Organic Chemistry I Lecture Fall 2017 8/28/17 Monday Exam I Dr. Hahn Exam # _____

Name Icey (print) Name OC (sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If you run out of space, continue on the empty back pages but clearly label where the remaining answer can be found. (If I can't find your answer or cannot read it, I obviously cannot grade it). Return your entire exam including the periodic table. (Please count your exam pages and make sure there are 7 real pages + periodic table pack)

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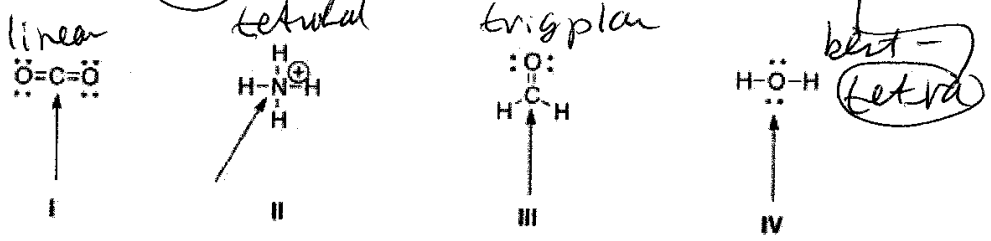
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. (2 pts each, 32 pts total)

1) Determine the **electron geometry** around the indicated atom in each species. 1) B

linear tetrahedral trigplan bent – tetrd



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C) I = Tetrahedral; II = trigonal planar; III = linear; IV = tetrahedral
D) I = Trigonal planar; II = linear; III = tetrahedral; IV = trigonal planar

2) Which of the following compounds has the lowest boiling point? 2) C

branched

A) II B) I C) IV D) III

3) Which of the following molecules has non-polar covalent bonds? 3) A

A) N_2 B) HF C) CO_2 D) CCl_4

4) What is the ground-state electronic configuration of a carbon atom? 4) B

A) $1s^2, 2s^2, 2p^4$ B) $1s^2, 2s^2, 2p^2$ C) $1s^2, 2s^2, 2p^6$ D) $1s^2, 2s^2, 2p^5$

no partial credit MC

NA = not attempted

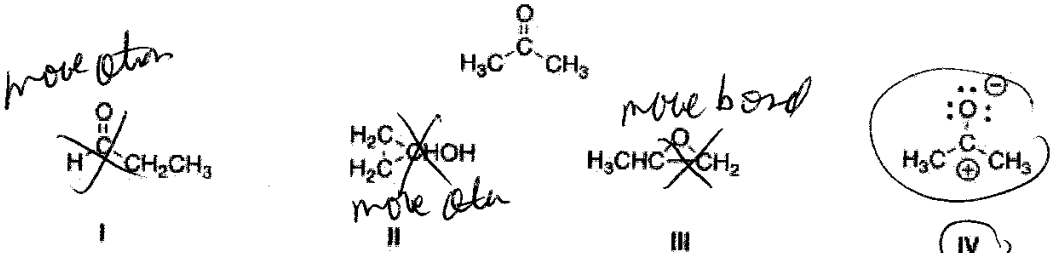
attempt ½ credit

NW = no work ½ credit

5) Which of the following statements about electronegativity and the periodic table is true? 5) D

A) Electronegativity increases down a column of the periodic table.
B) Electronegativity decreases across a row of the periodic table.
C) Electronegativity does not change down a column of the periodic table.
D) Electronegativity increases across a row of the periodic table.

