

CHEMISTRY 241
EXAMINATION I
Wednesday, February 1, 2006
Professor William P. Dailey

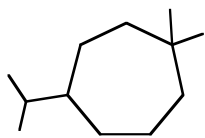
NAME: _____

Student ID number : _____

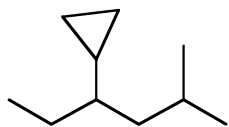
QUESTIONS	POINTS	SCORE
1.	18	_____
2.	8	_____
3.	7	_____
4.	12	_____
5.	5	_____
6.	5	_____
7.	8	_____
8.	15	_____
9.	12	_____
10.	10	_____
	TOTAL	_____

READ ALL QUESTIONS CAREFULLY BEFORE ANSWERING THEM.

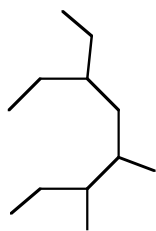
1. (15 points)a. Provide correct IUPAC names for the following compounds.



1,1-Dimethyl-4-(1-methylethyl)cycloheptane
or 4-Isopropyl-1,1-dimethylcycloheptane



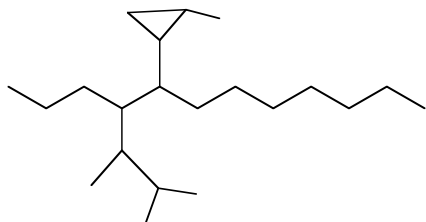
4-Cyclopropyl-2-methylhexane



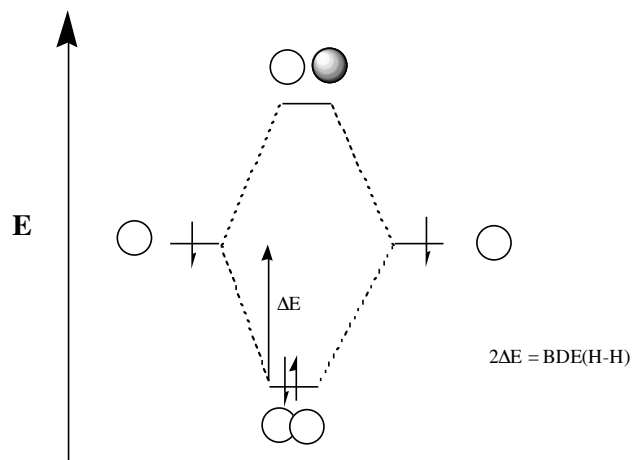
6-Ethyl-3,4-dimethyloctane

(3 points)b. Draw a correct structural representation for the following compound.

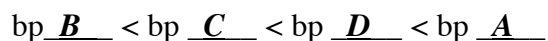
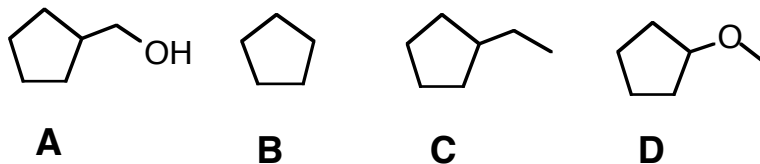
5-(1,2-dimethylpropyl)-4-(2-methylcyclopropyl)decane



2. (8 points) Draw a simple molecular orbital diagram to illustrate the bond between two hydrogen atoms in molecular hydrogen. Use an energy scale to show how the starting atomic orbitals combine to form the molecular orbital(s). Show how you can relate the bond energy of the H-H bond to your diagram.



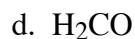
3. a. (3 points) Rank the following compounds in order of increasing boiling point.



- b. (4 Points) Clearly explain your reasoning for this ordering.

B has fewer atoms than the others, so it has less surface area (van der Waals) interactions than the other. B and C have a very, very small dipole moment so there is little dipole-dipole interaction between them. This is in contrast to A and D which have a modest dipole moment. Finally, A has the ability to hydrogen bond to itself while none of the others do.

