CHE 230 001
Organic Chemistry 1
Exam 1
September 23, 2013

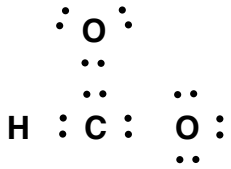
Name: KEY

Student number:

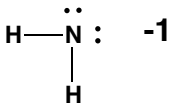
Before you begin this exam: **First**: You are allowed to have a simple model set at your seat. Please put away all other materials. Calculators will not be needed. **Second:** Place your student identification on your desk. A proctor will come around to check everyone's ID. **Third**: Read through the entire exam. Your goal, as always, is to score as many points as possible. Do not waste time on problems that you can't do if there are others that look easy. **Fourth**: READ EACH QUESTION CAREFULLY. Be sure you answer the question that is asked. **Fifth:** This exam must be turned in by 8:50 AM SHARP. There will be no extensions, so budget your time carefully.

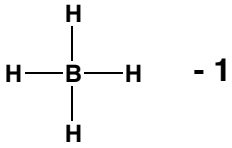
1.	9 points	_____
2.	8 points	_____
3.	16 points	_____
4.	12 points	_____
5.	12 points	_____
6.	9 points	_____
7.	8 points	_____
8.	9 points	_____
9.	9 points	_____
10.	4 points	_____
11.	4 points	_____
	100 points	_____

1. (9 points) Draw a valid Lewis dot structure for the formate anion. The arrangement of atoms is given below. *Use dots to represent electrons. Do not use lines to represent bonds or lone pairs.*

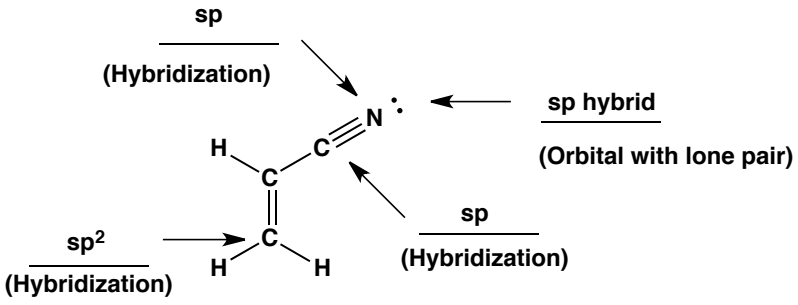


2. (8 points) Assign the formal charge to the N and to the B in the species below. ***Assume that both N and B have complete octets. Lone pairs are not shown here, so you may want to add them, if any.***





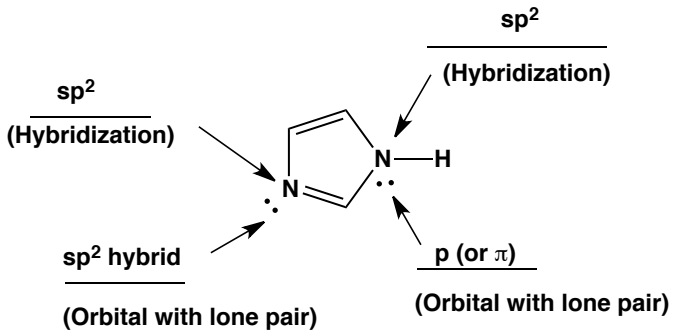
3. (16 points) a) Acrylonitrile (below) is the precursor to acrylic fiber and carbon fiber. Provide the hybridization at the indicated atoms and indicate the type of orbital (i.e. s, p, sp hybrid, sp^2 hybrid, or sp^3 hybrid) that contains the lone pair on nitrogen.



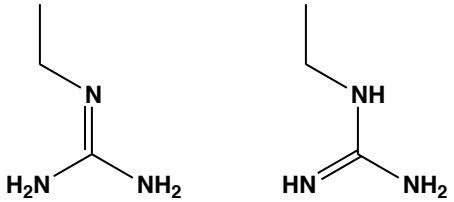
Acrylonitrile

3. (Continued)

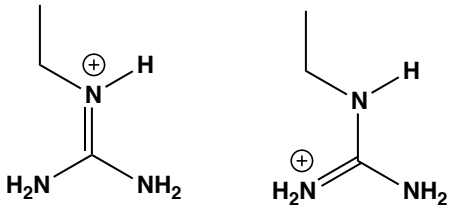
b) In the compound *imidazole* (below), provide the hybridization at the indicated atoms and provide the specific orbital (i.e. s, p, sp hybrid, sp^2 hybrid, or sp^3 hybrid) that holds the indicated lone pairs.



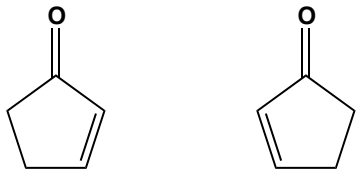
4. (12 points) For each of the pairs of compounds below, indicate (on the adjacent blank) if the pair are different structures (*structural isomers)*, resonance forms, identical, or none of the above.