6) Which of the following is a resonance structure of the compound below? 6) D



I

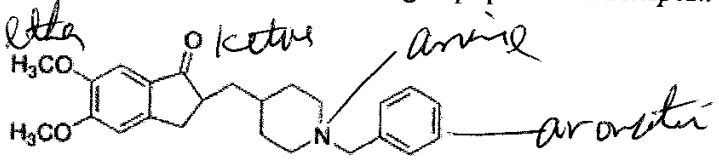
II

III

IV

A) I B) II C) III D) IV

7) Consider the molecule *donepezil* (used to treat Alzheimer's disease). Which of the following lists the correct functional groups present in *donepezil*? 7) B



donepezil (used to treat Alzheimer's disease)

A) Amide, aromatic, ester, ketone
B) Amine, aromatic, ether, ketone
C) Amide, aromatic, ether, ketone
D) Amine, aromatic, ester, ketone

8) Which of the following statements about resonance structures is true? 8) D

A) Resonance structures have different placement of atoms and different arrangement of electrons.
B) Resonance structures have the same placement of electrons but different arrangement of atoms.
C) Resonance structures have the same placement of atoms and the same arrangement of electrons.
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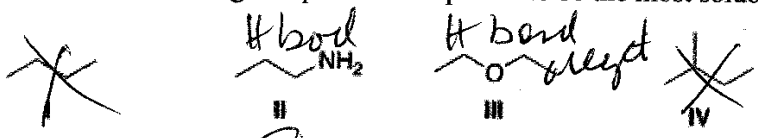
9) Which of the following compounds is expected to be the most soluble in H_2O? 9) B

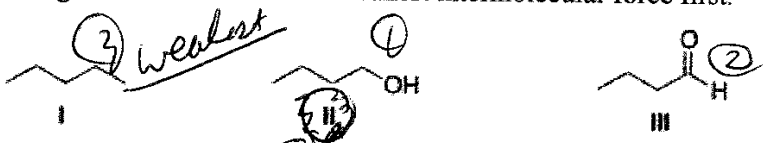


A) I B) II C) III D) IV

10) What intermolecular force is generally considered the strongest? 10) D

A) Covalent bonds B) Dipole-dipole
C) London dispersion forces D) Hydrogen bonding

11) Rank the following compounds in order of increasing strength of intermolecular forces, putting the molecule with the weakest intermolecular force first. 11) B



A) II < III < I B) I < III < II C) I < II < III D) II < I < III

12) Which atomic orbitals overlap to form the C-H s bonding molecular orbitals of ethylene, $H_2C{=}CH_2$? 12) D

A) C*sp* + H1*s* B) C2*p* + H1*s* C) Csp^3 + H1*s* D) Csp^2 + H1*s*

13) What is the approximate C-C-C bond angle in propene, $CH_3CH = CH_2$? 13) C

A) 109.5° B) 90° C) 120° D) 180°

14) Which of the following statements about bonding is true? 14) C

A) Covalent bonds result from the sharing of electrons between two metals.
B) Ionic bonds result from the sharing of electrons between two non-metals.
C) Ionic bonds result from the transfer of electrons from a metal to a non-metal.
D) Covalent bonds result from the transfer of electrons from one element to another.

15) Which of the following molecules has nonpolar covalent bonds? 15) D

A) HCl B) $CHCl_3$ C) NO D) N_2

16) Which of the following statements best describes the relationship between the surface area of a molecule and the strength of the intermolecular forces? 16) A

A) The larger the surface area, the stronger the intermolecular forces.
B) The smaller the surface area, the stronger the intermolecular forces.
C) The larger the surface area, the weaker the intermolecular forces.
D) There is no relationship between surface area and intermolecular forces.

Part II: Short Answers (37 pts) Show work on all questions for partial and full credit even on questions which do not specify.

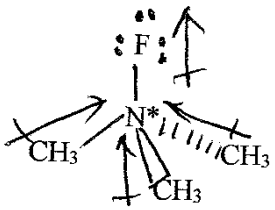
1. (a) Give the electron configuration for the element **Ca** starting from $1s^2$ ..... (10 pts total, 6 pts)

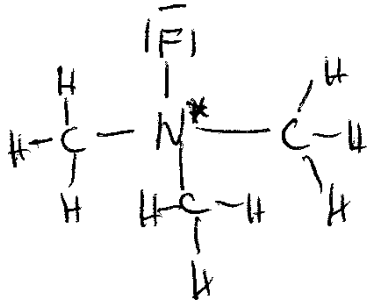
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$

(b) What group (in the periodic table) is the element **Ca** in ? 2A (2 pt)

(c) How many valence electrons is in the element **Ca ?** 2 (2 pt)

