NAME (Print): _____

SIGNATURE: _____

Chemistry 310M/318M
Dr. Brent Iverson
1st Midterm
Sept. 28, 2005

Please print the first three letters of your last name in the three boxes

Please Note: This test may be a bit long, but there is a reason. I would like to give you a lot of little questions, so you can find ones you can answer and show me what you know, rather than just a few questions that may be testing the one thing you forgot. **I recommend you look the exam over and answer the questions you are sure of first**, then go back and try to figure out the rest. Also make sure to **look at the point totals** on the questions as a guide to help budget your time.

Note: You must have your answers written in blue or black pen if you want a regrade!!!!

Do not take this in red ink, as that is what we will use to grade it!

Please answer the following before you begin:

Have you been to a recitation section? _____

Page	Points	
1		**(28)**
2		**(17)**
3		**(32)**
4		**(20)**
5		**(18)**
6		**(18)**
7		**(13)**
8		**(26)**
9		**(13)**
10		**(20)**
11		**(20)**
Total		**(225)**
HW		
T Score		

Signature_____ Pg 1 _____(28)

1. (6 pts) In the space provided, write the most important question in chemistry.

2. In the space provided, draw acceptable Lewis line structures for the following molecules. Make sure to show all formal charges and lone pairs of electrons. (Do not assume that all of the following molecules are uncharged as identifying a charged molecule is part of the question).

A) (4 pts) **$CH_3CH_2CH_3$**

B) (4 pts) **$CH_3CH_2CHCH_2$**

C) (6 pts) **$CH_3OCH_2CH_2NH_3$**

D) (8 pts) For this one you need to draw the two most important contributing sructures.

CH_3CO_2

3. (1 pt each) For the following TRUE and FALSE questions, CIRCLE ALL THE TRUE STATEMENTS. This is not meant to be tricky, but please read the statements carefully so that you do not make any careless errors. This page is worth a lot of points, so take your time.

A. Resonance contributing structures are used when more than one structure are required to describe accurately how the electrons and charges are distributed in a molecule

B. Resonance contributing structures do not represent equilibrating structures, rather the hybrid (blending) of them is the true molecular representation.

C. When drawing resonance contributing structures you generally move atom nuclei and sigma bonds.

D. When drawing resonance contributing structures, you should move pi bonds (*one* bond of a double or triple bond) and lone pair electrons, not atom nuclei or sigma bonds.

E. Arrows drawn on contributing structures show how electron pairs move.

F. Equivalent resonance contributing structures make equal contributions to the resonance hybrid.

G. For unequal resonance contributing structures: full octets are favored, fewer charges are favored, and a negative charge on more electronegative atom (also positive charge on less electronegative atom) are favored.

H. Electrons have certain properties of particles and certain properties of waves.

I. For organic chemistry, it is best to think of electron density as particles, described by Newton's laws.

J. For organic chemistry, it is best to think of electron density as waves, described by wave equations.

K. According to the valence bond approach, the atomic orbitals on each atom are combined (hybridized) first, and bonds are derived from overlap of hybridized orbitals.

L. According to molecular orbital theory, the atomic orbitals on each atom are combined (hybridized) first, and bonds are derived from overlap of hybridized orbitals.

M. An sp^3 hybridized carbon atom has only two major hybridized orbitals, arranged in a bent geometry.

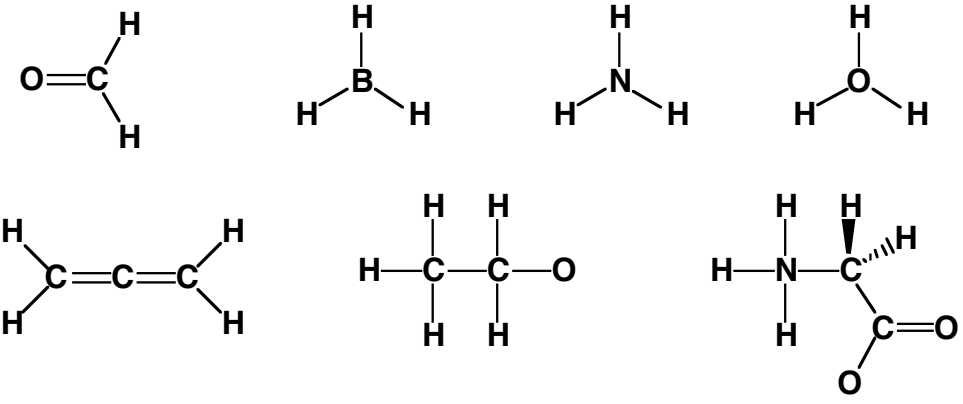
N. An sp^3 hybridized carbon atom has only one major hybridized orbital.