ISOMERS

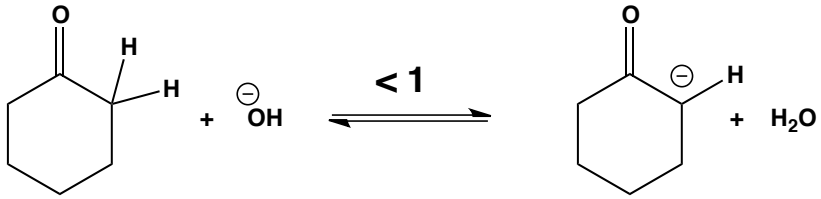


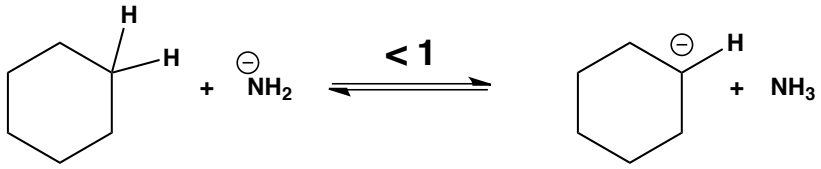
RESONANCE FORMS

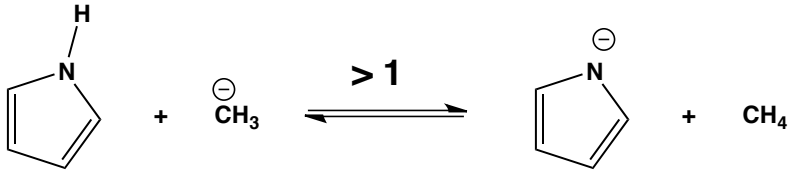


IDENTICAL

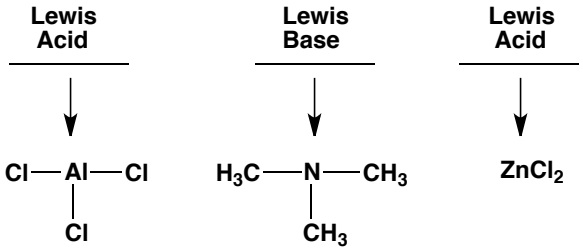
5. (12 points) Determine if Keq is *greater than 1 (>1) or less than one (<1)* for each acid-base equilibrium below. Write either >1 or <1 over the arrow, as appropriate.



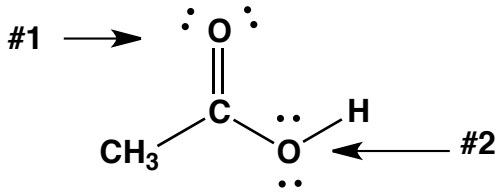




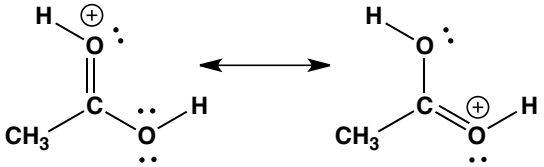
6. (9 points) Classify the indicated atoms in each of the following as either a Lewis acid **or** as a Lewis base (write 'acid' or 'base' on the line provided). Note: Lone pairs, if any, are not shown.



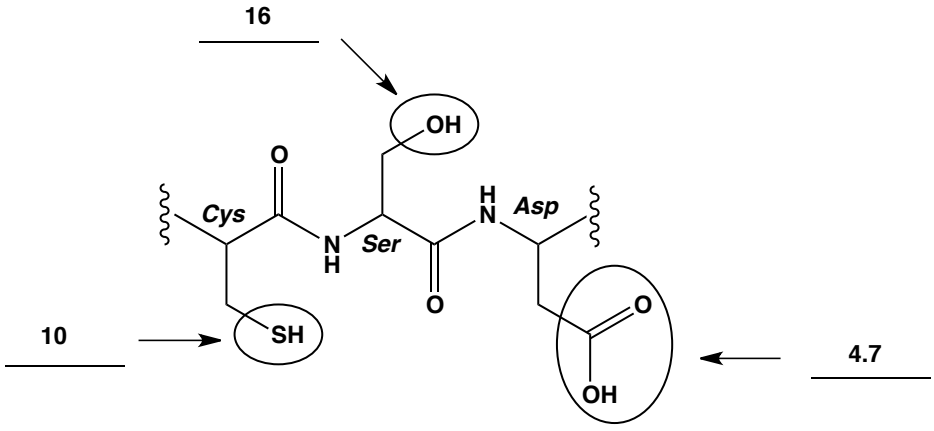
7. (8 points) Carboxylic acids are acids (of course…) but they are also bases. In the presence of very strong acids, carboxylic acids can be protonated on oxygen, but on <u>which</u> oxygen? Predict which oxygen in acetic acid (#1 or #2) is the most likely to be protonated, and explain why. A drawing (or two) and a sentence (or two) is all that is needed. **Do not exceed the space provided.**