2. VSEPRT: For the Lewis Dot structure shown below answer the following for the atom with the * (12 pts, 2 pts each)





2 pt each blank

a) What is the number of electron domain (VSEPRT electron pairs) around the atom with the * 4

b) How many lone pairs on the atom with the * 0

c) What is the structure of the electron pairs at the atom with the * tetrahedral

d) What is the structure of the molecule at the * tetrahedral

e) On the 3D structure of the molecule above, show all nonzero dipole moment arrows

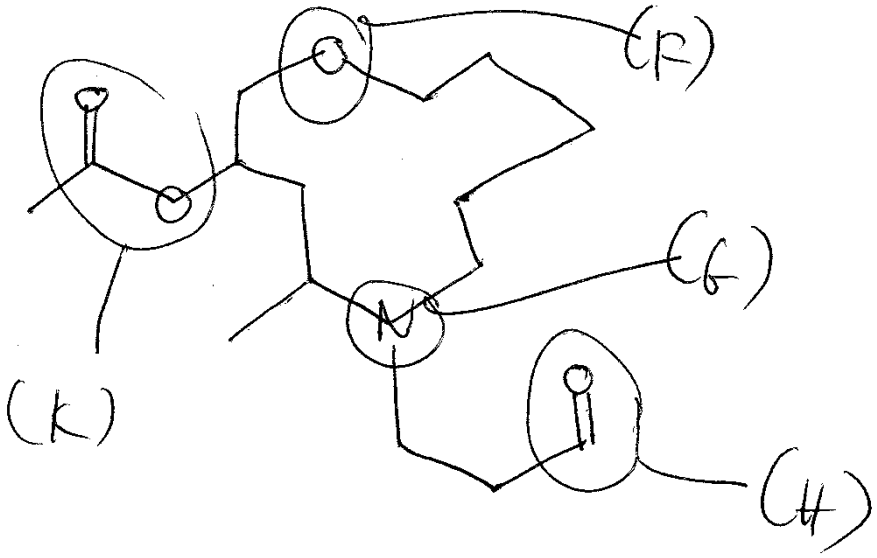
f) What is the intermolecular force in the molecule above ?

[(ionic bonding) (hydrogen bonding) (dipolar dipole bonding) (van der Waals)] (circle one)