O. An sp^3 hybridized carbon atom has four major hybridized orbitals, arrangened in a tetrahedral geometry.

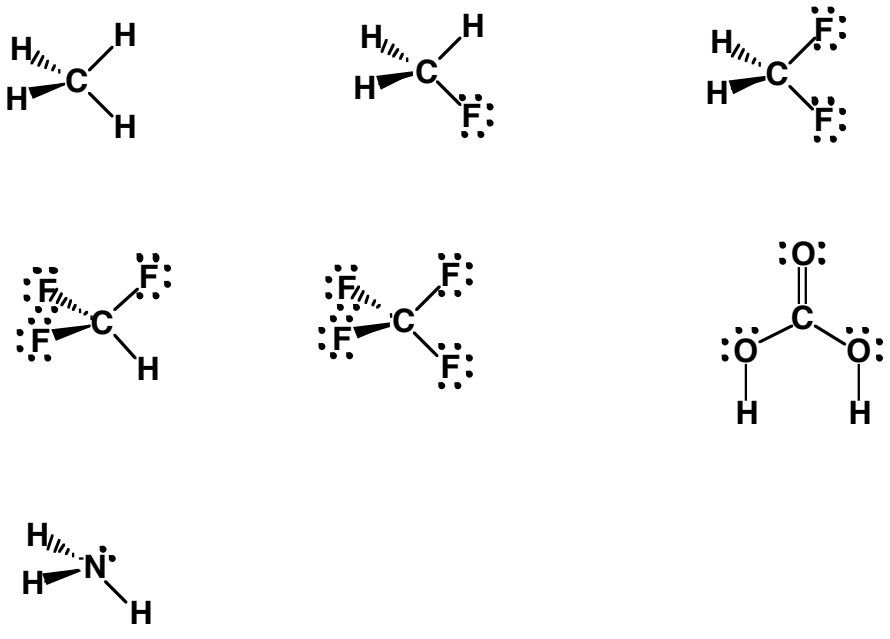
P. A sigma bond occurs when the majority of the electron density is found on the bond axis.

Q. A pi bond occurs when the majority of the electron density is found on the bond axis.

4. (11 pts) Some of the molecules shown below have formal charges. For those that do, write the correct formal charge next to the appropriate atom. IN ADDITION, SOME OF THE ATOMS ON THESE MOLECULES NEED LONE PAIRS ADDED. ADD ALL VALENCE LONE PAIRS OF ELECTRONS WHERE APPROPRIATE.

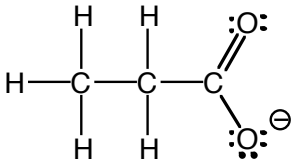


5. For the following molecules: 1) Use the ⟶ sign to indicate the direction of the bond dipole in all of the **polar** bonds. 2) Circle all molecules that have a measurable molecular dipole moment. 3) For the molecules you circled, to the best of your artistic ability, use an additional ⟶ sign to indicate the direction of the molecular dipole moment on the left side of the molecule.
(21 pts total)

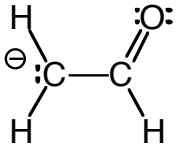


6. (20 pts) For each molecule in which contributing structures are appropriate, draw a second important contributing structure. **Draw arrows on the structure on the left to indicate the flow of electrons that leads to the contributing structure you drew on the right.** If the two contributing structures are **not** expected to contribute equally to the resonance hybrid, circle the one that makes the **larger** contribution. PLEASE READ THESE DIRECTIONS AGAIN TO MAKE SURE YOU KNOW EXACTLY WHAT WE WANT HERE!

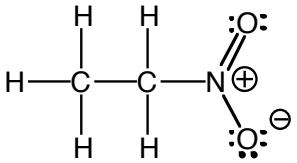
A.



