

Name _____

Department of Chemistry
SUNY/Oneonta

Chem 221 - Organic Chemistry I

Examination #1 - September 28, 1998

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 student (Social Security) number, course number (30022101) and the test number (01); darken the appropriate bubbles under the entries, making dark black marks which fill the bubbles.

You may use a set of molecular models and the tables provided, but no other aids, during the exam.

Answer all questions. The questions on Part I are worth 2 points each.

You have 90 minutes. Good luck!

1. The type of bonding in which electrons are shared by atoms, and which is most prevalent in organic compounds, is known as _____ bonding.

(a) male, (b) electron, (c) covalent, (d) ionic, (e) metallic

2. Organic chemistry is the branch of chemistry devoted to the study of

(a) "organic" foods. (b) the chemistry of organisms. (c) the chemistry of organs.

(d) the chemistry of carbon in its elemental state.

(e) the chemistry of the compounds of carbon.

3. Which of the following statements about orbitals is (are) *untrue*?

(I) The atomic 2p orbitals are higher in energy than the atomic 2s orbital.

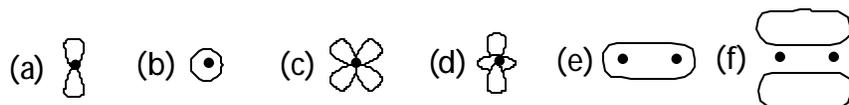
(II) When atomic orbitals combine to form hybrid atomic orbitals, the initial atomic orbitals come from different shells (*i.e.* have different principal quantum numbers).

(III) If two atomic orbitals combine to form molecular orbitals, two molecular orbitals will be formed.

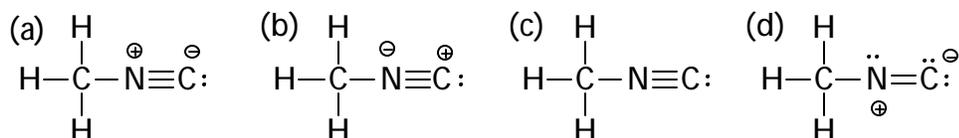
(IV) If two sp^2 hybridized atoms are bonded together, typically an sp^2 orbital on one will combine with an sp^2 orbital on the other to form a π and a π^* orbital.

(a) I only, (b) II only, (c) III only, (d) IV only, (e) I&III, (f) II&IV

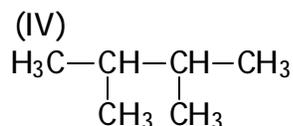
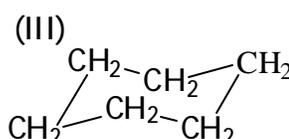
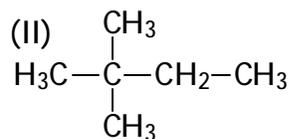
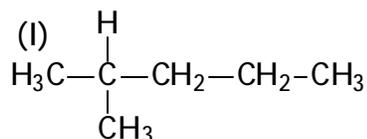
4. Which of the figures shown below is a reasonable representation of a σ orbital? [Nuclei are shown as dots.]



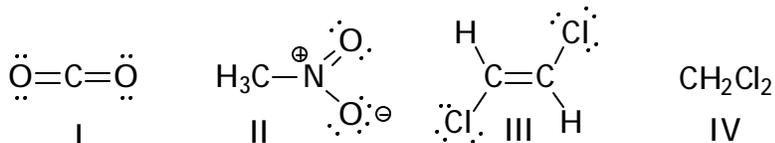
5. Which of the Lewis structures shown below is correct?



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

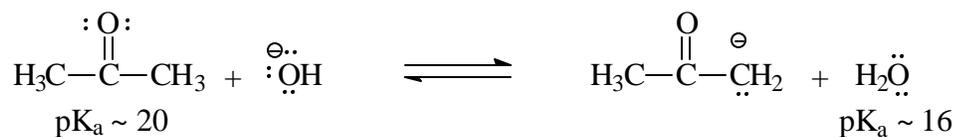


- (a) I only, (b) II only, (c) III only, (d) IV only, (e) I&III, (f) II&IV
7. What is the shape of the carbon atoms in ethane?
- (a) linear, (b) trigonal, planar, (c) tetrahedral, (d) octahedral
8. What is the hybridization of the carbon atoms in ethane?
- (a) sp , (b) sp^2 , (c) sp^3 , (d) d^2sp^3
9. Select the figure which correctly shows the direction of the dipole moment in $\text{CH}_2=\text{CCl}_2$.
- (a) $\begin{array}{c} \text{H} \quad \text{Cl} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \backslash \\ \text{H} \quad \text{Cl} \end{array}$ \leftarrow
- (b) $\begin{array}{c} \text{H} \quad \text{Cl} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \backslash \\ \text{H} \quad \text{Cl} \end{array}$ \uparrow
- (c) $\begin{array}{c} \text{H} \quad \text{Cl} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \backslash \\ \text{H} \quad \text{Cl} \end{array}$ \rightarrow
- (d) $\begin{array}{c} \text{H} \quad \text{Cl} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \backslash \\ \text{H} \quad \text{Cl} \end{array}$ \uparrow
10. Which of the following compounds have no dipole moment (*i.e.* dipole moment = 0).



