EXAM 1 CHEMISTRY 225b Friday, February 3, 2006

NAME (print): ______

TA:______ Sect. Day:______ Sect. Time:_____ Course ID: _____

Take a few moments to look over the exam. Answer each question on the exam paper.

No calculators. Important clues and structures are in **bold**.

Do all **preliminary** drawing or computations on the work sheets at the end of the exam. The work sheets will not be graded.

The exam is 55 minutes.

STOP writing and hand in your exam when you are asked to do so.

REMEMBER: Neatness is to your advantage.

Your grade will be posted this afternoon on the course Bulletinboard using the red ID number above. Remember this number for the rest of the term.

1. (20pts) Conformation

2. (25 pts) Potpourri

3. (15 pts) Resonance (Do 1 of 3)

4. (15 pts) Bonding (Do 1 of 2)

5. (25 pts) Thermochemistry

Total (100 pts)

1. **Comformation:** (20 pts) For the eclipsed and staggered conformations of 2-methylpentane viewed along the C2-C3 sigma bond, **draw a Newman projection** of the **most** stable eclipsed and staggered conformations. Place the appropriate energies in the Newman projections below. [Use the **circles** as

templates for the Newman projections.] Calculate the energy (kcal/mol) of both conformations. Place your answer in the appropriate **box**. Show work. [H/H, eclipsed, 1.0 kcal/mol; CH3/H eclipsed, 1.3 kcal/mol; C2H5/H, eclipsed, 1.4 kcal/mol; CH3/CH3, eclipsed, 3.0 kcal/mol; CH3/CH3, gauche, 0.9 kcal/mol; CH3/C2H5, gauche, 1.0 kcal/mol.] **Show your work!**



- 2. **Potpourri**: (25 pts.; equal weight) **Circle** the best answer(s) in each of the following:
 - a) If the difference in the heat of combustion of two isomers is 2 kcal/mol, what is the best estimate of the difference in their heats of formation (kcal/mol)?
 - 0 2 -5 5 157 -157
 - b) Circle the compound C_8H_{18} that is expected to have the **fewest** number of degrees between its melting and boiling points.

n-octane 2,2,3,3-tetramethylbutane 2,2-dimethylhexane

2,3-dimethylhexane 2,3,4-trimethylpentane

c) Circle the the acids that are readily deprotonated by NaOH

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n-hexane HCN NH_3 NH_4^+ CH_3CO_2H
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d) **Circle** the species with sp^3 hybridization

NH_4^+	ethylene	BF_4^-	ethane	BeH ₂
e) Circle the compounds with net dipole moments				
BrCH ₂ CH ₂ Br	CH ₂ Br ₂	trans- BrCH	=CHBr CBi	HCBr ₃

- 3. **Resonance:** (20 pts.) The concept of resonance plays an important role in organic chemistry. Explain and illustrate the role of resonance in **one** of the following cases. Use orbitals in your explanations.
 - a) The relative acidity of methanol vs. acetic acid
 - b) The enhanced ability of CH₂=CHCH₂Br to ionize to R+ Br-
 - c) Stabilization of the carbocation RCHOCH₃
- 4. **Bonding:** (15 pts) Provide a molecular orbital representation of **one** of the following compounds. Include pi-bonds, p-orbitals, etc. Provide necessary commentary about hybridization.
 - a) allene (1,2-propadiene) CH₂=C=CH₂
 - b) methylacetylene (1-propyne) CH₃CCH

5. Thermochemistry: (25 pts) Alkane A, C_5H_{12} gives a single free radical monochlorination product B. No other monochlorinated products are possible. The overall heat of the reaction is $DH_{rxn}^{o} = -29$ kcal/mol. BDEs: $Cl_2 = 58$ kcal/mol; HCl = 103 kcal/mol; R-H: (primary) = 101 kcal/mol, (secondary) = 99 kcal/mol, (tertiary) = 97 kcal/mol.

- a) What are the structures and IUPAC names of alkanes A and B?
- b) Show the propagation steps for this reaction.
- c) Calculate the heat of each propagation step and the BDE of R-Cl. Illustrate and show work. Work Sheets Work Sheets
 Work Sheets