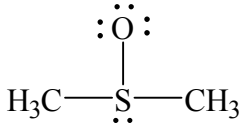
Organic Chemistry I
CHM2210
Exam I Fall 2006

Name KEY

Multiple Choice – Circle the letter of 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

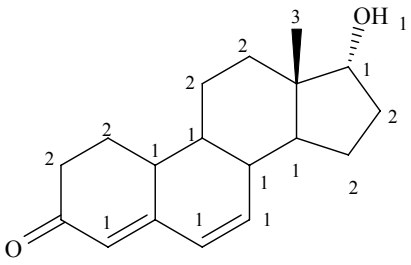
2. Which of the following compounds or ions would be trigonal planar in shape?

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

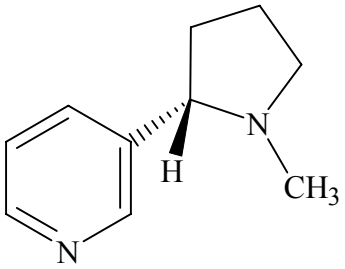
4. How many hydrogen atoms in the following steroid?



a. 18
b. 20
c. 21
d. 22
e. 24

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. FALSE

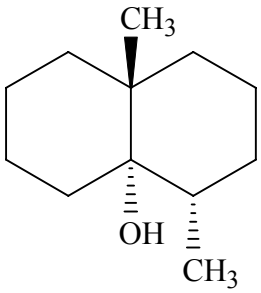
6. The structure of Nicotine is shown below. How many sp^2 hybridized carbon atoms are in the molecule?
(Don't forget bond-lines formulas don't show all H atoms and drawings don't always show unshared electron pairs.)



Nicotine

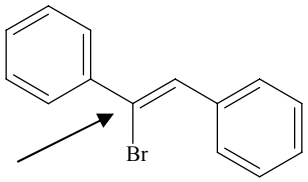
a. 2
b. 3
c. 4
d. 5
e. 0

7. A fairly common algal metabolite is the compound (-)-geosmin, which imparts a musty odor to water even at concentrations in the ppb range. What is the molecular formula of geosmin?



a. $C_{11}H_{20}O$
b. $C_{12}H_{22}O$
c. $C_{11}H_{21}O$
d. $C_{12}H_{20}O$
e. $C_{12}H_{21}O$

8. What would be the ideal value for the indicated bond angle in the following compound?



a. 90°
b. 109°
c. 120°
d. 180°
e. 360°

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 32 carbon atoms. What is its formula?

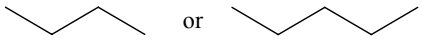
a. $C_{32}H_{32}$
b. $C_{32}H_{60}$
c. $C_{32}H_{64}$
d. $C_{32}H_{66}$
e. $C_{32}H_{68}$

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

a.

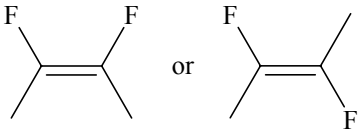
Highest

b.



Highest

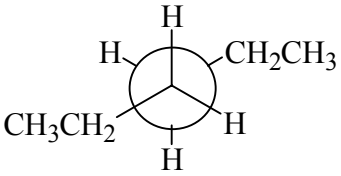
c.



Highest

12. The following Newman projection corresponds to which compound?

a. pentane
b. butane
c. 3-ethylbutane
d. hexane
e. 3-methylpentane



13. Which of the following should be able to dissolve a polar 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. Reactions that release a large amount of heat are often very favorable reactions. Such reactions are often referred to as _____ reactions.

a. entropy driven
b. enthalpy driven
c. free energy driven
d. activation energy driven
e. Volkswagen driven

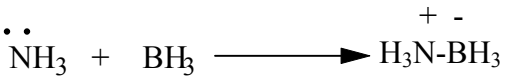
Fill in the Blanks (16 points)

1. Arrange these acids in the order of increasing acidity.

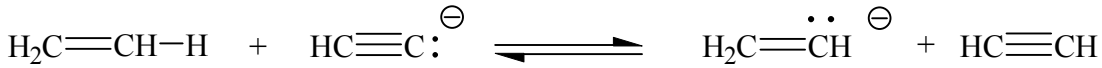
CH_4 H_2O HCl NH_3
(4 points)

$CH_4 < NH_3 < H_2O < HCl$

2. Predict the product for the Lewis acid-base reaction of ammonia with borane. (4 points)

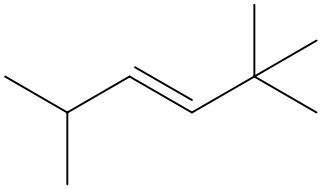


3. The reaction below will proceed to the left (As Written or To the Left)
(4 points).



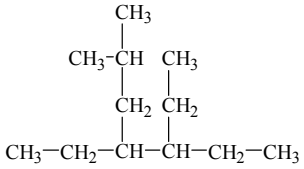
The pKa of ethene is 44 and the pKa of acetylene (ethyne) is 25.