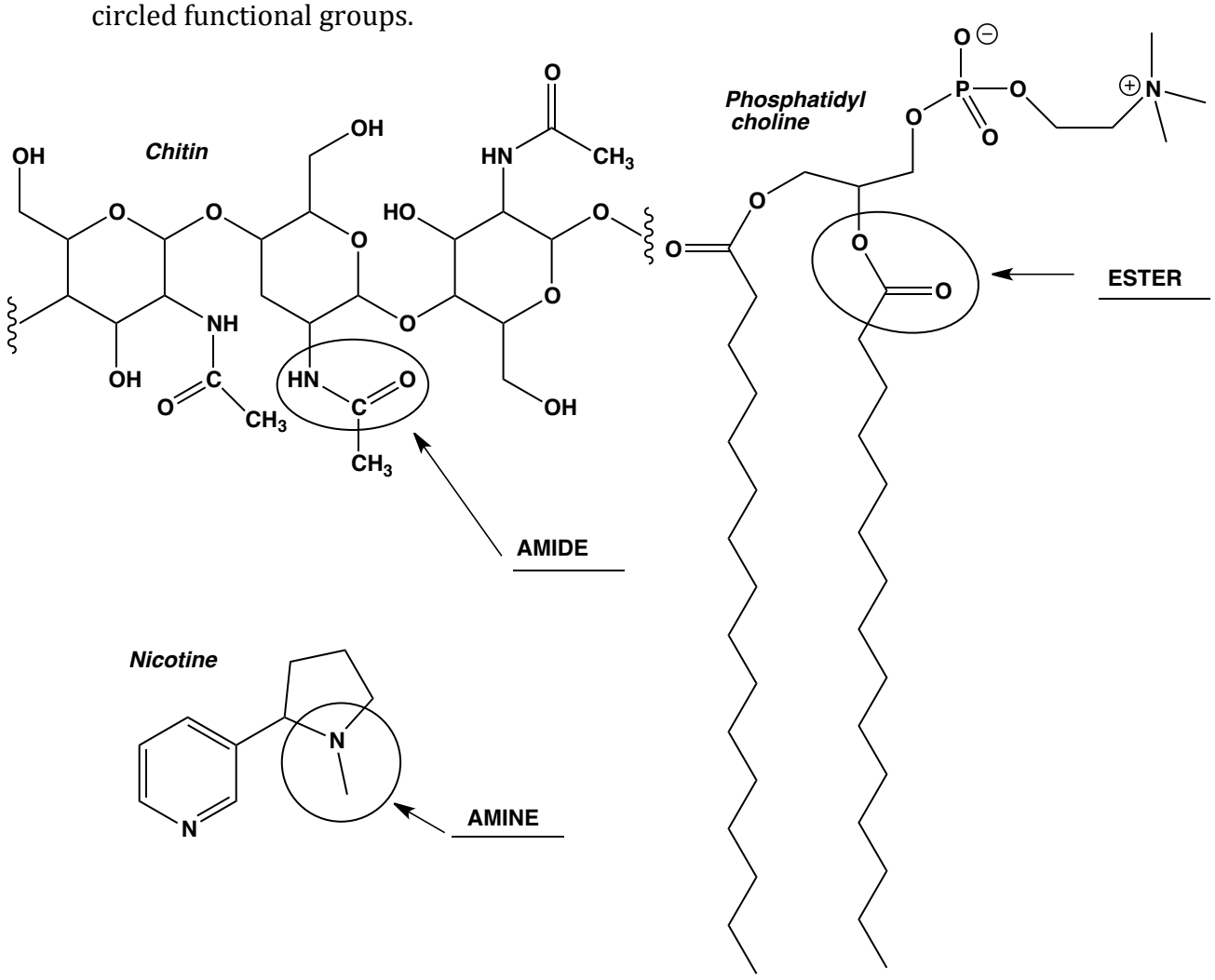
Protonation on #1 produces a cation that is resonance stabilized, while protonation on #2 does not.



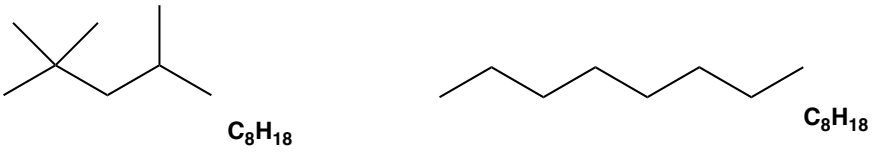
8. (9 points) Below is a drawing of a short segment of a hypothetical protein, showing three amino acid residues (cysteine, serine, and aspartic acid). Give the pK_a expected for the circled functional groups. Estimate to within ± 2pKa units.



9. (9 points) Below are the structures of *chitin,* a polymer that makes up insect shells, a *phospholipid*, a component of bilayer cell membranes, and *nicotine*. Name the circled functional groups.



10. (4 points) Which of the following is likely to have the ***highest*** boiling point? (circle one).



THIS ONE

11. (4 points) Carbonyl groups are quite polar. In the drawing below, indicate the correct partial charge (positive or negative) on the carbon and oxygen.