4. (12 Points) For each of the following compounds, illustrate the geometry of the molecule and indicate whether there is a molecular dipole moment and, if so, indicate its direction.



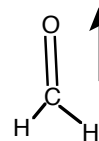
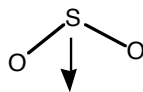
trigonal planar

linear

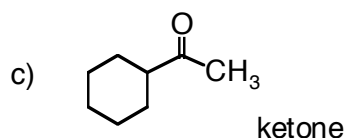
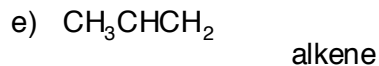
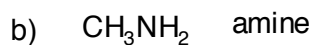
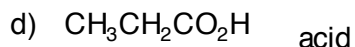
bent

no dipole

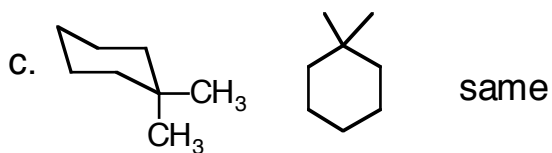
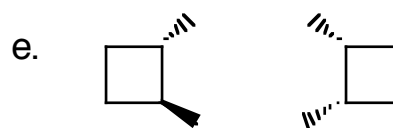
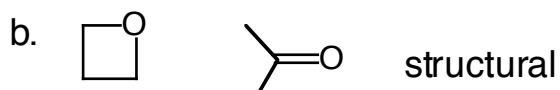
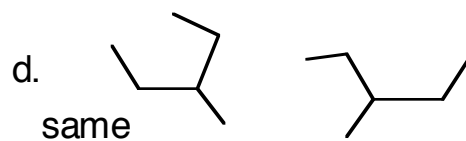
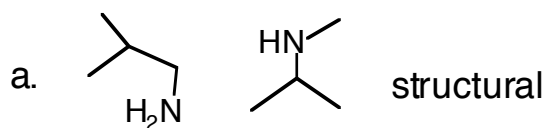
no dipole



5. (5 Points) Classify each of the following organic compounds as an alcohol, ketone, ester, aldehyde, amide, alkene, alkyne, ether, amine, nitroalkane, or nitrile.

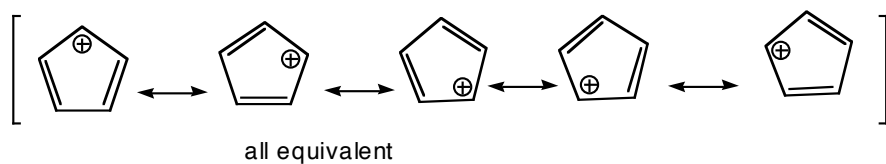
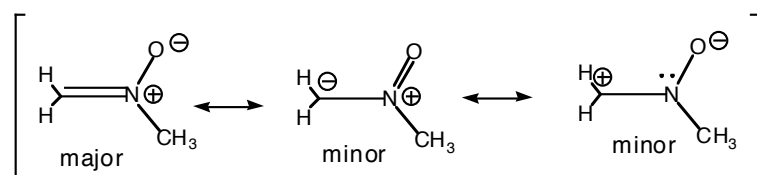


6. (5 Points) State whether the following pairs of compounds are the same compound, geometric isomers, structural isomers or not isomers.

