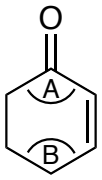
Multiple Choice. Choose the best answer for the following questions. (10 questions, 40 pts)

1. What atomic orbitals are involved in making a C-H bond in methane?

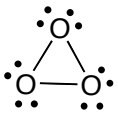
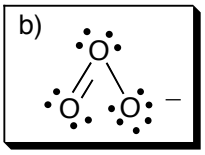
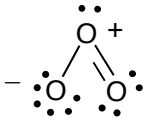
a) a 2p orbital on C and a 1s orbital on H
b) a 2s orbital on C and a 1s orbital on H
c) an sp3 orbital on C and a 1s orbital on H
d) an sp2 orbital on C and a 1s orbital on H

2. The bond angles A and B for the molecule below are:



a) A= 120°, B= 120°
b) A= 120°, B= 109°
c) A= 109°, B= 109°
d) A= 109°, B= 120°

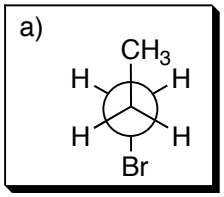
3. Ozone has the molecular formula of O_3. Which of the following is ***NOT*** a proper Lewis structure of O_3.

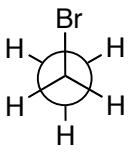
a) 
b) 
c) 
d) a, b, and c are all proper Lewis structures

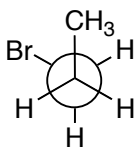
4. The barrier to rotation about the C-C bond of bromoethane is 15 KJ/mol. What energy value can be assigned to an H-Br eclipsing interaction?

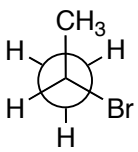
a) 15 KJ/mol
b) 4 KJ/ mol
c) 7 KJ/mol
d) The energy value cannot be determined with the information given.

5. Which of the following is the most stable conformation of 1-bromopropane?

a) 

b) 

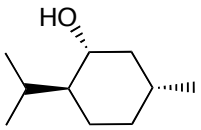
c) 

d) 

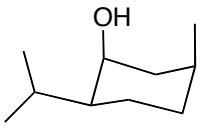
6. Ethoxide ion ($CH_3CH_2O^-$) is a useful base in organic chemistry. The pKa of ethanol is 16. Which of the following bases can be used to generate ethoxide ion from ethanol? (ignore the counter ion)

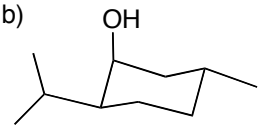
a) ^-CN (HCN, pKa = 9.3)
b) $CH_3CO_2^-$ (CH$_3$CO$_2$H, pKa = 4.7)
c) $^-NH_2$ (NH_3, pKa = 35)
d) all can be used equally as well

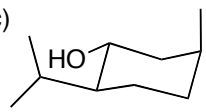
7. Menthol is a naturally occurring organic compound that is used as a flavoring. Menthol contains a cyclohexane ring and is shown below. Which is the proper chair conformation of menthol?

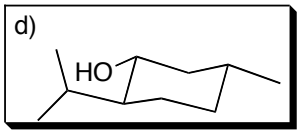


menthol

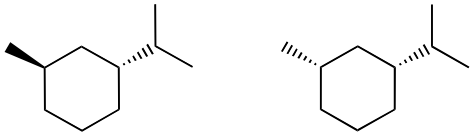
a) 

b) 

c) 

d) 

8. The two compounds shown below are



a) stereoisomers
b) constitutional isomers
c) conformers
d) identical

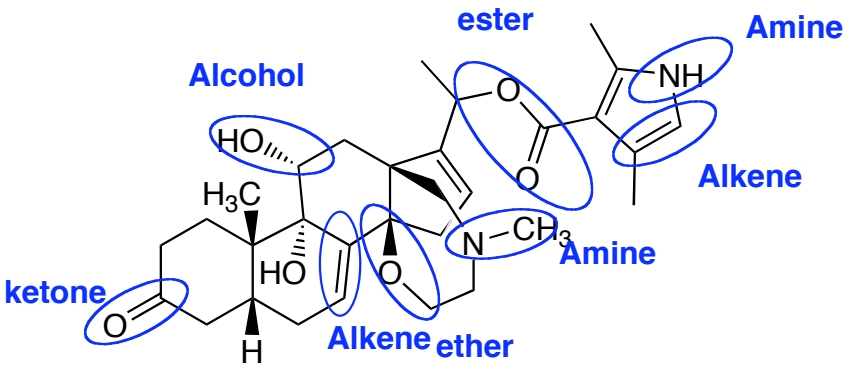
9. Consider rotation about the C2-C3 bond of 2-methylbutane. What is the total strain energy for the least stable conformation (i.e., what is the barrier to rotation)

