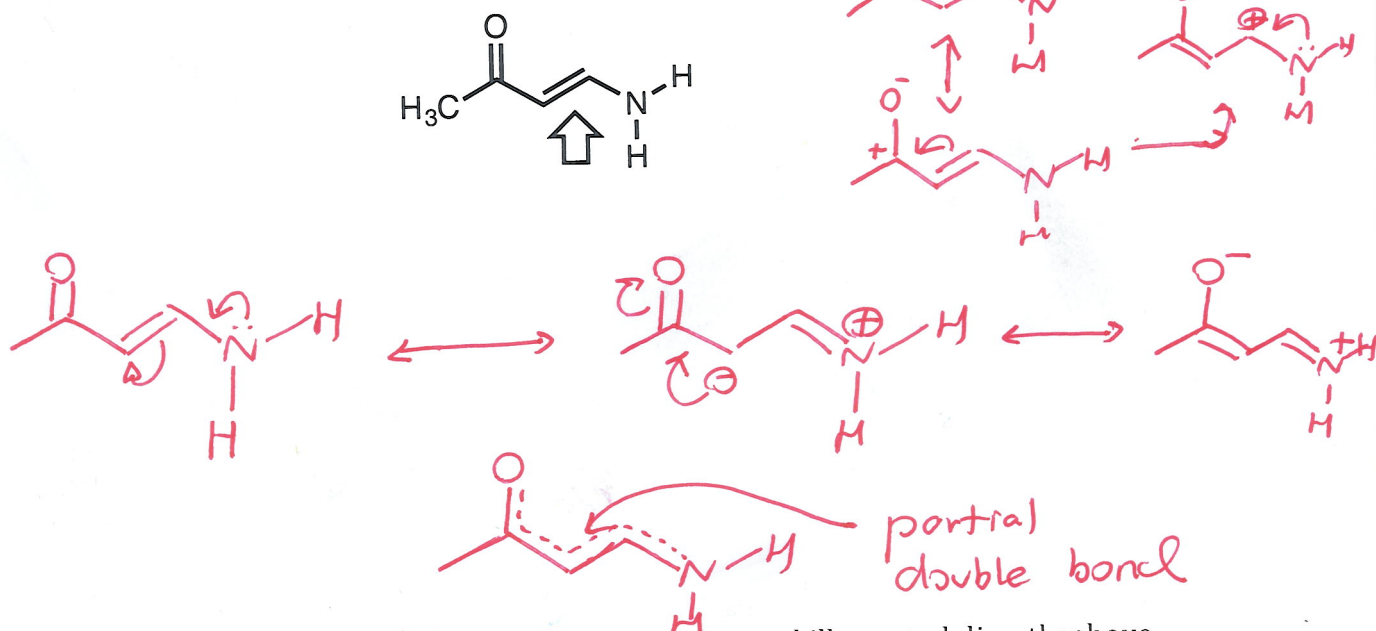


b) (5 points)