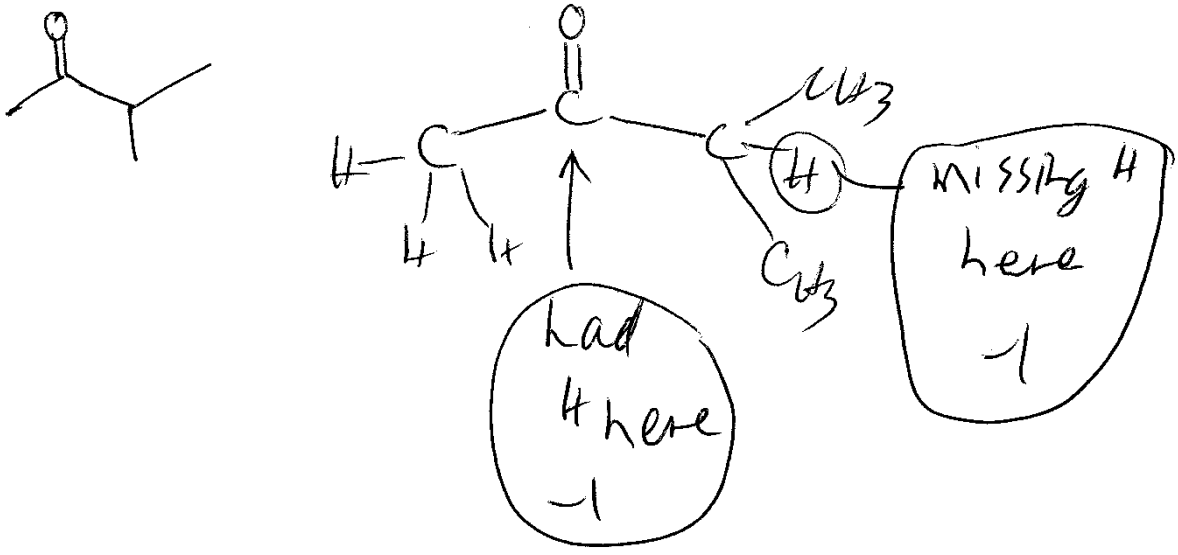
$-\frac{1}{2}$ pt per arrow

$-\frac{1}{4}$ pt wrong direction

3. Given the following molecule, fill in the parenthesis with the letter of the functional group. (A) alkene (B) alkyne (C) arene (D) alkyl halide (E) alcohol (F) ether (G) amine (H) aldehyde (I) ketone (J) carboxylic acid (K) ester (L) amide (M) acid halide (N) acid anhydride (You may use the same letter multiple times) (8 pts total, 2 pts each)



4. For the following skeletal molecular formula show the Lewis Dot (or structural) formula. (7 pts)



Part III: Long Answers (31 pts) Show work on all questions for partial and full credit even on questions which do not specify.

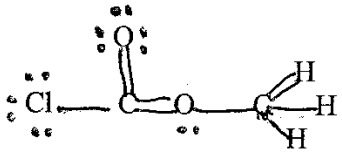
1. (a) Given the following formula, calculate the number of **valence electrons for the molecule**. Show work. $C_2H_3ClO_2$ (17 pts total #1, 8 pts this part)

C H Cl O
$2(4) + 3(1) + 7 + 2(6) = 30$

attempt −4

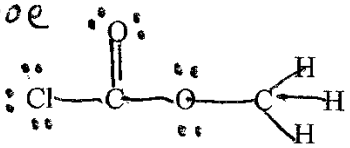
2pt 2pt 2pt 2pt

(b) Given the following 2 Lewis Dot structures (for the formula above), circle the correct one. (3 pt)



(1) $17 \times 2 = 34$

$15 \times 2 = 30\bar{e}$



(2)

(c) Given the Lewis Dot structure which you chose above, give at least 2 reasons why the incorrect one looks incorrect to you. (2 pts)

