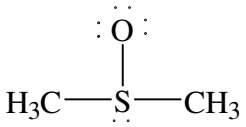
Organic Chemistry I
CHM2210
Sample Exam I Fall

Name _____

Multiple Choice – Circle the best answer (3 points each)

1. The formal charge on oxygen in the molecule shown is



   a. +2
   b. +1
   c. 0
   d. -1
   e. -2

2. Which of the following compounds or ions would be trigonal planar in shape?

   a. BF_4^{-1}
   b. H_3O^+
   c. AlF_3
   d. $:CH_3^-$

3. When an *s* orbital and 1 *p* orbitals hybridize to form hybrid molecular orbitals, _____ (how many) hybrid orbital(s) is/are formed that we refer to as _____ orbital(s). The atom will also then contain _____ unhybridized *p* orbitals.

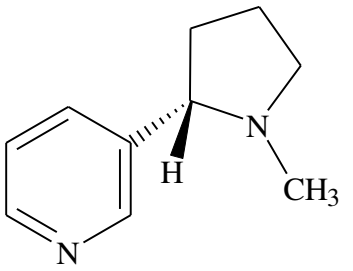
   a. 1, sp, 2
   b. 2, sp, 2
   c. 3, sp^2,1
   d. 4, sp^3,0
   e. 6, sp^3,0

4. Which of the following statements about π molecular orbitals is/are correct?

   a. π molecular orbitals are cylindrically symmetric along the bond axis.
   b. The overlap of the orbitals is in a side-to-side manner.
   c. When two atoms are connected by a double bond, both of these bonds are π bonds.
   d. Both a and c are correct.
   e. All statements are correct.

5. TRUE / FALSE – When different resonance forms of a molecule indicate a double-bond existing in one of several possible locations, the double bond is best considered as rapidly moving between the different positions as the molecule switches between the resonance forms. _____

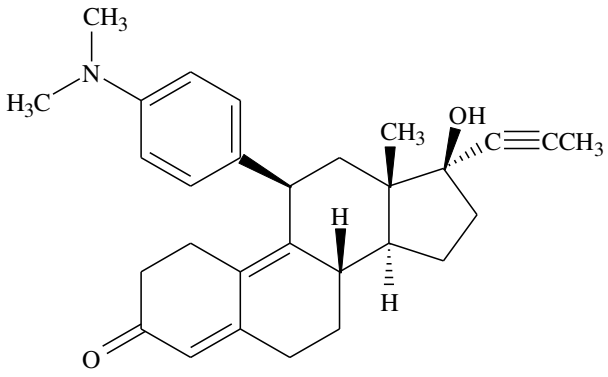
6. The structure of Nicotine is shown below. Which of the following statements concerning this structure is FALSE?
(Don't forget bond-lines formulas don't show all H atoms and drawings don't always show unshared electron pairs.)



Nicotine

a. The molecule contains 3 pi bonds.
b. The molecule contains 2 sp^2 hybridized nitrogen atoms.
c. The molecule contains 5 sp^3 hybridized carbon atoms.
d. The molecule can be classified as an amine.
e. The molecule contains an aromatic group.

7. The synthetic steroid RU-486 (the "morning after" pill) is shown below. How many pi (π)bonds are contained in the molecule..



a. 1
b. 2
c. 5
d. 7
e. 8

8. Which of the following molecules below HAS a net dipole moment?

a. CF_4
b. CS_2
c. CCl_4
d. $AlCl_3$

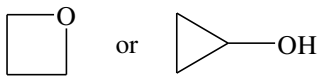
9. Which of the molecules below can hydrogen-bond to water but NOT to itself?

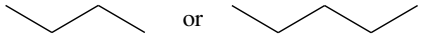
a. $CH_3\,CH_2\,O\,CH_2\,CH_3$
b. $CH_3\,CH_2\,COOH$
c. $(CH_3CH_2)_2\,CHOH$
d. $CH_3\,CH_2\,NHCH_2\,CH_3$
e. each of the above could H-bond with itself

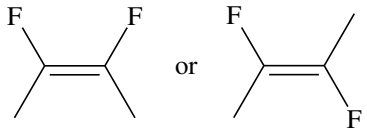
10. An alkane contains 15 carbon atoms. What is its formula?

    a. $C_{15}H_{15}$
    b. $C_{15}H_{17}$
    c. $C_{15}H_{30}$
    d. $C_{15}H_{32}$
    e. $C_{15}H_{60}$

11. CIRCLE which molecule in each of the following pairs has the higher boiling point. (NOT multiple choice)

    a. 

    b. 

    c. 