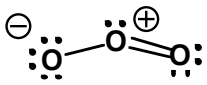
B.



C.

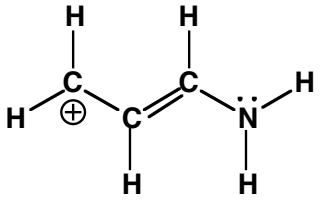


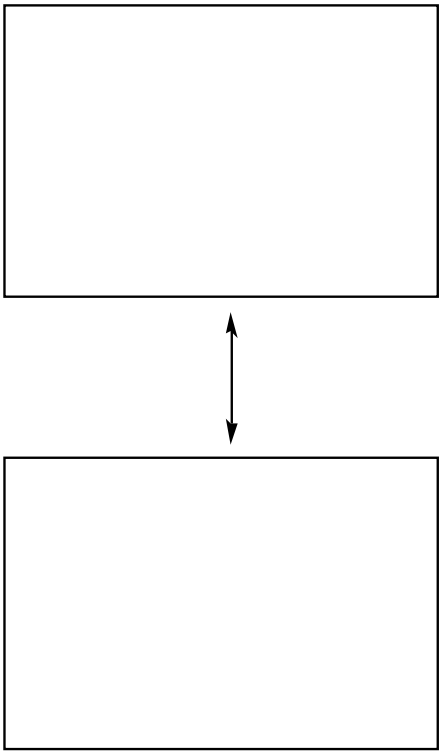
D.



Ozone

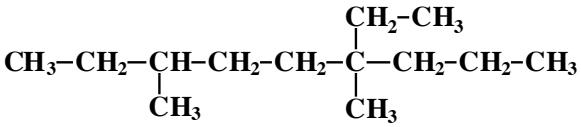
6. (cont.) (6 pts) For this molecule in which contributing structures are appropriate, draw the next two most important contributing structures. **Draw arrows on the structure on the left to indicate the flow of electrons that leads to the contributing structure you drew on the right.** You do not have to circle the predominant contributing structure, as you have not yet learned which one is more stable.





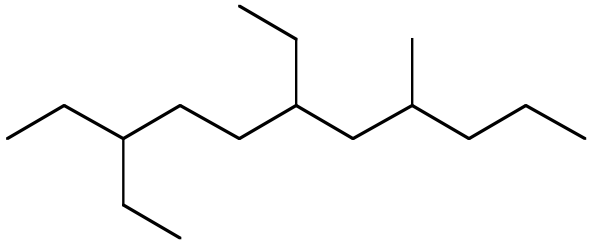
7. (6 pts each) Name the following molecules according to IUPAC nomenclature rules

A)



_____

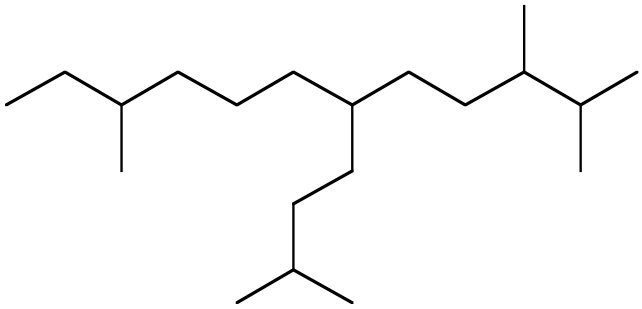
B)



_____

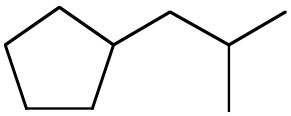
7. (cont.) (6 pts each) Name the following molecules according to IUPAC nomenclature rules

C)



_____

D)

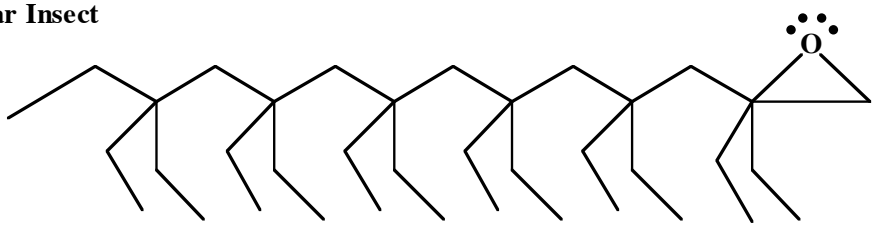


_____

E) For this one, write the structure that corresponds to the following IUPAC name.