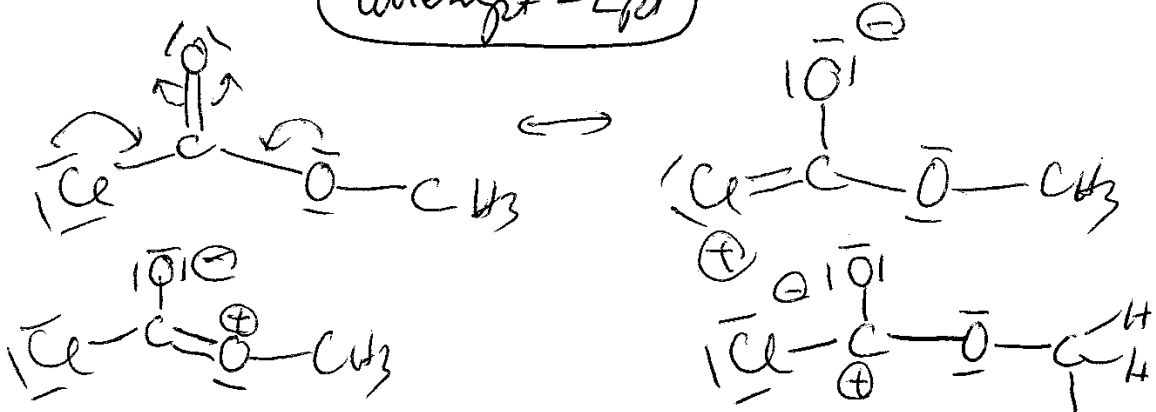
① Cl has too many ē

② C has more than octet

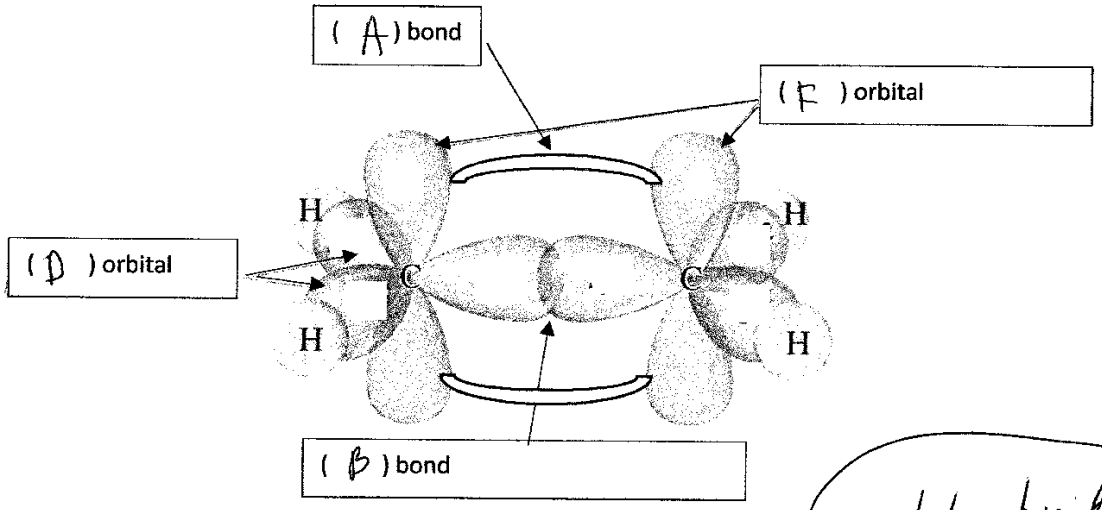
③ H has more than duet

(d) For the Lewis Dot Structure which you chose above, draw one resonance structure. (4 pts)

attempt −2pt

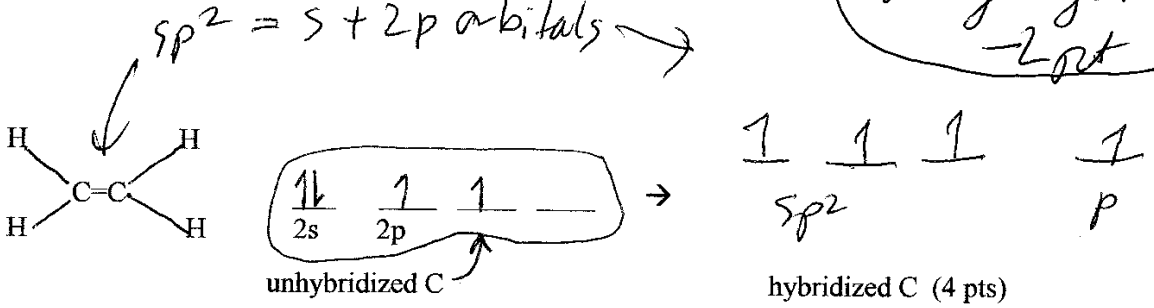


2. (a) Match the labeling in the following parenthesis. Each parenthesis can hold one to multiple letters. Each letter may be used once, no time or multiple times (A) π bond (B) σ bond (C) sp^3 hybridized orbitals (D) sp^2 hybridized orbitals (E) sp hybridized orbitals (F) unhybridzed p orbital (G) s orbital (14 pts total for #2, 8 pts this section, 2 pts each)



(b) The above structure is the molecule shown below. (4 pts this part)

not hybrid or wrong hybrid -2 pt



Given my drawing of the valence electron configuration diagram for the ground state of carbon, show the electron configuration diagram for the molecule above hybridized as shown above.

