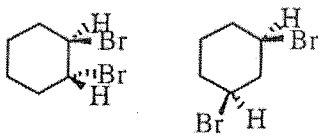
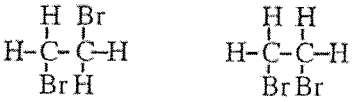
JASPERSE CHEM 341 TEST 1 VERSION 3

Ch. 1 Structure and Bonding
Ch. 2 Polar Covalent Bonds; Acids and Bases
Ch. 3 Organic Compounds: Alkanes and Cycloalkanes
Ch. 4 Stereochemistry of Alkanes and Cycloalkanes

1. (12 points) Give the relationship between the following pairs of structures. The possible relationships are the following:

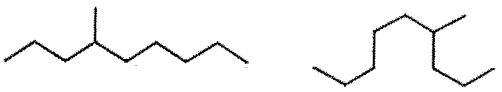
same compound structural isomers resonance structures
stereo isomers not isomers (different molecular formula)

a.  structural

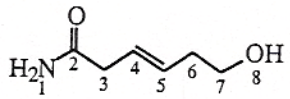
b.  same

c.  structural

d.  stereo (trans - cis)

e.  same

f.  resonance (only e's moved)

2. (10 Points) 

a. For the above structure, what is the hybridization and approximate bond angles (109, 120, or 180) about:

C-2	sp^2	120
C-4	sp^2	120
C-6	sp^3	109
O-8	sp^3	109

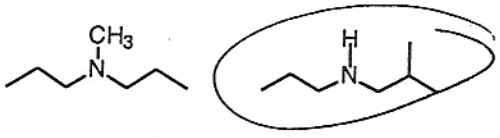
b. In the above structure, N-1 is found to have 120° bond angles. What is the hybridization of the nitrogen?

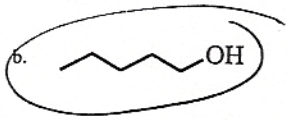
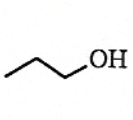
120 = sp^2

3. (2 Points) Bond rotation around C6-C7 in the above structure has a 7 kcal/mol barrier, while rotation around the C4-C5 bond has a 70 kcal/mol barrier. Explain very briefly why it is so much harder to rotate the latter bond?

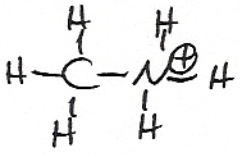
Alkene has overlapping p orbitals. To rotate double bond, p overlap would be lost. Full π bond would break.

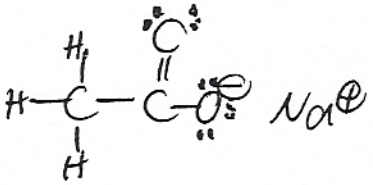
4. (4 points) For each of the pairs listed, circle the one with the higher boiling point.

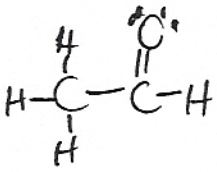
a.  H-bonding

b.   Molecular weight ⇒ London

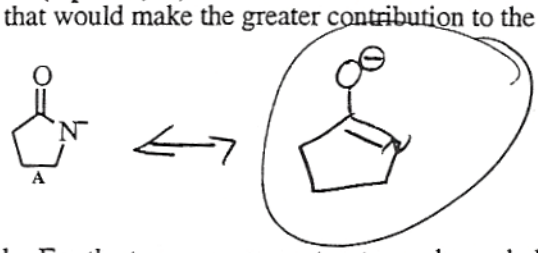
5. (6 points) Write a Lewis structure and assign any non-zero formal charges.

a. $[CH_3NH_3]^+$ 

b. CH_3CO_2Na 

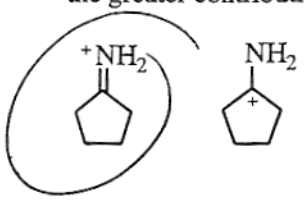
c. CH_3COH 

6. (5 points) a) draw the best resonance structure for anion **A**, and circle the resonance structure that would make the greater contribution to the resonance hybrid.



electroneg

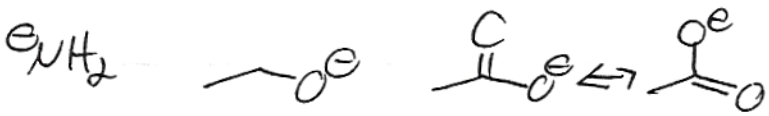
b. For the two resonance structures shown below, circle the resonance structure that would make the greater contribution to the resonance hybrid.



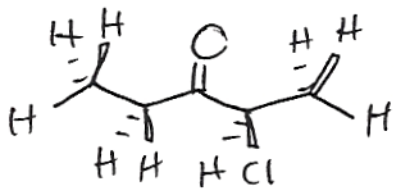
more bonds

7. (6 points) Rank the acidity of the following molecules, 1 being most acidic, 4 being least acidic. Hint: draw the anions!

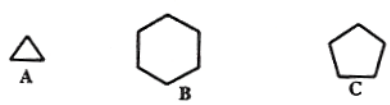
NH_3 (4) CH_3CH_2OH (3) CH_3CO_2H (2) HCl (1)



8. (6 points) Draw a line-angle picture for all of the atoms in the molecule $CH_3CH_2COCHClCH_3$, including the hydrogens. Use the hash-wedge convention to indicate atoms that are not in the plane of the paper.



9. (5 points) Rank the ring strain in the following, from 1(most) to 3 (least). Explain very briefly the differences in strain.



