

**CHEM 2410 – Principles of Organic Chemistry I – Summer 2016**

Instructor: Paul Bracher

**Quiz #1**Due: Friday, May 27<sup>th</sup>, 2016

12:00 p.m. (to the mailbox outside Monsanto Hall 103)

Student Name (Printed)	
Student Signature	

**Instructions & Scoring**

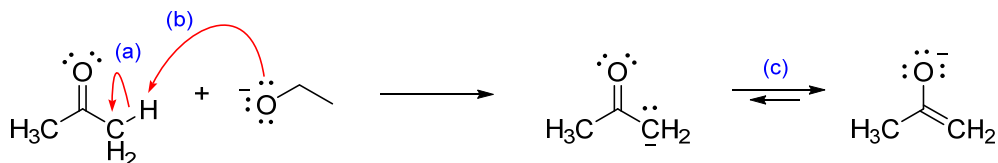
- Please write your answers on the official answer sheet. No answers marked in this booklet will be graded. Submissions submitted electronically will not be graded.
- You may use any resources you wish and collaborate with others.
- Any questions should be posted to the Blackboard discussion board so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

Problem	Points Earned	Points Available
I		60
II		10
III		14
IV		16
TOTAL		100

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

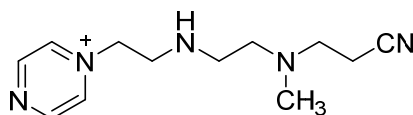
**Problem I.** Multiple choice (60 points total; +3 points for a correct answer, +1 points for answering with the letter “E”, and 0 points for an incorrect answer). For each question, select the best answer of the choices given. Write the answer, legibly, in the space provided on the answer sheet.

- (1) \_\_\_\_\_ Which of the following statements best describes the use of the arrows labeled (a), (b), and (c) in the acid–base reaction depicted below?



- (A) arrow (a) is used incorrectly  
 (B) arrow (b) is used incorrectly  
 (C) arrows (c) are used incorrectly  
 (D) arrows (a), (b), and (c) are all used incorrectly

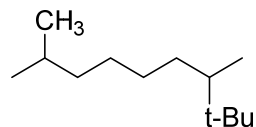
- (2) \_\_\_\_\_ How many of the five nitrogen atoms in structure **A** are  $sp^2$ -hybridized?



**A**

- (A) 0  
 (B) 1  
 (C) 2  
 (D) 3

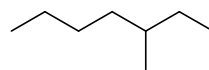
(3) \_\_\_\_\_ What is the systematic name of compound **B**?



**B**

- (A) 2-*tert*-butyl-7-methyloctane
- (B) 7-methyl-2-*tert*-butyloctane
- (C) 2-methyl-7-*tert*-butyloctane
- (D) 2,2,3,8-tetramethylnonane

(4) \_\_\_\_\_ Which of the following statements is not true of compound **C**.



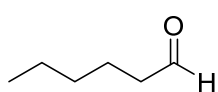
**C**

- (A) compound **C** is named 3-methylheptane
- (B) compound **C** has a lower melting point than 2,2,3,3-tetramethylbutane
- (C) compound **C** is a saturated hydrocarbon
- (D) compound **C** has more 2° hydrogen atoms than 1° hydrogen atoms

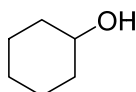
(5) \_\_\_\_\_ How many carbon atoms are in the smallest (lowest mass), acyclic, saturated hydrocarbon that has the word “isopropyl” in its proper IUPAC

- (A) 6 or fewer carbon atoms
- (B) 7 or 8 carbon atoms
- (C) 9 or 10 carbon atoms
- (D) 11 or more carbon atoms

(6) \_\_\_\_\_ Of the following isomers of  $C_6H_{12}O$ , which has the highest boiling point?



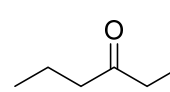
(A)



(B)

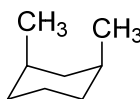


(C)



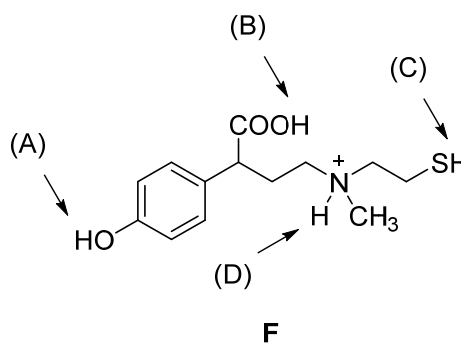
(D)

(7) \_\_\_\_\_ What term best describes compounds **D** and **E**?

