CHEM 346 – Organic Chemistry I – Fall 2014

Instructor: Paul Bracher

Hour Examination #1

Wednesday, September 17th, 2014

6:00–8:00 p.m. in Macelwane Hall 334

Student Name (Printed)	
Student Signature	

Instructions & Scoring

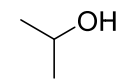
- Please write your answers on the official answer sheet. No answers marked in this booklet will be graded.
- Please write your name on the front *and* back of the answer sheet.
- You may use one letter-sized sheet of handwritten notes and your plastic model kit. No electronic resources are permitted and you may not communicate with others.
- Your exam answer sheet may be photocopied.

Problem	Points Earned	Points Available
I		30
II		18
III		18
IV		34
TOTAL		100

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

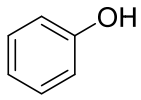
Problem I. Multiple choice (30 points total; +5 points for a correct answer, +2 points for an answer intentionally left blank, and 0 points for an incorrect answer). For each question, select the best answer of the choices given. Write the answer, legibly, in the space provided on the answer sheet.

(1) _____ Which of the following compounds will <u>not</u> be deprotonated (to *any* extent) by Sodium methoxide ($CH_3O^-/^+Na$)? The pK_a of each compound is listed below, and the pK_a of protonated methoxide (methanol, CH_3OH) is 15.5.



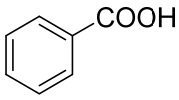
pK_a = 16.5

(a)



pK_a = 10.0

(b)



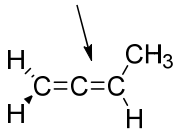
pK_a = 4.2

(c)

none of the above

(d)

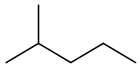
(2) _____ What types of orbitals are involved in the indicated connection between the second and third carbon atoms of 1,2-butadiene (**A**)?



A

(a) only *sp*-hybridized orbitals
(b) only sp^2-hybridized orbitals
(c) *sp*-hybridized and sp^2-hybridized orbitals
(d) *sp*-hybridized, sp^2-hybridized, and unhybridized *p* orbitals
(e) *sp*-hybridized, sp^2-hybridized, and sp^3-hybridized orbitals
(f) *sp*-hybridized, sp^2-hybridized, sp^3-hybridized, and unhybridized *p* orbitals

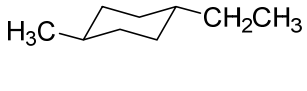
(3) _____ What statement is <u>not</u> true of compound **B**?



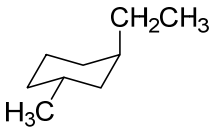
B

(a) **B** is a saturated hydrocarbon
(b) **B** is named 2-methylpentane
(c) **B** can serve as a Brønsted–Lowry acid
(d) **B** has at least one isomer that contains a cycloalkane ring
(e) **B** is polar (has a non-zero net dipole moment)

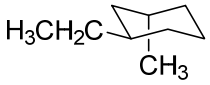
(4) _____ Which of the following structures represents the <u>most stable</u> conformation of *trans*-1-ethyl-3-methylcyclohexane?



(a)

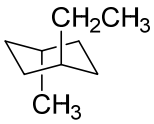


(b)



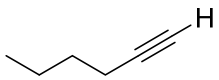
(c)

(d)

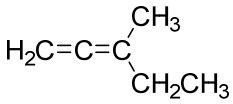


(e)

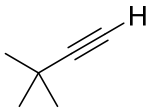
(5) _____ Which structure drawn below represents the most acidic hydrocarbon of molecular formula C_6H_{10} that also has a single tertiary carbon atom?



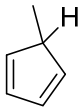
(a)



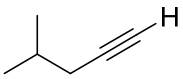
(b)



(c)

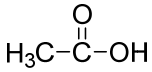


(d)



(e)

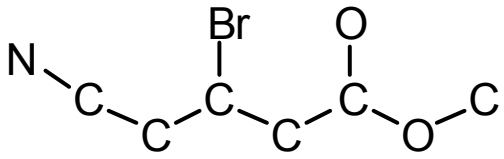
(6) _____ What statement is <u>not</u> true of acetic acid (**C**, H_3CCOOH)



C

(a) **C** has an sp^3-hybridized carbon atom
(b) the conjugate base of **C** is stabilized by a resonance effect
(c) trichloroacetic acid (Cl_3CCOOH) acid has a higher pK_a than **C** due to an inductive effect
(d) the bond angles around the carbon bonded to oxygen are close to 120°
(e) molecules of **C** are capable of hydrogen bonding

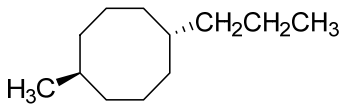
Problem II. Lewis Structure (18 points). Complete the Lewis structure for the ester methyl 3-bromo-4-cyanobutanoate (**D**) that has been started on your answer sheet. The compound has the molecular formula $C_6H_8BrNO_2$ and no atoms in the structure bear a formal charge. There are no C–C π bonds in the structure. All atoms in the structure (aside from hydrogen) have a full octet. Explicitly include—i.e., draw out—all hydrogens, bonding pairs, lone pairs, and non-zero formal charges on your Lewis structure.



D

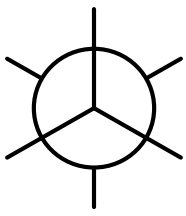
Problem III. Short Answers (18 points). Write your answers in the appropriate boxes on your answer sheet.

(1) (9 points) Provide the systematic name for compound **E**.



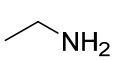
E

(2) (9 points) Draw a Newman projection of the <u>most stable</u> conformation of pentane (C_5H_{12}) while "looking down" the C2–C3 bond (the bond between the second and third carbon atoms of the chain). The drawing has been started for you on your answer sheet.

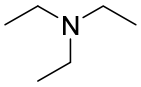


Problem IV. Explanations (34 points). For each question below, provide a brief explanation of no more than four sentences. For questions 1 and 2, also write the letter of your selection in the box on the answer sheet. You should draw out any relevant resonance forms, if the concept factors into your explanation.

(1) (9 points) Of compounds **F** and **G**, which has the higher solubility in water?

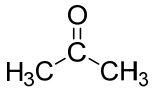


F

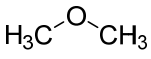


G

(2) (9 points) Of compounds **H** and **J**, which is the stronger acid?

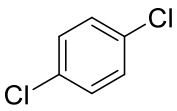


H



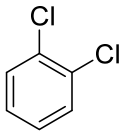
J

(3) (8 points) Provide an explanation for why 1,2-dichlorobenzene (**M**) has a higher boiling point but a lower melting point than 1,4-dichlorobenzene (**K**).



b.p. = 173 °C
m.p. = 52 °C

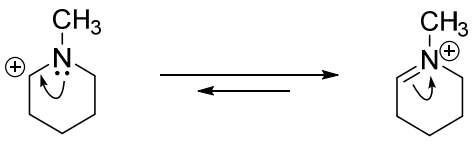
K



b.p. = 178 °C
m.p. = –18 °C

M

(4) (8 points) Explain what is wrong with the following figure.



N **P**