A: 1

B: 3

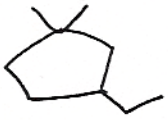
C: 2

A has severe angle strain. 60° angles far from ideal 109°.

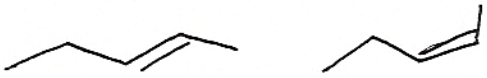
B has no angle or torsional strain.

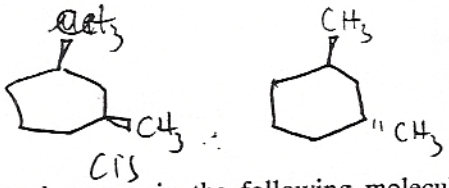
C has a little bit of torsional/eclipsing strain.

10. (6 points) Which of the following are capable of geometric (cis-trans) isomerism? (Yes/No).

a. 3-ethyl-1,1-dimethylcyclopentane  no

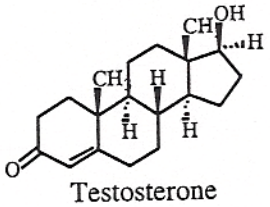
b. 3-pentene (name means a double bond is between carbons 3 and 4)

 Yes

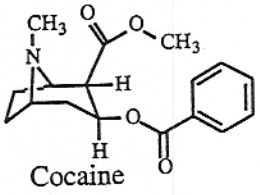
c. 1,3-dimethylcyclohexane  cis Yes

11. (9 points) Identify the functional groups in the following molecules. (Do not include "alkane", since that is not "functional". And do not specify "cyclic".)

a. H_2N ⌒ CO_2H ("GABA: brain neurotransmitter") amine acid

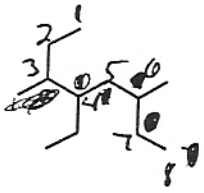
b. 
Testosterone

alcohol
alkene
ketone

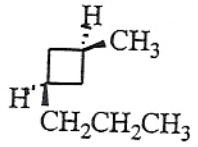
c. 
Cocaine

amine
ester
aromatic

12. (5 points) Give the IUPAC name for the following compounds.

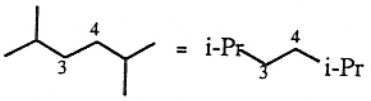
a. 

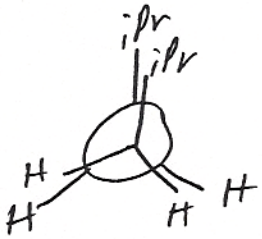
4-ethyl-3,6-dimethyl octane

b. 

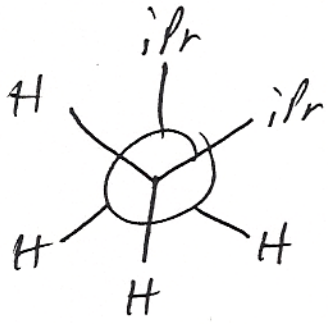
cis-3-methyl-1-propyl cyclobutane

13. (8 points) a. Draw Newman projections for the totally eclipsed, the gauch, and the anti conformations of 2,5-dimethylhexane, relative to the C3-C4 bond. You may abbreviate the isopropyl groups attached to C3 and C4 as "i-Pr" for convenience.
b. Explain very briefly why the rotation barrier around the C3-C4 bond of 2,5-dimethylhexane is greater than the rotation barrier in butane.

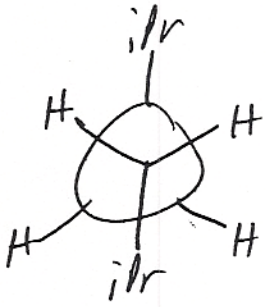




totally eclipsed



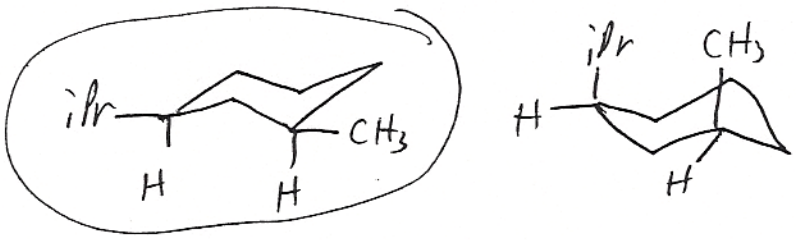
gauche



anti

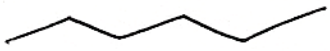
Rotation barrier is difference between best and worst. Total eclipse of bulky isopropyls is worse than just eclipsing two methyls.

14. (8 points) a.) Draw the two chair conformations of cis-3-methyl-1-isopropylcyclohexane. (You don't need to show the H's on carbons other than 1 and 3). For convenience, you may abbreviate methyl as "Me" and isopropyl as "iPr"
b.) **Circle the more stable conformation.**
c) Would trans-3-methyl-1-isopropylcyclohexane be more stable or less stable than the cis isomer?



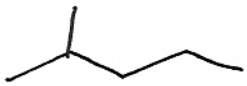
Trans would be less stable. In cis, both substituents can be equatorial. In trans, one must be axial.

15. (8 points) Draw line-angle structures and names for 4 of the 5 structural isomers of C_6H_{14}.

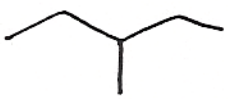


hexane

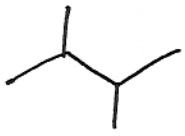
C_nH_{2n+2} so acyclic



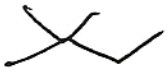
2-methylpentane



3-methylpentane



2,3-dimethylbutane



2,2-dimethylbutane