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

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



11. 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.
12. Which of the following statements best describes the situation that would exist at equilibrium for the above reaction?
- Only reactants would be present.
 - Only products would be present.
 - The mixture would be over 99% reactants and less than 1% products.
 - The mixture would be less than 1% reactants and over 99% products.
 - The mixture would be about 67% reactants and 33% products.
 - The mixture would be about 33% reactants and 67% products.
 - The mixture would be about 50% reactants and 50% products.
13. Arrange the following species in order of decreasing acidity (most acidic first). Base your answer on the most acidic proton(s) in each species, which are shown in a sans serif font.
- I: CH₃OH II: CH₃SH III: CH₃SH₂[⊕] IV: CH₃O[⊖]
- I>II>III>IV,
 - IV>III>II>I,
 - III>II>I>IV,
 - III>I>II>IV,
 - IV>I>II>III
 - None of the above answers is correct.

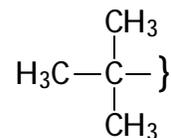
14. Rank the following substances in order of decreasing acidity (most acidic first).
The pK_a values appear in parenthesis after the substance name.
- I: hydrogen chloride (-6), II: phenol (9.9), III: acetone (19), IV: acetic acid (4.8)
- (a) I>II>III>IV, (b) IV>III>II>I, (c) III>II>IV>I, (d) I>IV>II>III, (e) IV>II>III>I
15. The general molecular formula for *acyclic* alkanes is _____, while the general molecular formula for *cyclic* alkanes containing *one ring* is _____.
- (a) C_nH_{2n+2} / C_nH_{2n} , (b) C_nH_{2n} / C_nH_{2n+2} , (c) C_nH_{2n} / C_nH_{2n-2} , (d) C_nH_{2n+2} / C_nH_{2n+2}
16. How many configurational isomers are there for C_6H_{14} ? [Hint: Draw them out and count them up.]
- (a) 3, (b) 4, (c) 5, (d) 6, (e) 7, (f) 8
17. Select the correct IUPAC name for the following compound:
 $(CH_3)_2CHCH_2C(CH_3)(CH_2CH_3)CH_2CH_2CH_3$
- (a) 2,4-dimethyl-4-ethylheptane, (b) 1,1,3-trimethyl-3-ethylhexane,
(c) 4,6,6-trimethyl-4-ethylhexane, (d) 4,6-dimethyl-4-ethylheptane
18. How many 1° , 2° , 3° and 4° carbons are present in the compound in question #17? [Select the correct row in the table below, or answer (e).]

	1°	2°	3°	4°
(a)	2	5	2	2
(b)	5	4	1	1
(c)	6	3	1	0
(d)	4	4	2	1

(e) None of the above answers is correct.

19. The alkyl group shown to the right is known as

- (a) isopropyl. (b) butyl. (c) isobutyl. (d) *sec*-butyl. (e) *tert*-butyl.
(f) Michael.

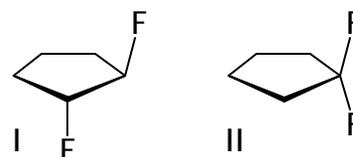


20. Alkane molecules are attracted to each other because of

- (a) London or van der Waals forces. (b) dipole-dipole attractions. (c) ionic bonds.
(d) love. (e) lust.

21. What is the relationship between I & II?

- (a) They are the same molecule.
(b) They are constitutional (structural) isomers.
(c) They are stereoisomers.
(d) They are conformational isomers.



22. What is the name of compound I in question #21?

- (a) *cis*-1,2-difluorocyclopentane, (b) *trans*-1,2-difluorocyclopentane,
(c) *cis*-4,5-difluorocyclopentane, (d) *trans*-4,5-difluorocyclopentane

23. Cyclohexane has a puckered rather than a flat structure. The puckered structure is favored over the flat one because the puckered one has less _____ strain.

- (a) angle and torsional, (b) angle and steric, (c) torsional and steric,
(d) eye, (e) brain

24. Considering rotation around the C(2)-C(3) bond of butane, which of the following conformations is most stable?

- (a) anti-periplanar, (b) anti-clinal, (c) syn-clinal, (d) syn-periplanar

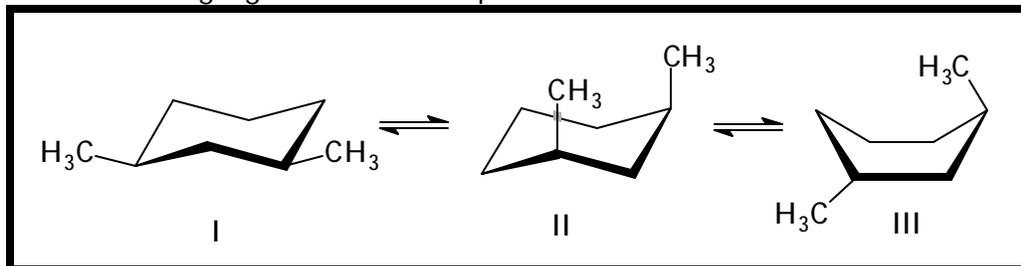
25. Consider the following statement: "In relation to question 24, in a sample of butane at room temperature, all of the molecules will be in the most stable conformation."