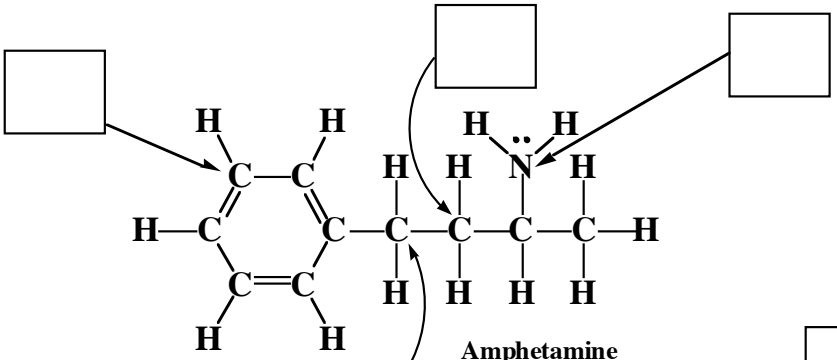
3-Ethyl-5-(1-methylethyl)octane

Molecular Insect

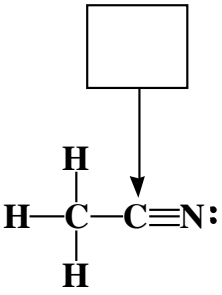


(You don't need to name this one!)

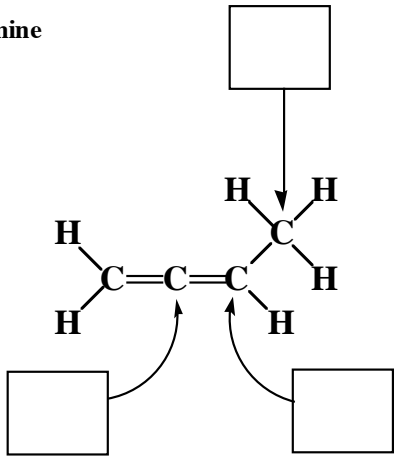
8. (13 pts) In the box provided, write the hybridization state (sp^3, etc.) of the atom indicated by the arrow.