a) 7.6 KJ/mol
b) 16 KJ/mol
c) 18 KJ/mol
d) 21 KJ/ml

10. Which of the following is the highest energy conformation of cyclohexane?

a. chair
b. boat
c. half-chair
d. eclipsed

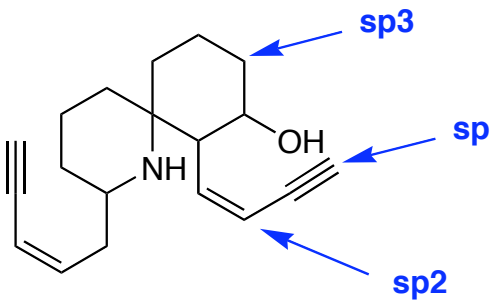
11. Batrachotoxin is the active toxin from the poison dart frog, *Phyllobates terribilis*. The structure of batrachotoxin is shown below. Clearly identify (circle) and name five different functional groups other than alkane and cycloalkane. Be sure the circle the entire functional group. (10 pts)



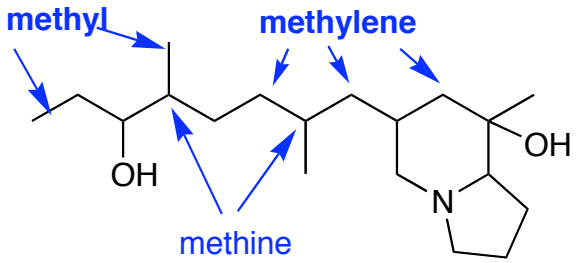
Batrachotoxin

12. a. Histioniconotoxin is the active toxin from the poison dart frog *Dendrobates histrionicus*. Clearly identify an sp3, sp2 and sp hybridized carbon (one each) in histioniconotoxin. If there are no carbons of a particular hybridization, please state this. (5 pts)

b. Pumiliotoxin is the active toxin from the poison dart frog *Dendrobates pumilio*. Clearly identify a methyl, methylene and methine group of pumiliotoxin. If there are no such groups, please indicate this. (5 pts total)

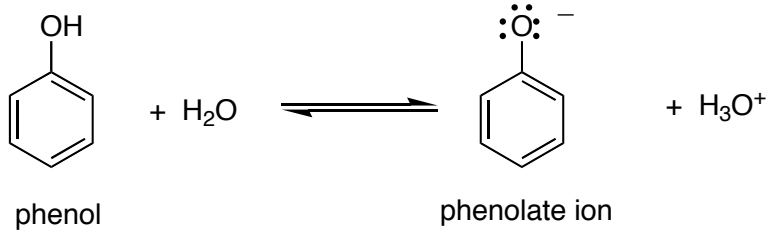


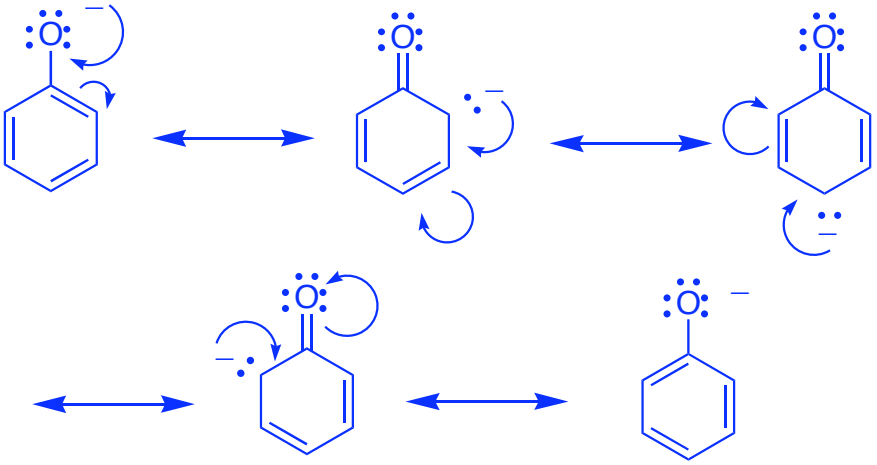
Histionicotoxin



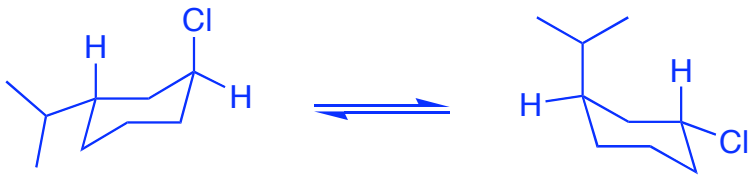
Pumiliotoxin

13. The pKa of methanol is about 16. Phenol is an unusually acidic alcohol with a pKa of about 10. The increased acidity of phenol can be attributed to the resonance stabilization of the conjugate base of phenol (phenolate ion). Draw all unique resonance forms of the phenolate ion and draw mechanistic arrows showing how they interconvert. (10 pts)