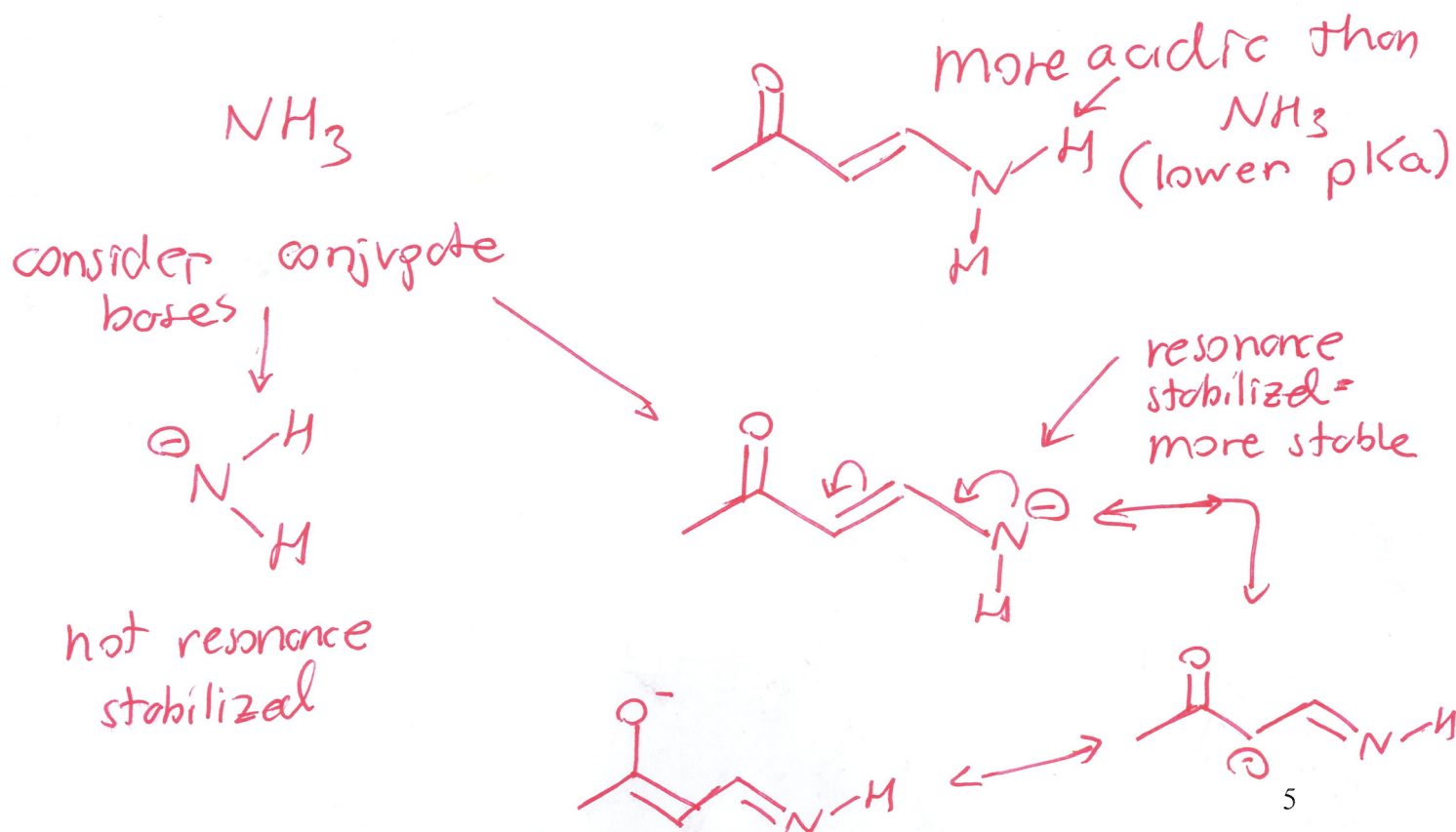


6. (10 points)

(5 points) Typically carbon-carbon double bonds have high energies to bond rotation. However, for the structure illustrated below, the barrier to rotation of the indicated carbon-carbon double is significantly reduced. Why? Please rationalize your answer with appropriately drawn figures. (10 points)