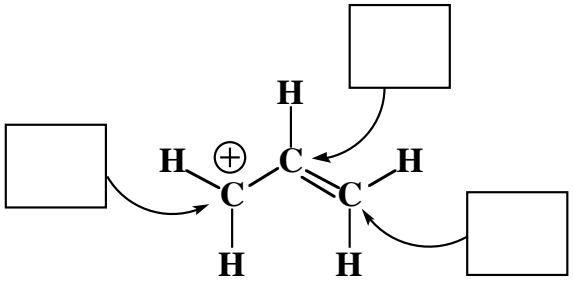


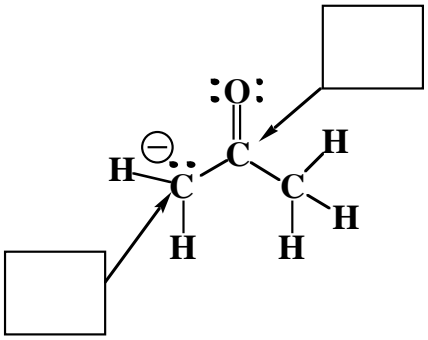
Amphetamine



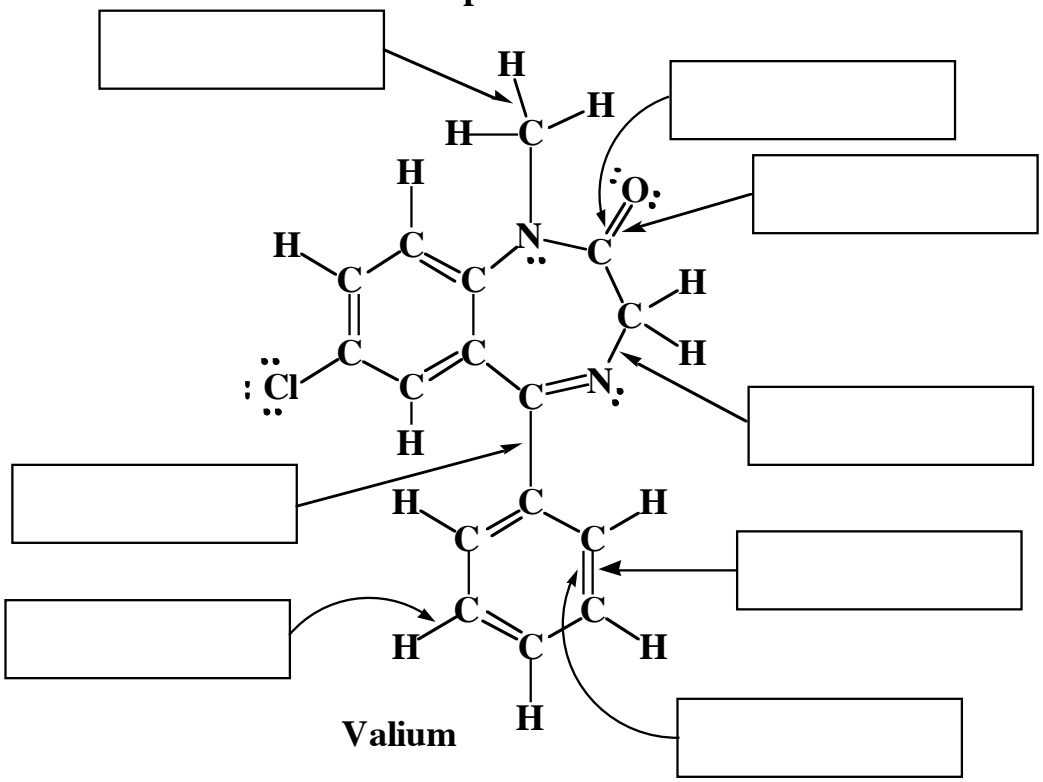
Acetonitrile (a solvent)





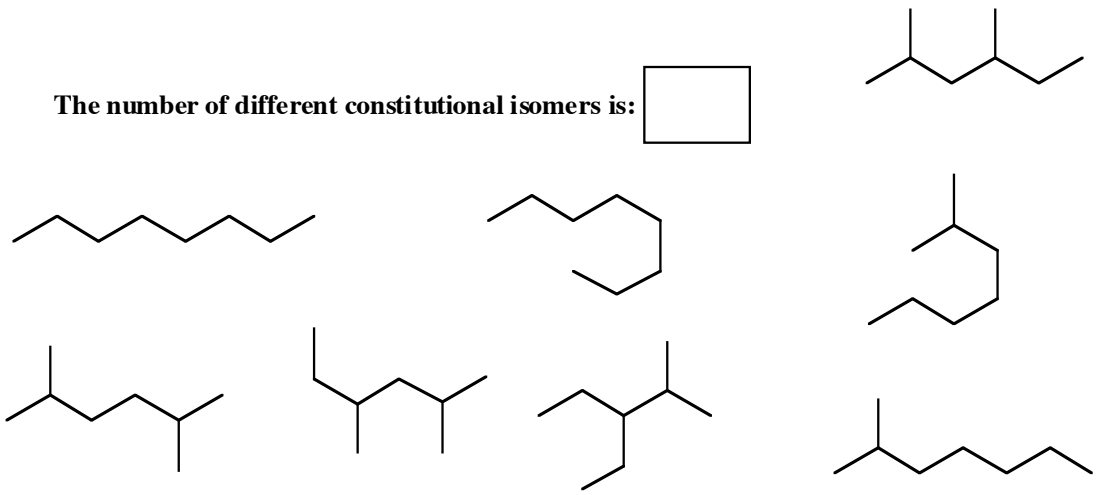


9. (16 pts) You knew this was going to be on the test. In the spaces provided, indicate the type of bond, and the hybridized orbitals that overlap to form the bond.
For example, one answer could be: $\sigma_{Csp^3\text{-}H1s}$



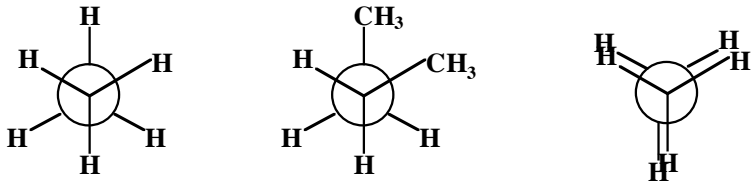
10. (10 pts) For the following molecules: 1) in the box provided state how many **DIFFERENT** constitutional isomers are represented by the structures below. 2) **CIRCLE** all of the molecules with the IUPAC name of 2,4-dimethylhexane.