(c) Input electrons into your hybridized carbon electron configuration diagram above. (2 pts)

(use arrows)

as long as spread out 4 arrows no pts off

but spread out -1 pt

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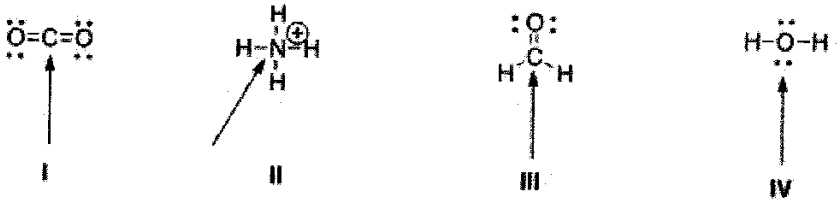

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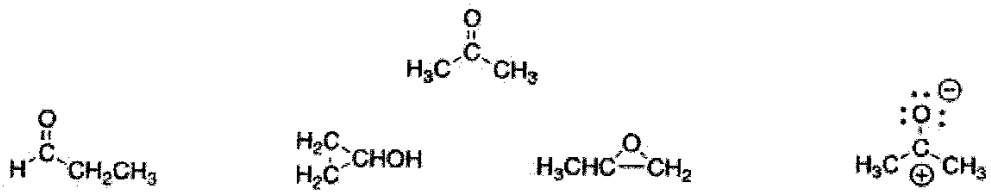

I II III IV

A) I B) II C) III D) IV

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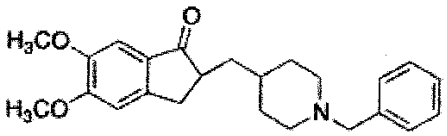

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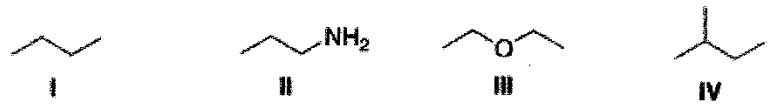

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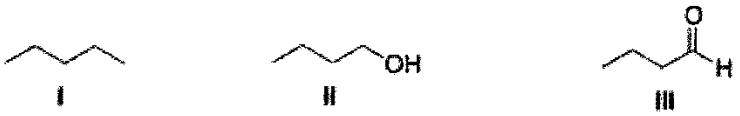

I II III

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12) Which atomic orbitals overlap to form the C-H s bonding molecular orbitals of ethylene, $H_2C{=}CH_2$? 12) _____

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Part II: Short Answers (37 pts) Show work on all questions for partial and full credit even on questions which do not specify.

1. (a) Give the electron configuration for the element **Ca** starting from $1s^2$ ..... (10 pts total, 6 pts)

(b) What group (in the periodic table) is the element **Ca** in ? _____ (2 pt)

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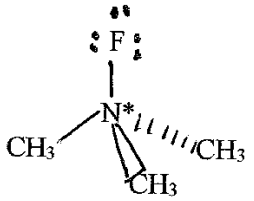

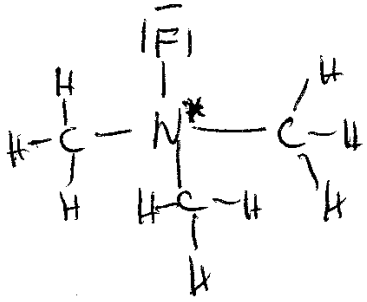

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b) How many lone pairs on the atom with the * _____

c) What is the structure of the electron pairs at the atom with the * _____

d) What is the structure of the molecule at the * _____

e) On the 3D structure of the molecule above, show all nonzero dipole moment arrows

f) What is the intermolecular force in the molecule above ?

[(ionic bonding) (hydrogen bonding) (dipolar dipole bonding) (van der Waals)] (circle one)