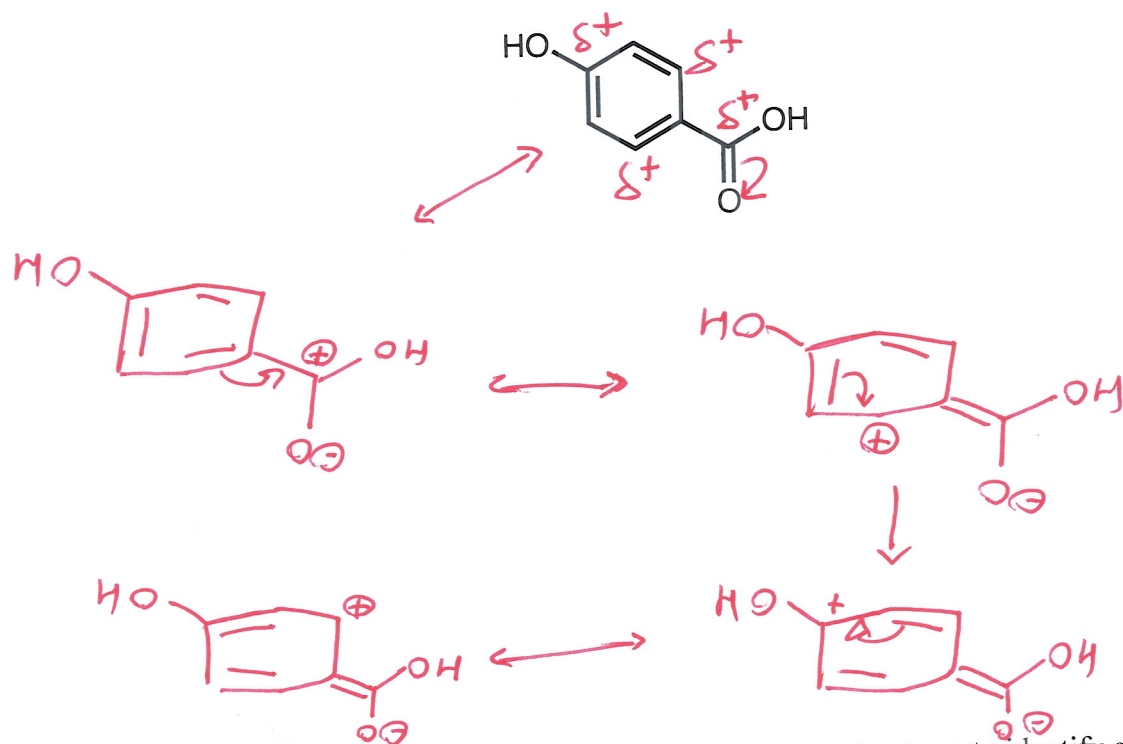


b) (5 points) Would you expect the N-H bonds of the compound illustrated directly above to have a higher or lower pKa than ammonia (NH₃). Explain why?

