Exam 1 Spring 2014

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 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) (4 points) For the compound illustrated below indicate the most acidic hydrogen and indicate its pKa.



b) (2 points) Identify all of the functional groups found in the molecule illustrated below.



c) (4 points) For the compound illustrated above, draw a constitutional isomer that is ***more*** acidic. Please indicate the identity of all functional groups.

2. (10 points) For the molecule illustrated below, please answer the following questions:



a) (4 points) How many carbon atoms are present? How many hydrogen atoms are present?

Carbons: Hydrogens:

b) (3 points) Indicate on the above structure the hybridization of each heteroatom.

c) (3 points) Indicate on the above structure whether each lone pair is delocalized or localized.

3. (10 points)

(3 points) Indicate the hybridization of each atom.



(7 points) Draw an orbital overlap picture for the molecule illustrated directly above.

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)



5. (6 points) Indicate the most acidic proton on each compound illustrated below.



b) (4 points) In which direction does the equilibrium lie? What is Keq for the following process?



6. (10 points)

a) (4 points) For the acid/base reaction illustrated below, predict the products. Show the mechanism with clearly drawn arrows (only consider left to right).



b) (4 points) In what direction does the equilibrium lie? Briefly support your answer using base stability principles.

c) (2 points) If the above reaction is carried out in H2O as solvent, what would you expect the products to be?

7. (10 points)

a) (5 points) For the structure illustrated below, use resonance structures to identify all carbons that are electron deficient. Mark the appropriate carbons in the figure below with a δ+.



b) (5 points) For the structure illustrated below, use resonance structures to identify all carbons that are electron rich. Mark the appropriate carbons in the figure below with a δ-.



8. (10 points)

a) (5 points) Draw the conjugate base of the following two molecules illustrated below.



b) (5 points) Which of the two molecules is more acidic? Briefly support your answer with appropriate figures and/or text.

9. (10 points)

a) (6 points) Hydroxide is not a suitable base for deprotonating an alkyne, why? Use pKa values to support your answer.



b) (4 points) Propose a base that would be suitable to deprotonate the alkyne.

10. (10 points)

a) (5 points) Please rank the following compounds in order of their acidity, with 1 being the most acidic and 4 being the least acidic.



b) (5 points) The barrier to rotation of the indicated bond of an amide is significantly higher than a typical C-N bond, why?





Scratch work: