

Chemistry 116 Sec. A (8:00-8:50)
Exam No. 1
“Structure and Functionality”
September 24, 2004

Instructions: You will have 60 min. to complete the exam. At the 60 min. mark, I will request that all remaining test takers cease writing, turn their exams over, and pass them to their rightmost isle. If you finish early, you may turn in the exam at the front of the room prior to leaving. *In fairness to all, anyone still working on the exam after “time” is called will receive a grade of zero!*

Be sure to read the instructions for each question. It may be helpful to skim the entire exam and solve the easier questions first.

Exam Agreement: I, _____, have read and agree
(Please print)

to abide by the instructions above. On my honor, I have neither given nor accepted any help during this exam.

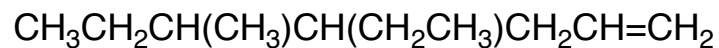
Signature: _____

College: _____

**DO NOT OPEN THIS EXAM UNTIL
INSTRUCTED TO DO SO**

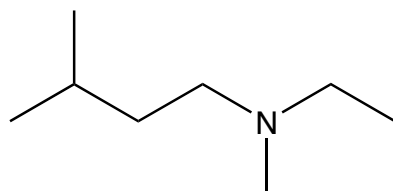
- 1) Translate the following structures to the representation requested and provide a name if indicated.
(14 points)

Bond - Line (skeletal) Formula

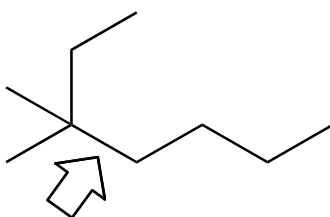


Name the above molecule: _____

Condensed Structural Formula

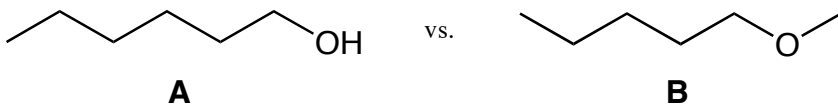


- 2) Draw Newman projections of the 3 most stable conformations of the following compound viewed down the indicated bond. Circle the most favorable conformation. For full credit, briefly describe or illustrate why your choice is the most favorable. (10 points)

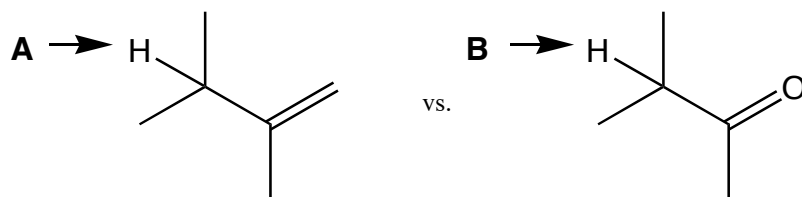


3) For each pair of molecules shown below, select the one that best fits the accompanying description by circling it. Provide a concise but thorough rationale for each of your decisions using words and/or pictures. *Note: a picture is required to receive full credit on most of these. Do not exceed the space provided.* (18 points)

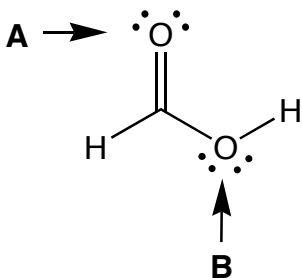
a) The higher boiling point?



b) The more acidic proton?



c) The more basic atom?

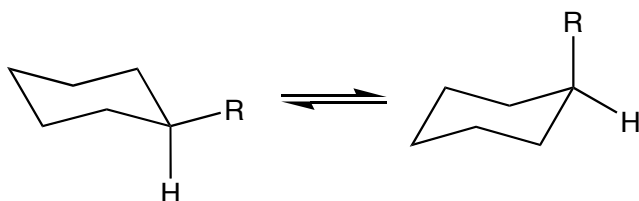


- 4) *N*-methylformamide has a condensed structural formula of CH_3NHCHO . Draw the uncharged Lewis structure of this molecule in the space indicated in the box below. In the remaining space, draw the two most valid resonance structures for *N*-methylformamide and answer the questions that follow. *Note: for full credit, be sure to show all lone pairs of electrons and charges where appropriate.* (15 points)

uncharged Lewis structure

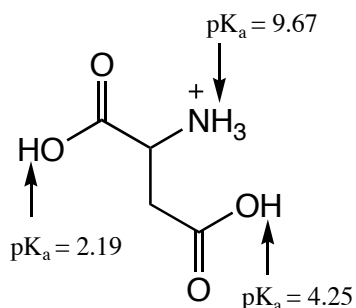
- a) Redraw the uncharged Lewis structure below and circle the atoms that would react with a Lewis base. Place a square around the atoms that would react with a Lewis acid. *Note: your circles and squares must be distinguishable for full or partial credit.* (6 points)
- b) Researchers have found that one of the CN bonds in *N*-methylformamide *does not* exhibit free rotation. Draw the orbital picture for *N*-methylformamide that explains this phenomenon and point out the orbital types, bond types, and bond angles in your picture. You will be graded on both the accuracy of your drawing and on whether or not it explains the experimental data indicated. (12 points)
- c) Would you expect *N*-methylformamide to be soluble in water? Yes or No (circle one, 2 points)

- 5) The following trends have been observed for the amount of energy it takes to place a substituent in the axial position. As you can see in the table, going from H to CH₃ causes a drastic increase in free energy (1.74 kcal/mol). However, increasing the size of the 'R' group results in only a minor change in ΔG even when the 'R' group is isopropyl (this only increases ΔG by 0.41 kcal/mol). *Using perspective (dash-wedge) drawings, illustrate and explain why the increase in ΔG is only gradual up to isopropyl, but increases drastically when the 'R' group is *t*-butyl.* (12 points)



R	ΔG (kcal/mol)
H	0
CH ₃	1.74
CH ₂ CH ₃	1.75
CH(CH ₃) ₂	2.15
C(CH ₃) ₃	5.00

- 6) Glutamic acid is one of the common amino acids found in nature. Draw the predominant structure of glutamic acid when placed in a solution of $pH = 3.2$. Also, indicate its overall charge. (11 points)



overall charge =

Grading Summary

Page	Point Value	Points Earned
2	24	
3	18	
4	35	
5	23	
	Total Score =	