The number of different constitutional isomers is: ☐



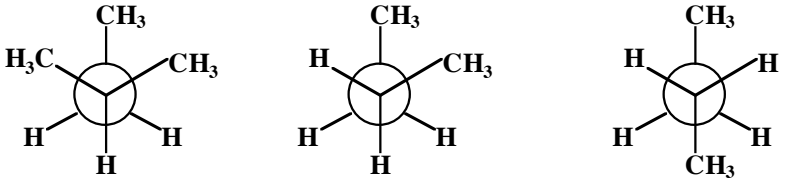
11. (13 pts) This page tests your understanding of important chemical terms. Make sure you read these carefully so that you do not make any silly mistakes.

A) Circle the structure with the MOST <u>torsional strain</u>.



The structure you circled is given the special name _____

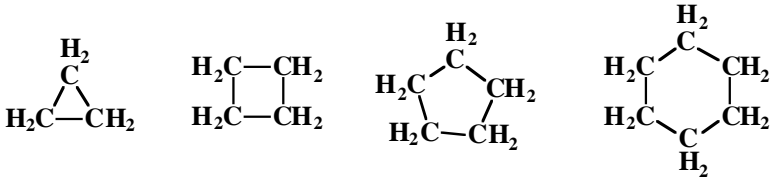
B) Circle the structure with the LEAST <u>steric strain</u>.



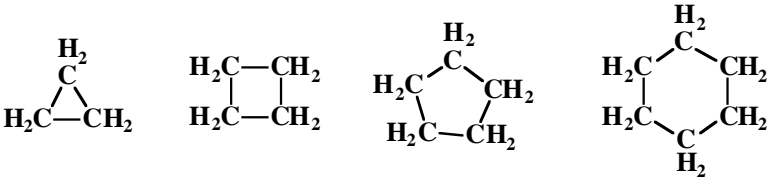
The structure you circled is given the two special names _____

and _____ **.**

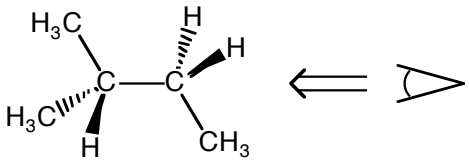
C) Circle the structure with the MOST <u>angle strain</u>.

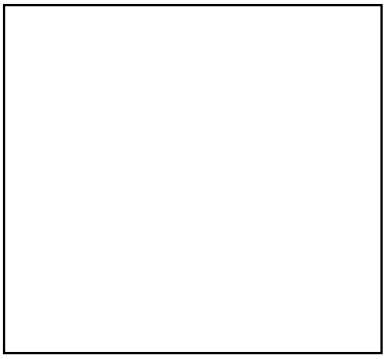


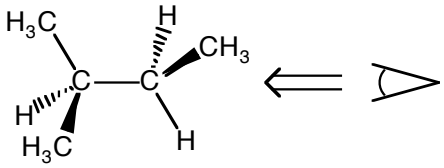
D) Circle the structure with the LEAST <u>torsional strain</u>.

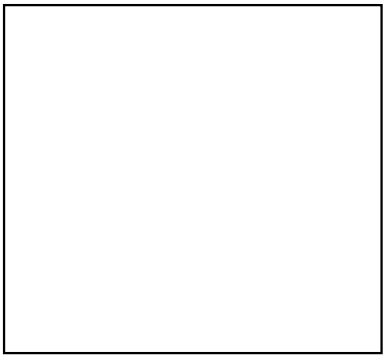


12. (14 pts) Draw a Newman projection for each alkane viewed down the bond as indicated. Circle the Newman projection you drew that represents a conformation with the MOST STERIC STRAIN.

