

CHEM 3311-100 Fall 2007

Exam 1

Professor R. Hoenigman

Average = 65

High = 99

Low = 18

I pledge to uphold the CU Honor Code:

Signature _____

Name (printed) _____

Last four digits of your student ID number _____

Recitation TA _____

Recitation number, day, and time _____

You have 1 hour to complete this exam.

No model kits or calculators allowed.

Periodic table and scratch paper are attached.

DO NOT TURN THIS PAGE UNTIL INSTRUCTED TO DO SO.

Recitation Sections:

#	Day	Time	TA
111	Monday	8 am	Noel
151	Monday	2 pm	Noel
191	Monday	5 pm	Noel
113	Tuesday	8 am	Noel
193	Tuesday	5 pm	Noel
112	Wednesday	8 am	Doug
152	Wednesday	11 am	Jon
192	Wednesday	5 pm	Doug
153	Thursday	8 am	Noel

Page 1 _____/27 Page 4 _____/11

Page 2 _____/14 Page 5 _____/24

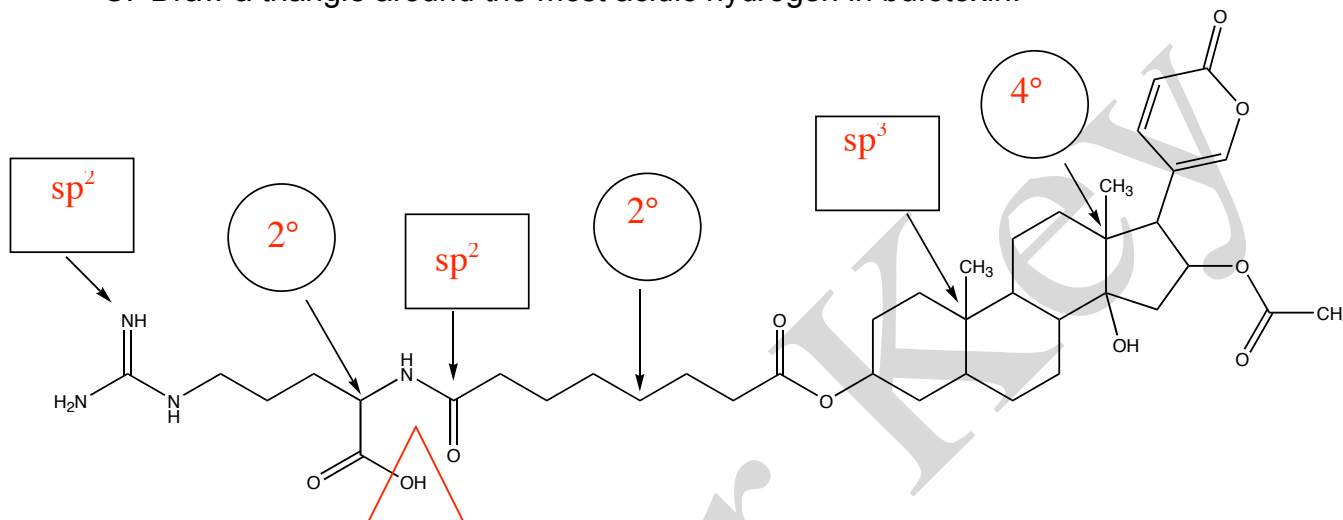
Page 3 _____/24

TOTAL _____/100

1. (15 pts) Bufotoxin (shown below) is the active component of the venom of the common European toad *Bufo vulgaris*, and is one of the most toxic compounds known.*

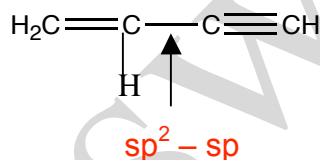
(*Le Couteur, P.; Burreson, J. *Napoleon's Buttons*, New York, Tarcher/Putnam, 2003.)

- Label each atom indicated by a box as sp^3 , sp^2 , sp , or none of these.
- Label each atom indicated by a circle as 1° , 2° , 3° , or 4° .
- Draw a triangle around the most acidic hydrogen in bufotoxin.



2. (6 pts) Vinylacetylene (shown below) is used in the synthesis of neoprene, a synthetic rubber. Identify the orbital overlaps involved in the indicated bond. How many σ bonds, and how many π bonds are there in vinylacetylene?

Book Problem 2.19

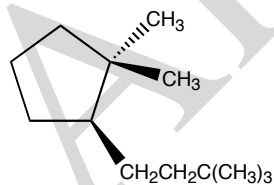


_____ 3 _____ π bonds

_____ 7 _____ σ bonds

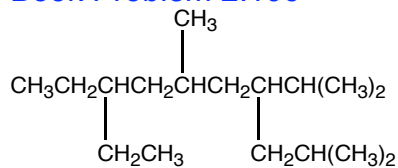
3. (6 pts) Give the IUPAC name for each of the following compounds.

A.



1,1-dimethyl-2-(3,3-dimethylbutyl)cyclopentane

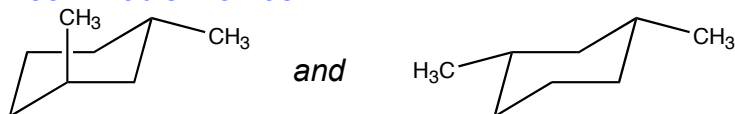
B. Book Problem 2.10c



8-ethyl-4-isopropyl-2,6-dimethyldecane –or–
8-ethyl-2,6-dimethyl-4-(1-methylethyl)decane

4. (8 pts) State whether the following pairs of compounds are constitutional isomers, stereoisomers, conformers, resonance structures, the same structure, or have no relation. Place your answer in the box.