12. Which would be the least polar molecule?

    a. CH_3I
    b. CH_3C
    c. CH_3OH
    d. CH_3Br
    e. CH_3F

13. Which of the following should be able to dissolve an ionic compound?

    a. liquid NH_3
    b. CCl_4
    c. benzene
    d. hexane

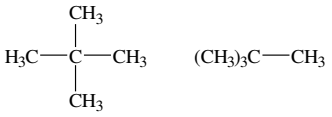
14. Which of the formula types gives us the MOST information about the structure of a molecule?

    a. a bond-line formula
    b. a molecular formula
    c. a Lewis structure
    d. a condensed formula

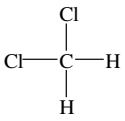
15. Which of the following is NOT an intermolecular force?

a. Ion-ion
b. Dipole-dipole
c. Hydrogen bonding
d. London force
e. Resonance

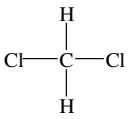
16. Which of the pairs below are structural or constitutional isomers?

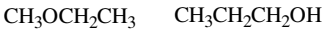


1



2





3

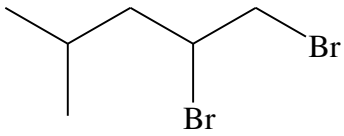
a. 1 and 2
b. 1 and 3
c. only 3
d. only 2
e. only 1

Fill in the Blanks (13 points)

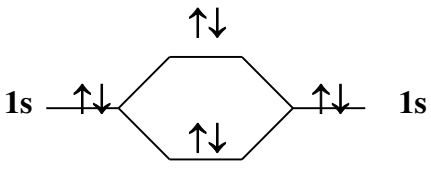
1. The carbon to carbon sigma bond in ethene (CH_2=CH_2) is formed by the _____ overlap of _____ orbitals of the two carbon atoms. The pi bond between the carbon atoms is formed by the _____ overlap of _____ orbitals of the two atoms. (to answer use: s, p, d, f, sp, sp^2, sp^3, side-to-side, end-to-end) (4 points)

2. Draw the bond-line formula for $CH_3CH_2COCH(CH_3)CH_3$ below. (3 points)

3. Write the condensed formula for the molecule shown below. _____ (3 points)



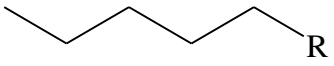
4. Below is the molecular orbital diagram for the helium molecule, He_2. Circle the electrons found in an antibonding orbital. The He_2 molecule doesn't exist normally because the bond order is _____. (3 points)



Short Answer (18 points)

1. Draw a 3-D picture of a molecule of propane ($CH_3CH_2CH_3$) <u>showing the orbital overlaps involved in the bonding</u>. Indicate the hybridization of all carbon atoms and label all bonds as either sigma or pi bonds. (4 points)

2. Name the following alkyl groups shown attached to the R group. (1 pt. each)



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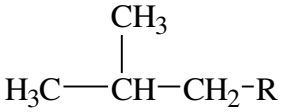

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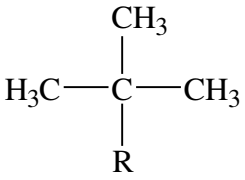

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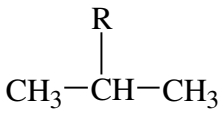

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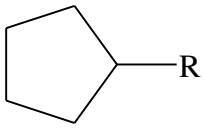


_____

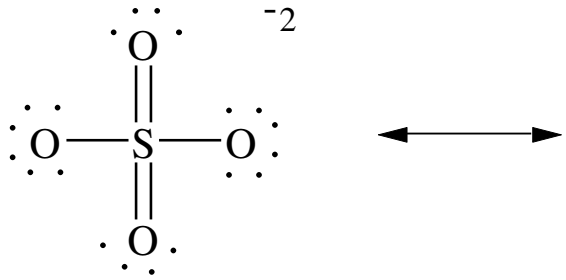
CH_3-R

_____

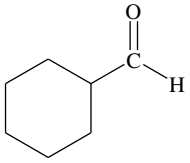
3. Write the molecular formulas and names for the first five <u>even</u> numbered alkanes. (C2-C10) (1 point each)

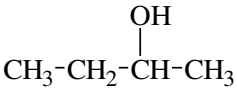
Formula	Name
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

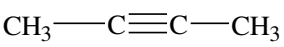
4. Draw one equivalent resonance form for the SULFATE ion shown. (3 points)

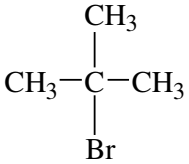


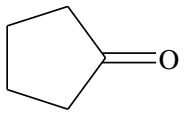
Classify the general type of each compound given below as an alkane, alkene, alcohol, aldehyde, ketone, etc. (2 points each)

1.  1. _____

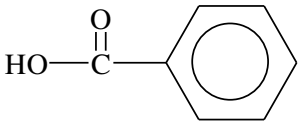
2.  2. _____

3.  3. _____

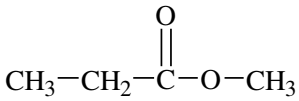
4.  4. _____

5. 

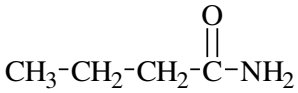
5. _____

6. 

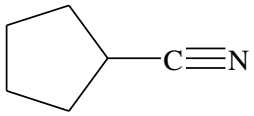
6. _____

7. 

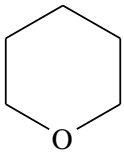
7. _____

8. 

8. _____

9. 

9. _____

10. 

10. _____