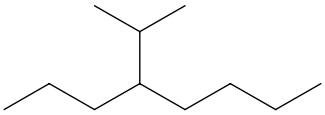
4. The molecule below contains how many quaternary carbon atoms? One (4 points)

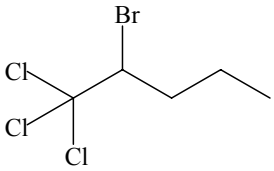


Short Answer (16 points)

1. Name the following compounds. (6 points)







4,5-diethyl-2-methylheptane

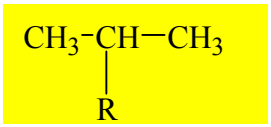
4-(methylethyl)octane

2-bromo-1,1,1trichloropentane

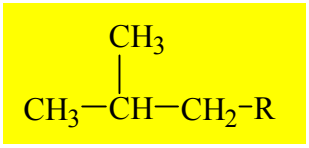
2. Using structural formulas, draw the following alkyl groups shown attached to an R group as shown in the example.
(1 pt. each)

CH_3–R

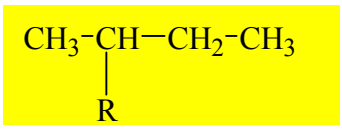
Methyl



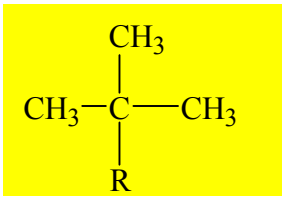
Isopropyl



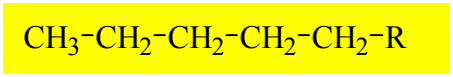
isobutyl



sec-butyl

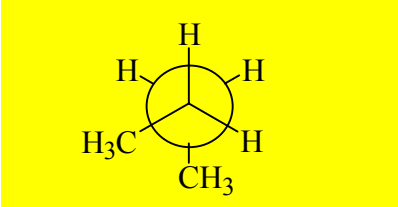


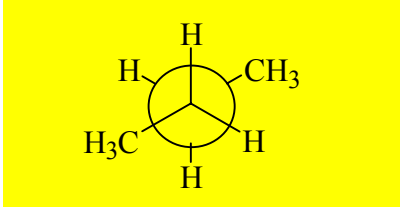
tert-butyl



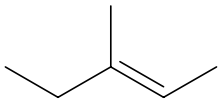
pentyl

3. Using Newman Projections, draw the two conformations of butane that represent energy minima on the energy diagram produced when butane is rotated around the C2-C3 bond. (4 points)

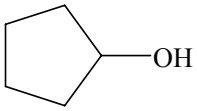




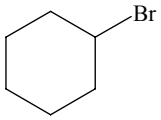
Classify the general type of each compound given below as an alkane, alkene, alcohol, aldehyde, ketone, etc. (2 points each)

1. 

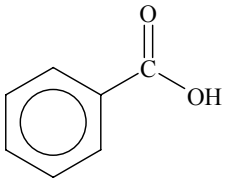
1. Alkene

2. 

2. Alcohol

3. 

3. Alkyl halide

4. 

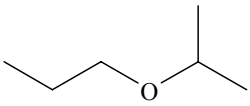
4. Aryl carboxylic acid

5. CH_3-C≡N

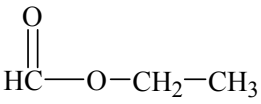
5. Nitrile

6. CH_3-CH_2-NH-CH_2-CH_3

6. Amine

7. 

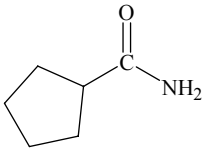
7. Ether

8. 

8. Ester

9. HC≡C—CH_3

9. Alkyne

10. 

10. Amide