A. [Book Problem 3.26e](#)



Stereoisomers

B. [Book Problem 2.28e](#)

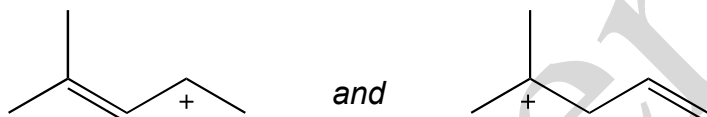
cyclobutylcyclopentane

and

1-ethyl-1-methylcyclohexane

No Relation

C.



Constitutional Isomers

D.



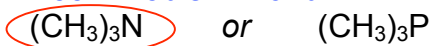
Constitutional Isomers

5. (6 pts) Among isomeric alkanes, the unbranched isomer is the least stable and has the highest boiling point; the most branched isomer is the most stable and has the lowest boiling point. Does this mean that one alkane boils lower than another because it is more stable? Explain. [Book Problem 2.37](#)

No, a branched alkane boils lower than a straight chain isomer due to less surface area. The boiling point is due to interactions between molecules (van der waals forces), which is dependent on surface area. Boiling point and stability are not related.

6. (12 pts) Circle the more basic species in each of the following pairs. In the box, provide a short explanation for your choice.

A. Book Problem 1.67b



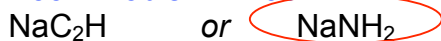
The conjugate base of the weaker acid is the stronger base.

B. Book Problem 1.29a



Nitrogen is less electronegative than oxygen and is therefore more willing to share its electrons.

C. Book Problem 1.29b



The conjugate base of the weaker acid is the stronger base. (NH_3 $pK_a = 36$, C_2H_2 $pK_a = 26$)

7. (12 pts) For each of the following pairs, circle the compound that has the *lower* heat of combustion. In the box, give a brief reason for your choice. (lower ΔH_{comb} = more stable)

A. Book Problem 3.10a and b, CT on 9/26
trans-1-*tert*-butyl-3-methylcyclohexane

or



Less torsional strain with both substituents in the equatorial position

B. Book Problem 3.28b



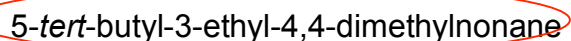
or



Less ring strain

C. 3-ethyl-5-isobutyl-4,4-dimethylnonane

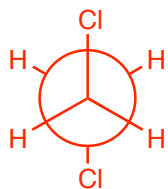
or



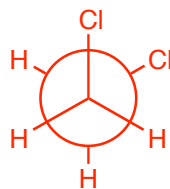
More branches = more stable isomer

8. (11 pts) This is a two part question. [Book Problem 3.39](#)

- A. Draw Newman projections for the gauche and anti conformations of 1,2-dichloroethane ($\text{ClCH}_2\text{CH}_2\text{Cl}$). Label your Newman projections as gauche or anti.



anti conformation



gauche conformation

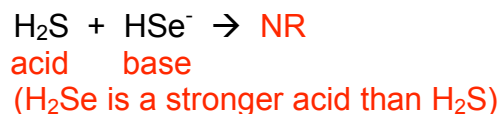
- B. The measured dipole moment of $\text{ClCH}_2\text{CH}_2\text{Cl}$ is 1.12 D. Which one of the following statements about 1,2-dichloroethane is *false*? Explain why.

- It may exist entirely in the anti conformation.
- It may exist entirely in the gauche conformation.
- It may exist as a mixture of anti and gauche conformations.

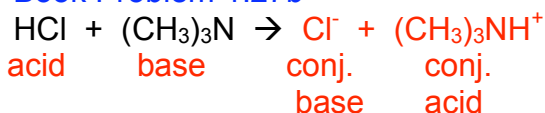
Statement i must be false. In order to have a dipole moment the compound cannot be exclusively in the anti conformation. In the anti conformation, the C-Cl dipole moments cancel out for an overall molecular dipole of zero. The gauche conformation contributes to the dipole moment of the molecule.

9. (24 pts) Complete the following acid-base reactions. Show all non-zero formal charges. If no reaction occurs write NR. Label each acid and base in the reactants. If the reaction is a Bronsted-Lowery acid-base reaction, also label the conjugate acid and conjugate base.

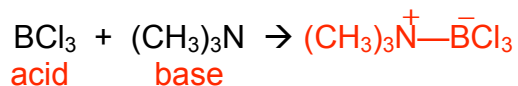
A.



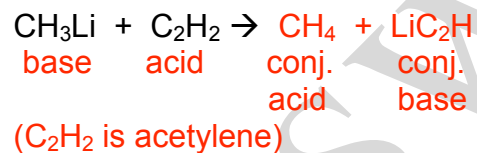
B. Book Problem 1.27b



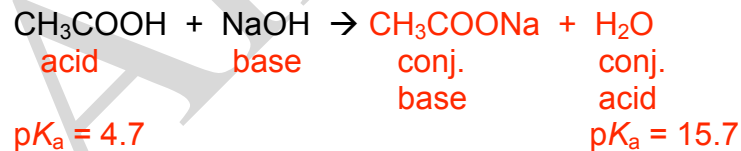
C.



D.



E.



F.