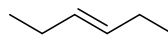
**D****E**

- (A) identical
- (B) constitutional isomers
- (C) conformational isomers
- (D) stereoisomers

(8) \_\_\_\_\_ Which of the labeled hydrogen atoms is the most acidic in compound **F**?



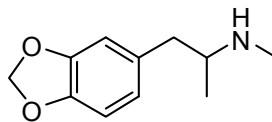
- (9) \_\_\_\_\_ What type(s) of orbitals form the bond between the C3 and C4 carbon atoms in 3-hexene (**G**)?



**G**

- (A)  $sp^2$  orbitals only
- (B)  $sp^3$  orbitals only
- (C)  $p$  and  $sp^2$  orbitals
- (D)  $p$  and  $sp^3$  orbitals

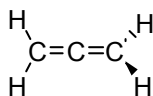
- (10) \_\_\_\_\_ Which of the following functional groups is not present in 3,4-methylenedioxy-methamphetamine (**H**), a drug more commonly known as ecstasy?



**H**

- (A) amine
- (B) alcohol
- (C) ether
- (D) aromatic ring

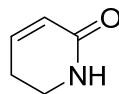
(11) \_\_\_\_\_ What is the approximate value of the H–C–C bond angles in propadiene (**J**)?



**J**

- (A) 90°
- (B) 109.5°
- (C) 120°
- (D) 180°

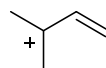
(12) \_\_\_\_\_ How many nonbonding pairs of valence electrons (i.e., lone pairs) are present in compound **K**?



**K**

- (A) 0
- (B) 1
- (C) 2
- (D) 3

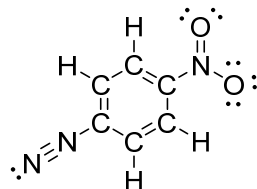
(13) \_\_\_\_\_ How many carbon atoms are  $sp^2$ -hybridized in cation **L**?



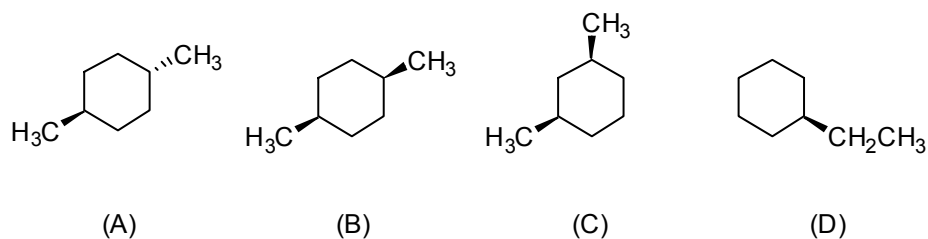
**L**

- (A) 0 or 1
- (B) 2
- (C) 3
- (D) 4 or 5

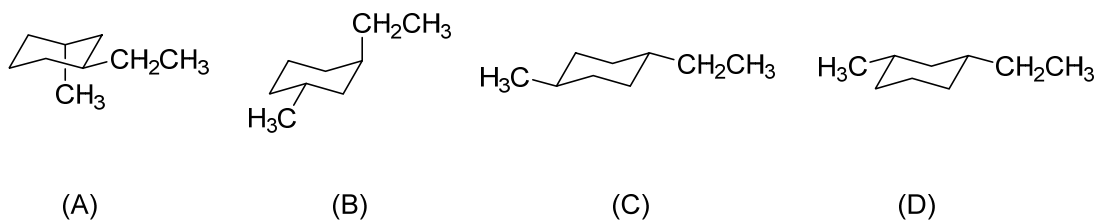
- (14) \_\_\_\_\_ What is the net sum of the formal charges on all the nitrogen atoms in the following Lewis structure? All atoms, lone pairs, and bonding pairs have been drawn explicitly in this structure, but no charges or formal charges have been labeled.