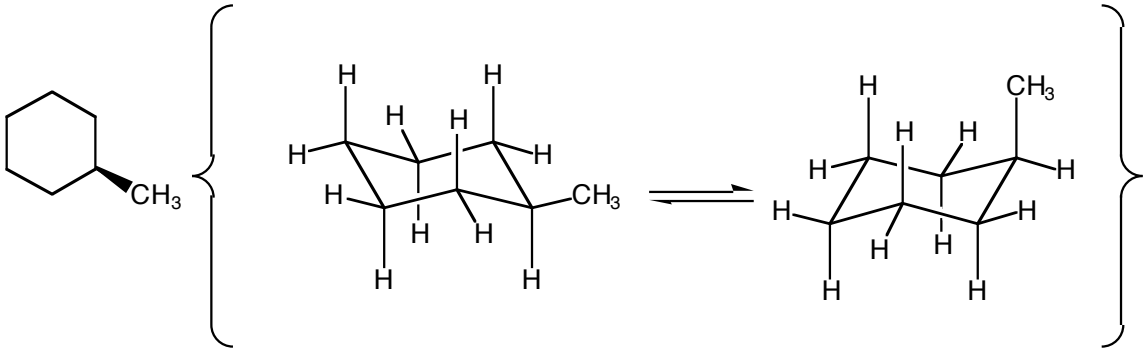




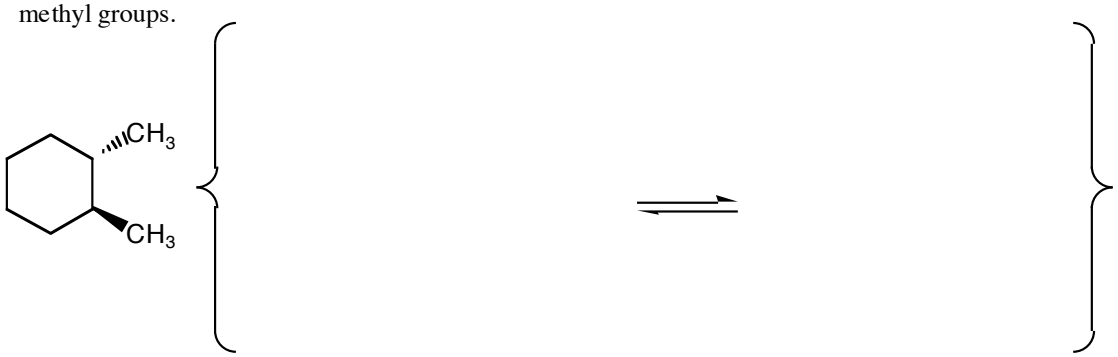




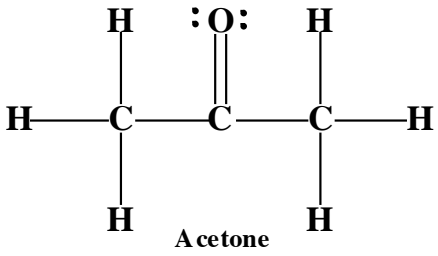
13. (6 pts) On the following chair structures: 1) **CIRCLE all of the AXIAL atoms or groups**. 2) **DRAW A BOX AROUND the more stable chair conformation**.



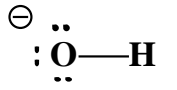
14. (12 pts) Now it is your turn. For the following cyclohexane derivative, draw the two alternative chair conformations, and circle the one the predominates at equilibrium. Note that you do not have to draw H atoms on the structures is you do not want to. You just need to indicate the precise placement of the methyl groups.



15. (8 pts) Here is an "apply what you know" problem. Fret not, it is only worth 8 pts total! If you get this correct, you will understand the basis for most of the chemistry in Chapter 16!! Remember the most important question in Chemistry! **Shown below are the acetone molecule, a proton, and the hydroxide anion. Draw all the appropriate bond dipole moments on the acetone and hydroxide anion molecules for all the polar covalent bonds. Draw a BOX around the atom on the acetone molecule that is most likely to interact with the proton, and draw a CIRCLE around the atom on the acetone molecule most likely to interact with the hydroxide anion.** Read these directions again to make sure you know what we want!



Acetone



Hydroxide anion