14. The energy difference between the two chair conformations of chlorocyclohexane is 2.8 KJ/mol. The energy difference between chair conformations of (1-methylethyl)cyclohexane is 9.2 KJ/mol.
   a) Draw the two chair conformation of trans-1-chloro-3-(1-methylethyl)cyclohexane. (5 pts)
   b) Calculate is the energy difference between the two conformations. (5 pts)
   c) Calculate the equilibrium constant between the two conformations. (5 pts)



E= 2.8 KJ/mol E= 9.2 KJ/mol

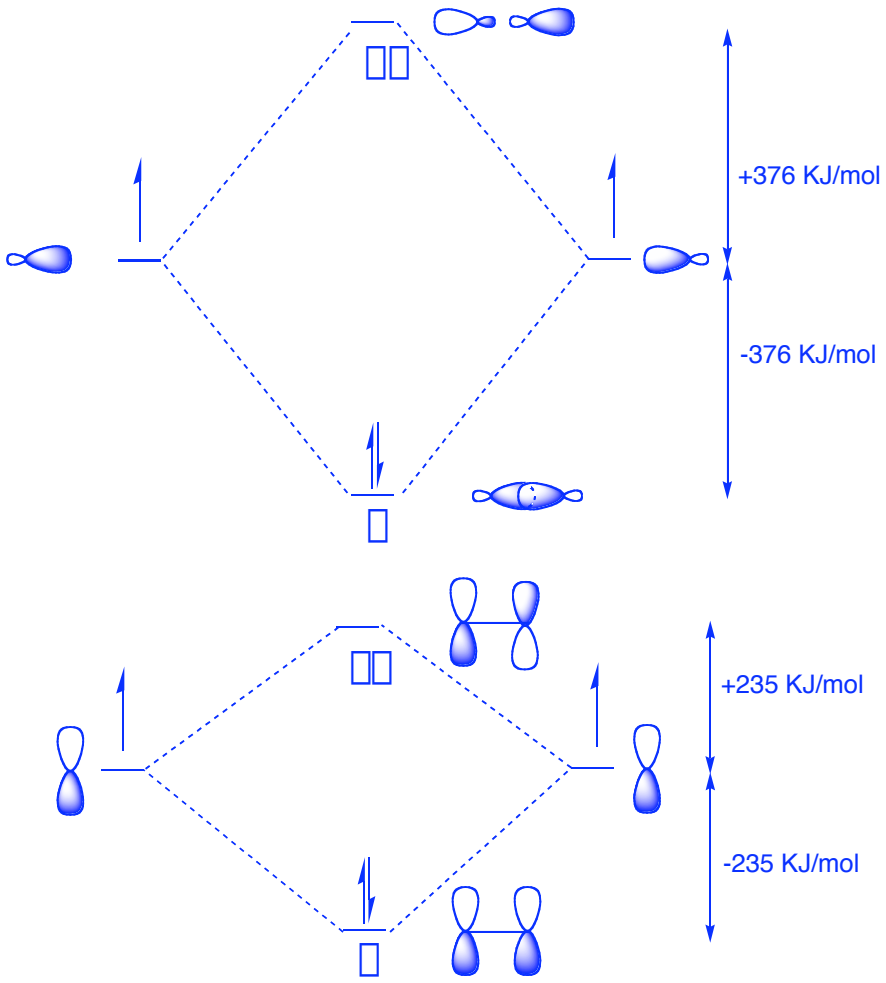
$$\Delta E = 9.2 - 2.8 = 6.4 \text{ KJ/mol}$$

$$6.4 = -(300\ ^\circ\text{K})\ (8.3 \times 10^{-3}\ \text{KJ/ mol}\ ^\circ\text{K})(\ln K_{eq})$$

$$\frac{-6.4}{(300)\ (8.3 \times 10^{-3})} = \ln K_{eq}$$

$$K_{eq} = e^{\left(\frac{-6.4}{(300)\ (8.3 \times 10^{-3})}\right)}$$

15. The bond dissociation energy for a carbon-carbon □-bond is 376 KJ/mol while that of a carbon-carbon □-bond is 235 KJ/mol. With this information, draw a molecular orbital diagram of both bonds in the carbon-carbon double bonds. Draw the orbitals showing their relative energies. (15 pts)



Problem	1-10:_____	(40 pts)		13:_____	(10 pts)
	11:_____	(10 pts)		14:_____	(15 pts)
	12:_____	(10 pts)		15:_____	(15 pts)

Total out of 100: _____