CHEM 346 – Organic Chemistry I – Fall 2014

Instructor: Paul Bracher

Quiz #2

Due: Friday, September 12th, 2014

6:00 p.m. (in Monsanto Hall 103)

Student Name (Printed)	
Student Signature	

Instructions & Scoring

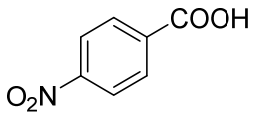
- Please write your answers on the official answer sheet. No answers marked in this booklet will be graded. Submissions submitted electronically will not be graded.
- You may use any resources you wish and collaborate with others.
- Any questions should be posted to the Blackboard discussion board so all students have equal access to the information.
- Your quiz answer sheet may be photocopied.

Problem	Points Earned	Points Available
I		30
II		20
III		14
IV		36
TOTAL		100

This quiz focuses on Chapters 1 through 4 in Janice Smith's *Organic Chemistry*, 4th ed.

Problem I. Multiple choice (30 points total; +5 points for a correct answer, +2 points for an answer intentionally left blank, and 0 points for an incorrect answer). For each question, select the best answer of the choices given. Write the answer, legibly, in the space provided on the answer sheet.

(1) _____ When a small sample of 4-nitrobenzoic acid (**A**) is dissolved in an aqueous solution buffered at pH 3.0, what percentage of the carboxyl groups (–COOH) will be deprotonated once an equilibrium has been established? Assume the pH of the solution does not change significantly over the course of the experiment.

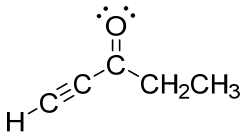


$pK_a = 3.4$

A

(a) 10%
(b) 28%
(c) 40%
(d) 60%
(e) 72%

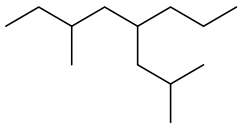
(2) _____ Which of the following pairs of orbitals do not interact to form any of the σ bonds in compound **B**, shown below.



B

(a) an *sp*-hybridized orbital with an *sp*-hybridized orbital
(b) an *sp*-hybridized orbital with an sp^2-hybridized orbital
(c) an sp^2-hybridized orbital with an sp^2-hybridized orbital
(d) an sp^2-hybridized orbital with an sp^3-hybridized orbital
(e) an sp^3-hybridized orbital with an sp^3-hybridized orbital
(f) all of the above pairs of orbitals interact to form bonds in **B**

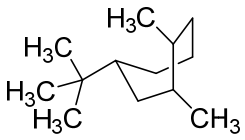
(3) _____ What is the systematic name of compound **C**?



C

(a) 2,6-dimethyl-4-propyloctane
(b) 3-methyl-5-isobutyloctane
(c) 5-isobutyl-3-methyloctane
(d) 4-isobutyl-6-methylоctane
(e) 3,7-dimethyl-5-propyloctane

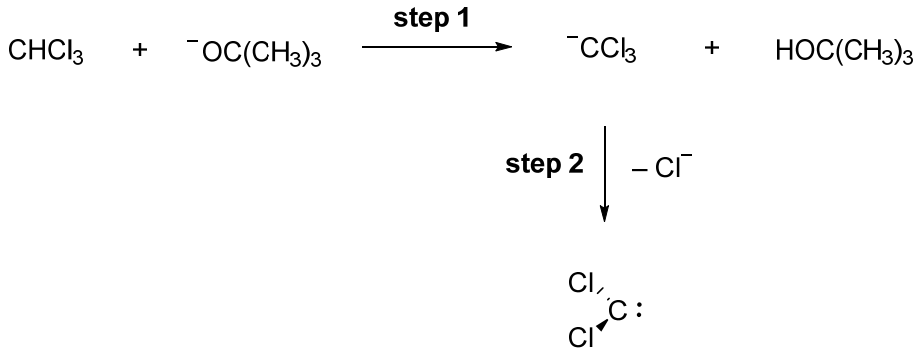
(4) _____ What is the systematic name of compound **D**?



D

(a) 1-*tert*-butyl-3,4-dimethylcycloheptane
(b) 1,2-dimethyl-4-*tert*-butylcycloheptane
(c) 4-*tert*-butyl-1,2-dimethylcycloheptane
(d) 1,2-dimethyl-6-*tert*-butylcycloheptane
(e) 3,4-dimethyl-1-isobutylcycloheptane

For questions 5 and 6, consider the following sequence of reactions.



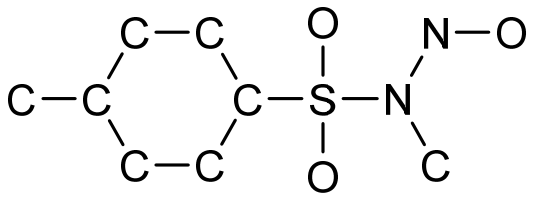
(5) _____ In the first step, $CHCl_3$ is serving as

(a) a Brønsted–Lowry acid
(b) a Lewis acid
(c) a nucleophile
(d) both (a) and (b)
(e) (a), (b), and (c)
(f) none of the above

(6) _____ What is the formal charge on the carbon atom in $:CCl_2$, the molecule drawn as the product of the second step?

(a) −1
(b) 0
(c) +1
(d) this is an impossible “Rhode Island” carbon

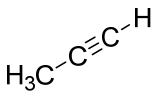
Problem II. Lewis Structure (20 points). Complete the Lewis structure for compound **E**, shown below, which when treated with base, produces the highly explosive compound diazomethane (CH_2N_2). The compound has the molecular formula $C_8H_{10}N_2O_3S$. All of the hydrogen atoms in **E** are bonded to carbon atoms. Among other features, the compound has an aromatic ring and one atom with "expanded valence" that is surrounded by more than an octet of electrons. Explicitly include—i.e., draw out—all hydrogens, bonding pairs, lone pairs, and non-zero formal charges on your Lewis structure. The molecule has been started on your answer sheet.



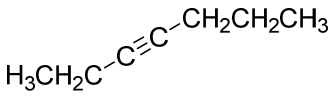
E

Problem III. Short Answer (14 points). Among all neutral (uncharged) organic molecules in which every carbon atom possesses a full octet of valence electrons, draw the structure of the smallest (by mass) compound that possesses <u>at least</u> one *sp*-hybridized carbon atom, one sp^2-hybridized carbon atom, and one sp^3-hybridized carbon atom. Your structure should not have any bond angles that deviate far from the ideal values for any particular hybridization of carbon.

Problem IV. Explanations (36 points). For each question posed below, write the letter of your answer in the box on the answer sheet and provide a brief explanation (no more than four sentences) for your choice. You should draw out any relevant resonance forms, if the concept factors into your explanation.



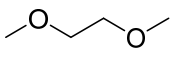
F



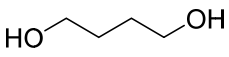
G

(1) (9 points) Of compounds **F** and **G**, which is the stronger acid?

(2) (9 points) Of compounds **F** and **G**, which has the higher boiling point?

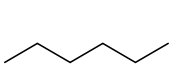


H

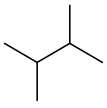


J

(3) (9 points) Of compounds **H** and **J**, which has the higher boiling point?



K



M

(4) (9 points) Of compounds **K** and **M**, which has the higher boiling point?