- (a) The above statement is true.
(b) The above statement is false. All of the indicated (anti-periplanar, anti-clinal, *etc.*) conformations of butane will be equally populated.

(c) The above statement is false. All of the indicated conformations of butane will be populated, but the more stable ones will have smaller populations.

(d) The above statement is false. All of the indicated conformations of butane will be populated, but the more stable ones will have larger populations.

The following figure relates to questions 26-30.

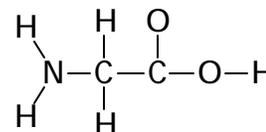


26. Which conformation of the compound shown above is *most* stable?
- (a) I, (b) II, (c) III, (d) The conformations shown are of equal stability.
27. Which conformation of the compound shown above is *least* stable?
- (a) I, (b) II, (c) III, (d) The conformations shown are of equal stability.
28. Which conformation of the compound shown above has 1,3-diaxial interactions?
- (a) I, (b) II, (c) III, (d) None of the conformations has this sort of steric interaction.
29. Which conformation of the compound shown above has torsional strain and bowsprit-flagpole interactions.
- (a) I, (b) II, (c) III, (d) Bogus question, dude! There's no such thing as torsional strain and bowsprit-flagpole interactions.
30. Conversion of one of the conformations to another involves
- (a) breaking σ bonds. (b) breaking p bonds. (c) rotation around σ bonds. (d) rotation around p bonds.

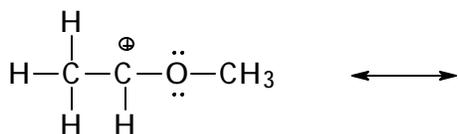
Directions for Part II --- Answer the questions in the space provided. If there is insufficient

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.

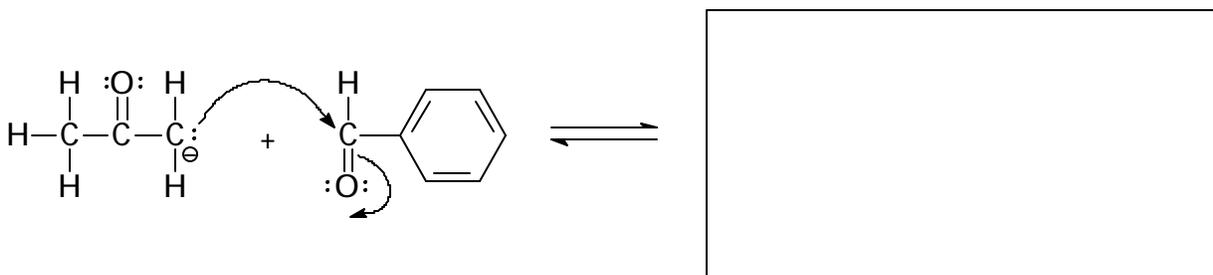


- (b) Draw a second resonance structure for the ion shown below.



- (c) Draw Lewis or Kekule structures of all the possible constitutional isomers of C_3H_9N .

2. (a) Shown below are the reactants in one step of the mechanism for the synthesis of dibenzalacetone from acetone and benzaldehyde. Draw the Lewis structure of the product. [The curved arrows have their usual meaning and should help you if you've forgotten the details of this mechanism.]



(b) Label each of the two reactants above, using as many of the following labels as is appropriate, in terms of their behavior in this reaction:

Lewis acid, Lewis base, Lowry-Bronsted acid, Lowry-Bronsted base.

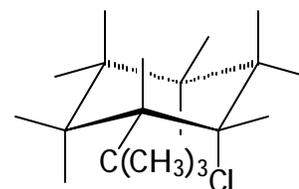
3. Using the molecular formula $C_4H_{10}O$ draw a Lewis structure of
(a) a primary (1°) alcohol,

(b) a secondary (2°) alcohol, and

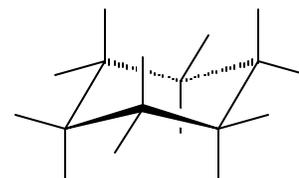
(c) a tertiary (3°) alcohol.

4. Consider *cis*-1-*tert*-butyl-2-chlorocyclohexane in the conformation shown to the right.

(a) (i) Is the *tert*-butyl group axial or equatorial?
(ii) Is the Cl axial or equatorial?

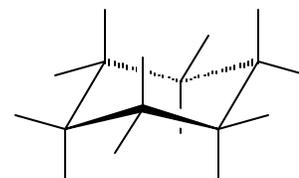


(b) Using the skeleton to the right, draw another chair conformation (ring flip) of this molecule.



(c) Which conformation, (a) or (b), is more stable *and why*?

(d) Using the skeleton to the right, draw *trans*-1-*tert*-butyl-2-chlorocyclohexane in its most stable chair conformation.



Part I (60)	_____
Part II	
1. (14)	_____
2. (9)	_____
3. (6)	_____
4. (11)	_____
Total (100)	_____