

Name \_\_\_\_\_

Department of Chemistry  
SUNY/Oneonta

Chem 221 - Organic Chemistry I

Examination #1 - September 22, 2004

INSTRUCTIONS —

This examination has two parts. The first part is in multiple choice format; the questions are in this Exam Booklet and the answers should be placed on the "Test Scoring Answer Sheet" which must be turned in and will be machine graded.

The second part requires your responding to questions in this Exam Booklet by writing answers into the spaces provided. The Exam Booklet must be handed in and will be returned to you with a grade.

On the Test Scoring Answer Sheet, using a soft pencil, enter the following data (in the appropriate places):

your name,

instructor's name,

your OSC Student Number,

course number (30022101),

and the test number (01);

darken the appropriate bubbles under the entries (leave the bubbles under the letter "A" in your OSC student number blank, but darken the bubbles under the numbers), making dark black marks which fill the bubbles.

You may use a set of molecular models and the periodic table (last page) provided, but no other aids, during the exam.

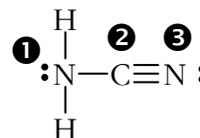
Answer all questions. The questions on Part I are worth 5 points each.

You have 50 minutes. Good luck!

1. Originally, organic chemistry was the chemistry of
- (a) the elemental forms of carbon. (b) hydrocarbons. (c) the compounds of carbon.  
(d) the compounds of carbon that occur in living organisms.
2. Which of the following is not an allotropic form of carbon?
- (a) diamond, (b) quartz, (c) graphite, (d) fullerenes

Now for some real questions.

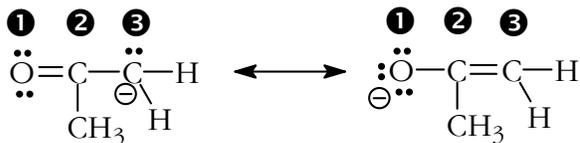
3. Hybrid orbitals of the  $sp^2$  type are formed by combining
- (a) a 2s orbital and one 2p orbital, leaving two 2p orbitals unchanged.  
(b) a 2s orbital and two 2p orbitals, leaving one 2p orbital unchanged.  
(c) a 2s orbital and all three 2p orbitals.  
(d) None of the above answers is correct.
4. A carbon-carbon double bond consists of
- (a) two  $\sigma$ -bonds. (b) two  $\pi$ -bonds. (c) one  $\sigma$ -bond and one  $\pi$ -bond.  
(d) None of the previous answers is correct.
5. The term *structural isomers* is defined as
- (a) molecules that are different but have the same molecular formula.  
(b) molecules that have the same molecular formula but whose atomic attachments are different.  
(c) molecules that have different atoms but the same number of electrons.  
(d) different molecules that contain the same elements.
6. What are the geometries of the two nitrogens and carbon in cyanamide?



	①	②	③
(a)	tetrahedral	linear (digonal)	trigonal-planar
(b)	tetrahedral	linear (digonal)	linear (digonal)
(c)	tetrahedral	trigonal-planar	trigonal-planar
(d)	trigonal-planar	linear (digonal)	linear (digonal)

- (e) None of the above answers is correct.

7. What are the hybridizations of the oxygen and two labeled carbons in the acetate anion?



	1	2	3
(a)	$sp^2$	$sp$	$sp$
(b)	$sp^2$	$sp^2$	$sp^2$
(c)	$sp^3$	$sp^2$	$sp^2$
(d)	$sp^2$	$sp^2$	$sp^3$

(e) None of the above answers is correct.

8. The molecular formula for an *acyclic alkane* containing 20 carbon atoms would be \_\_\_\_\_, while the molecular formula for a *cyclic alkane* of 20 carbons containing *one ring* would be \_\_\_\_\_.

(a)  $C_{20}H_{42} / C_{20}H_{40}$ , (b)  $C_{20}H_{42} / C_{20}H_{42}$ , (c)  $C_{20}H_{40} / C_{20}H_{40}$ ,  
 (d) It is impossible to answer this question using the information given.

9. The bond between two atoms in a molecule will normally be covalent if

(a) the sum of the electronegativities of the atoms is less than 1.7.  
 (b) the sum of the electronegativities of the atoms is greater than 1.7.  
 (c) the difference between the electronegativities of the atoms is less than 1.7.  
 (b) the difference between the electronegativities of the atoms is greater than 1.7.

10. Bronsted-Lowry Definitions:

An acid is a(n) \_\_\_1\_\_\_. A base is a(n) \_\_\_2\_\_\_.