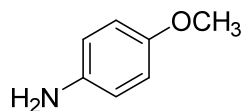
- (A) -1  
 (B) 0  
 (C) +1  
 (D) +2
- (15) \_\_\_\_\_ Which of the following isomers of  $C_8H_{16}$  will have the most exothermic heat of combustion? That is, if one mole of each compound is burned (completely), which will release the most heat?



- (16) \_\_\_\_\_ Which of the following structures represents the most stable conformation of *cis*-1-ethyl-3-methylcyclohexane?



- (17) \_\_\_\_\_ When a small sample of 4-methoxyaniline (**M**) is dissolved in aqueous solution buffered at pH 7, roughly 2.5% of the nitrogen atoms in the sample become protonated. Which of the following values is closest to the  $pK_a$  of (protonated) 4-methoxyaniline?

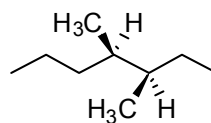


$pK_a = ?$

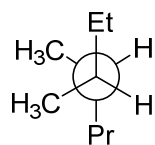
**M**

- (A) 4.2  
 (B) 5.4  
 (C) 8.6  
 (D) 9.4

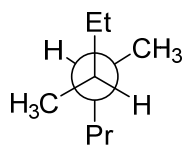
- (18) \_\_\_\_\_ Which of the following Newman projections is an accurate representation of alkane **N**? “Et” is the abbreviation for an ethyl group ( $-\text{CH}_2\text{CH}_3$ ). “Pr” is the abbreviation for a propyl group ( $-\text{CH}_2\text{CH}_2\text{CH}_3$ ).



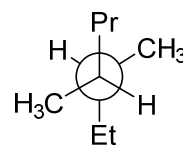
**N**



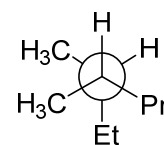
(A)



(B)



(C)



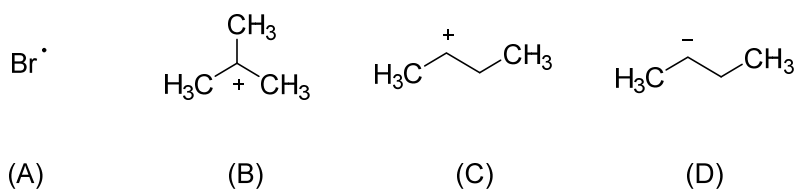
(D)



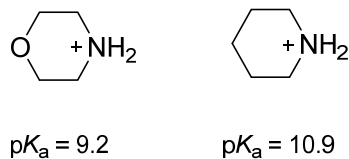
- (19) \_\_\_\_\_ Which of the following is the most likely product of the heterolytic cleavage of the C–Br bond in compound **P**? (*t*-Bu = a *tert*-butyl group)

t-Bu–Br

**P**



- (20) \_\_\_\_\_ Which of the following statements is central to explaining the difference in acidity between these two compounds?

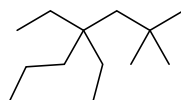


- (A) the oxygen atom destabilizes the parent acid by a resonance effect  
 (B) the oxygen atom stabilizes the parent acid by a resonance effect  
 (C) the oxygen atom destabilizes the parent acid by an inductive effect  
 (D) the oxygen atom stabilizes the parent acid by an inductive effect

**Problem II.** Lewis Structure (10 points). Draw a Lewis structure for a molecular that is composed of 4 carbon atoms and 2 nitrogen atoms (and no other elements) with no formal charges in the structure.

**Problem III.** Alkanes and Substituted Alkanes (14 points). Provide the systematic IUPAC names requested below.

(1) (7 points) Provide the IUPAC name for compound **Q**.

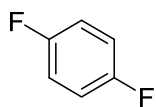
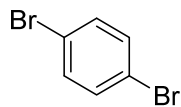


**Q**

(2) (7 points) Provide the IUPAC name for an alkane that is an isomer of  $C_7H_{14}$  and has the number 2 in its name but not the number 1.

**Problem IV.** Explanations (16 points). For each question posed below, write the letter of your answer in the box on the answer sheet and provide a brief explanation (of no more than four sentences) for your choice. You should draw out any relevant resonance forms if the concept factors into your explanation.

(1) (8 points) Of compounds **R** and **S**, which has the lower melting point?

**R****S**

(2) (8 points) Of compounds **T** and **U**, which has the lower  $pK_a$ ?

**T****U**