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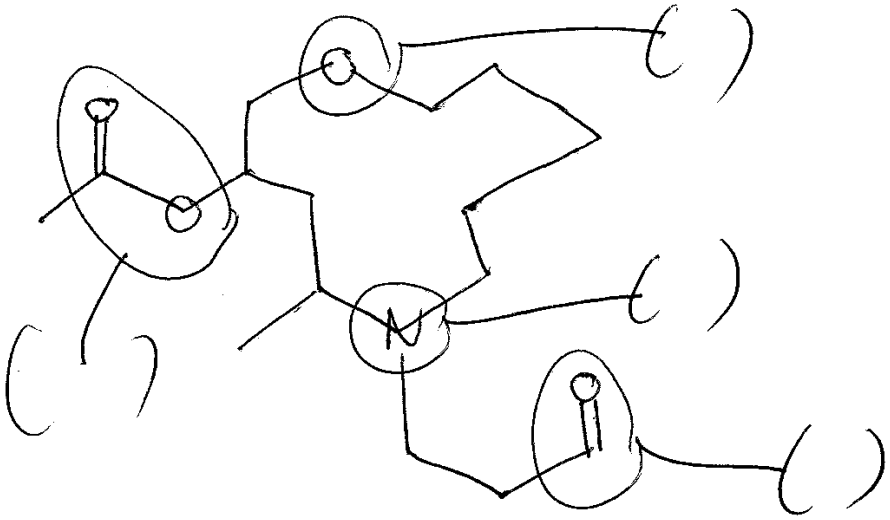

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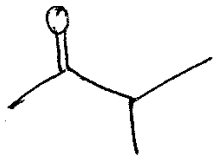

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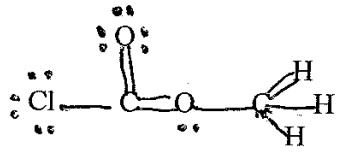
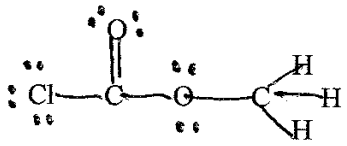


(1)



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(c) Given the Lewis Dot structure which you chose above, give at least 2 reasons why the incorrect one looks incorrect to you. (2 pts)

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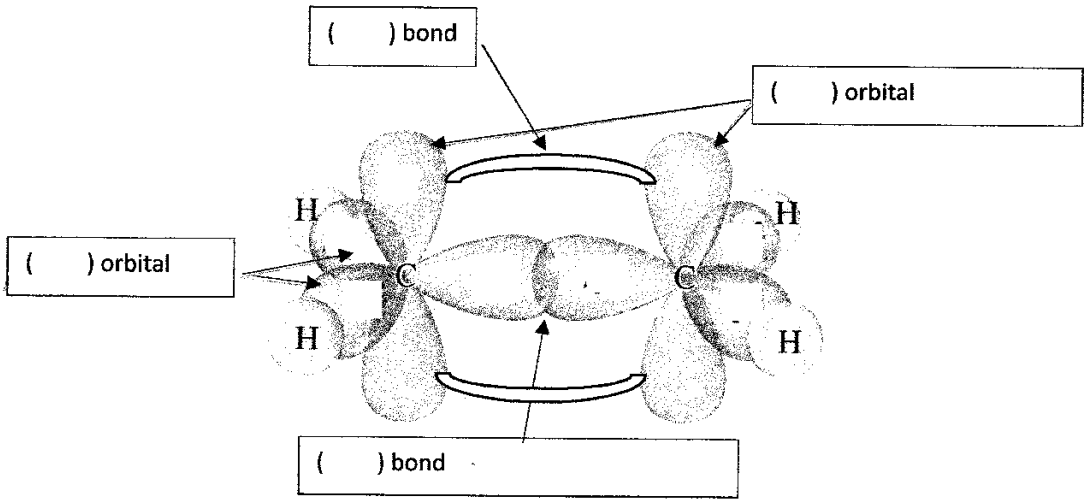
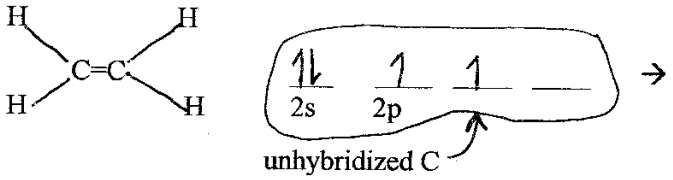


(b) The above structure is the molecule shown below. (4 pts this part)



hybridized C (4 pts)

Given my drawing of the valence electron configuration diagram for the ground state of carbon, show the electron configuration diagram for the molecule above hybridized as shown above.

(c) Input electrons into your hybridized carbon electron configuration diagram above. (2 pts)
(use arrows)