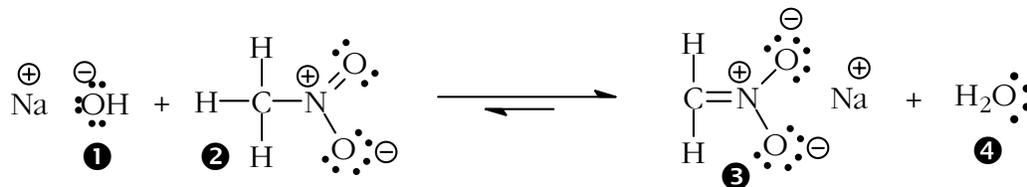
Lewis Definitions:

An acid is a(n) \_\_\_3\_\_\_. A base is a(n) \_\_\_4\_\_\_.

	1	2	3	4
(a)	proton donor	proton acceptor	electron pair donor	electron pair acceptor
(b)	electron pair donor	electron pair acceptor	proton donor	proton acceptor
(c)	proton acceptor	proton donor	electron pair acceptor	electron pair donor
(d)	electron pair acceptor	electron pair donor	proton acceptor	proton donor

(e) None of the above answers is correct.

11. Consider the reaction between hydroxide ion **1** and nitromethane **2** to form the sodium salt of nitromethane **3** and water **4**



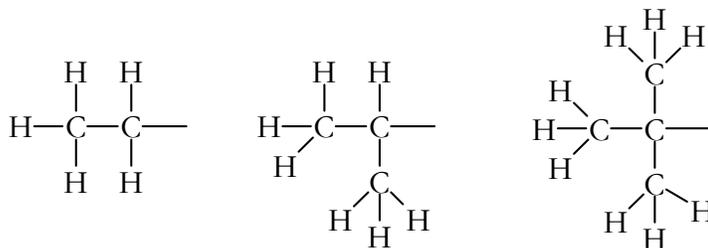
Characterize the species 1 through 4 with regard to their acidic or basic properties in this reaction.

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
(a)	strong acid	strong base	weak acid	weak base
(b)	weak acid	weak base	strong acid	strong base
(c)	strong base	strong acid	weak base	weak acid
(d)	weak base	weak acid	strong base	strong acid
(e)	strong acid	strong base	weak base	weak acid
(f)	weak acid	weak base	strong base	strong acid

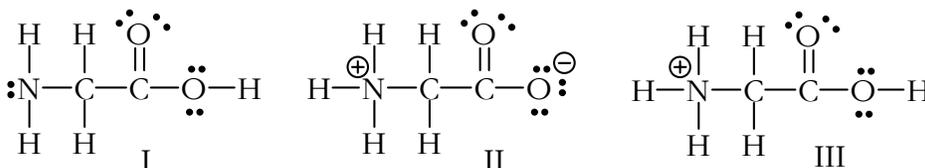
(g) None of the above answers is correct.

12. The alkyl groups shown below are, in order from left to right, named

- (a) ethyl, propyl, isobutyl,  
 (b) methyl, isopropyl, butyl,  
 (c) ethyl, isopropyl, *tert*-butyl,  
 (d) methyl, isopropyl, isobutyl,  
 (e) None of the above answers is correct.

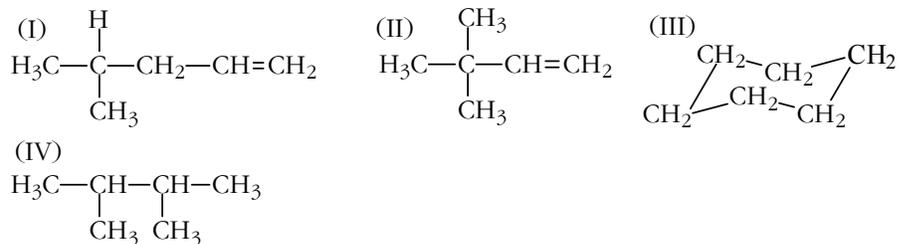


13. Which of the structures shown below is/are not legitimate Lewis structures?

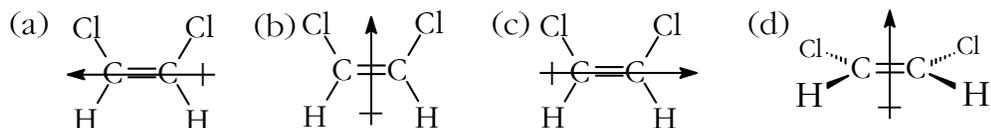


- (a) I, (b) II, (c) III, (d) II & III, (e) None of the previous answers is correct.