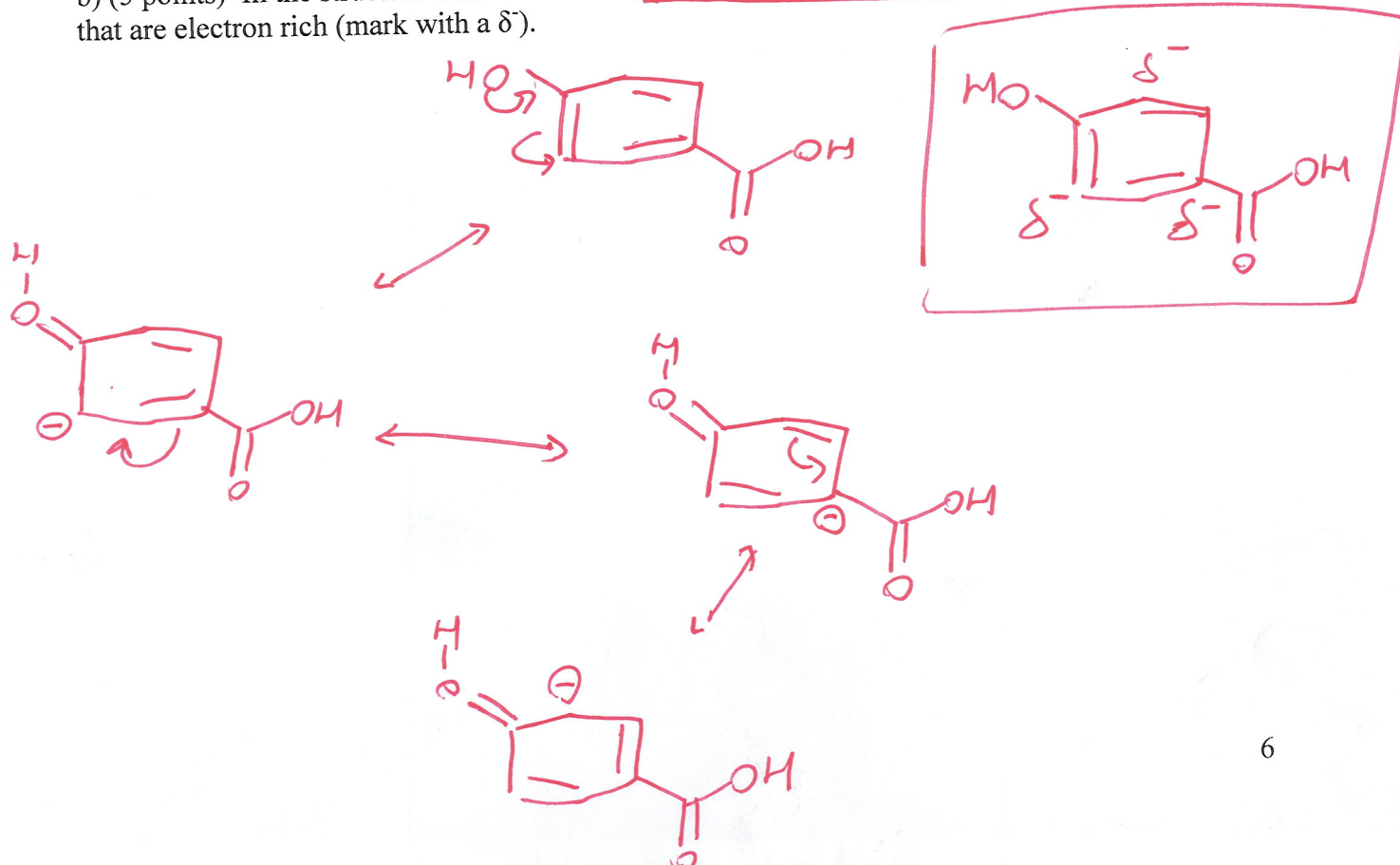


7. (10 points)

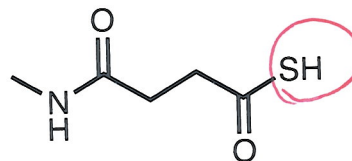
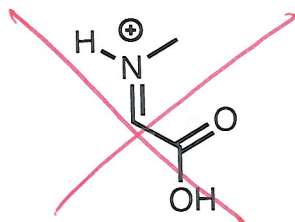
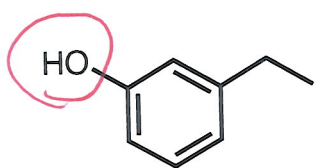
a) (5 points) In the structure illustrated below, use resonance structures to identify all carbons that are electron deficient (mark with a δ^+).



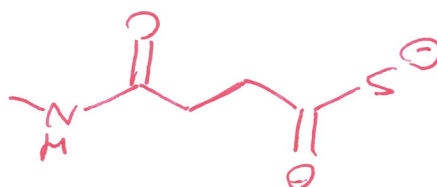
b) (5 points) In the structure illustrated above, use resonance structures to identify all carbons that are electron rich (mark with a δ^-).



8. (10 points) Indicate the most acidic proton on each compound.



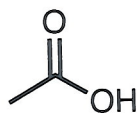
most stable
conjugate base



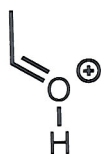
most stable
conjugate base

9. (10 points)

a) (4 points) Please rank the following compounds in order of their acidity, with 1 being the most acidic and 4 being the least acidic.



2



1



3



4

b) (6 points) Provide approximate pKa values for the molecules illustrated directly above



pKa =

4



-2



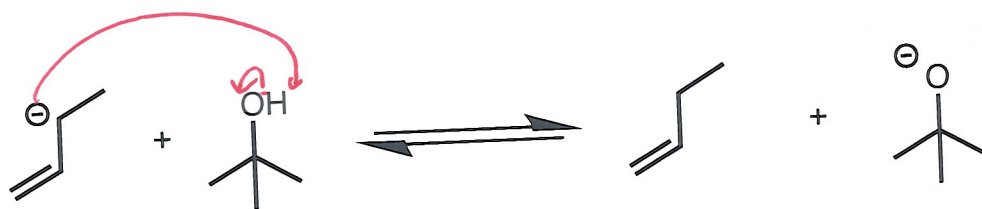
16



38

10. (10 points)

a) (4 points) Please draw a mechanism for the following reaction (you only have consider left to right).



$pK_a = 18$

$pK_a = 43$

b) (3 points) What direction would you expect the equilibrium to lie and by how much?

equilibrium lies to right

$$K_{eq} = 10^{25}$$

c) (3 points) If an amine was added to above reaction, what would happen?

nothing

$\text{CH}_3\text{CH}_2\text{NH}_2$ $pK_a = 38$

products would still lie to the right and remain unchanged