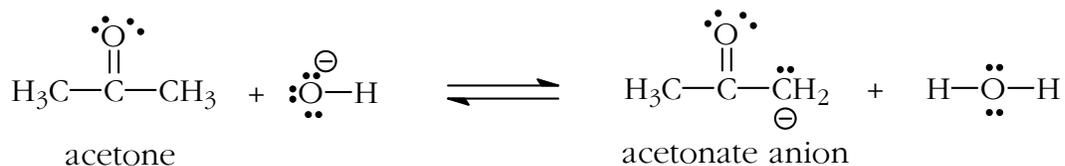
14. Which of the molecules shown below are *not* constitutional (structural) isomers of  $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}=\text{CH}_2$ ?



- (a) I only, (b) II only, (c) III only, (d) IV only, (e) I&III, (f) I&IV
15. Select the figure which correctly shows the direction of the dipole moment in *cis*- $\text{CHCl}=\text{CHCl}$ . [Note: The molecule has approximately the shape shown.]



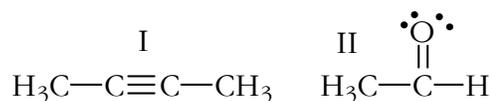
[16-17.] One of the reaction steps in the formation of dibenzalacetone from acetone and benzaldehyde involves the reaction of acetone with hydroxide ion as shown below.



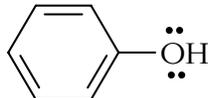
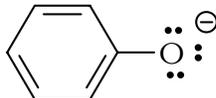
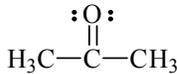
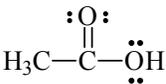
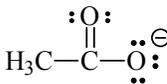
16. This reaction can be characterized as
- a Lowry-Bronsted acid-base reaction, only.
  - a Lewis acid-base reaction, only.
  - both a Lowry-Bronsted and Lewis acid-base reaction.
  - Bogus question! This is not an acid-base reaction.
17. Which of the following statements best describes the character of the reactants above?
- Acetone is a base and hydroxide is an acid.
  - Acetone is an acid and hydroxide is a base.
  - Acetone and hydroxide cannot be characterized as acids or bases.
  - Both of these reactants function as both acid and base.

18. To what functional group family do the two compounds shown to the right belong?

- (a) I-alkyne, II-aldehyde,  
 (b) I-arene, II-carboxylic acid,  
 (c) I-alcohol, II-ester, (d) I-alkene, II-ketone



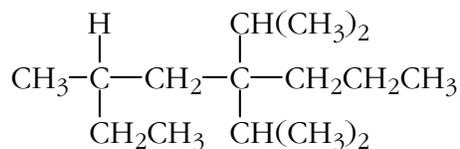
19. Rank the **bases** in the table below in order of decreasing basicity (most basic first). The  $\text{pK}_a$  values of the **conjugate acids** of the bases are also shown in the table.

Acid	$\text{pK}_a$	Base
HCl	-6	$\text{Cl}^-$ (I)
	9.9	 (II)
	19	 (III)
	4.8	 (IV)

- (a) I>II>III>IV, (b) IV>III>II>I, (c) III>II>IV>I, (d) I>IV>II>III, (e) IV>II>III>I

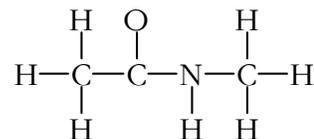
20. Select the correct IUPAC name for the compound to the right.

- (a) 3-methyl-5,5-diisopropyloctane,  
 (b) 2-ethyl-4,4-diisopropyloctane,  
 (c) 3-methyl-5,5-di-*sec*-butyloctane,  
 (d) 2-ethyl-4,4-dipropyloctane

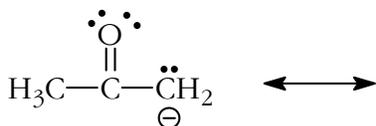


**Directions for Part II --- Answer the questions in the space provided. If there is insufficient space continue your answer on the back of the sheet but clearly indicate on the front of the sheet that you have done this.**

1. (a) Convert the skeleton structure on the right into a complete Lewis structure, clearly showing all bonds and unshared valence electrons.



- (b) Draw a second resonance structure for the molecule shown below.



- (c) Circle the structure in part (b) that makes the greater contribution.

2. (a) Write down the mechanism for the reaction of methane with chlorine to produce chloromethane:



You should show initiation and propagation steps. You do not need to show more than one termination step.

- (b) The species in the mechanism that have an unpaired electron are known as \_\_\_\_\_.
- (c) A reaction, like this one, in which the product of a later step is a reactant in an earlier step is known as a \_\_\_\_\_ reaction.

Part I (100)	_____
Part II	
1. (15)	_____
2. (10)	_____
Total (125)	_____