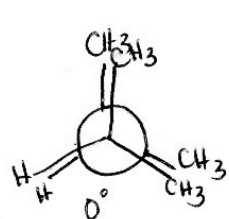
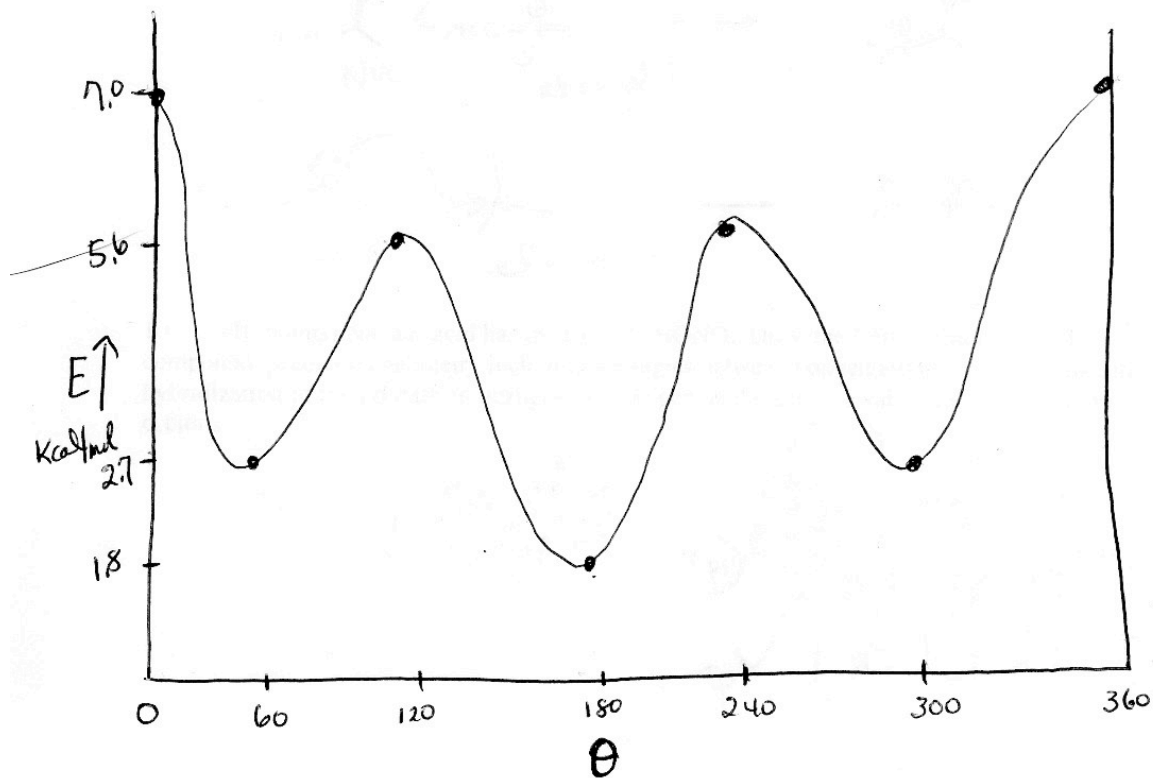


geometric

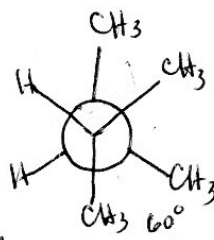
7. (8 Points) Draw all the important resonance structures for the following molecules. Label each as a major, minor, or equivalent form to the resonance hybrid.



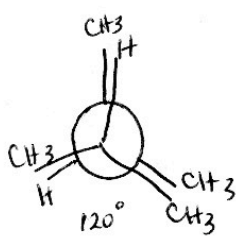
8. (15 Points) Sketch a curve of relative potential energy vs. dihedral angle for the rotation about the 2,3-bond of 2,3-dimethylbutane. Label each energy minimum and energy maximum with a Newman projection and predict the relative energy for each point in kcal/mol or kJ/mol (label which!).



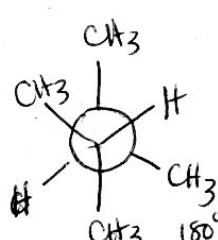
$$E = 3 + 3 + 1 = 7 \text{ kcal/mol}$$



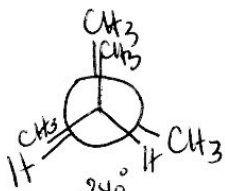
$$E = 3(0.9) = 2.7$$



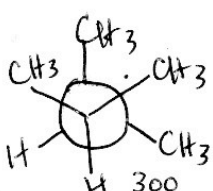
$$E = 1.3 + 1.3 + 3 = 5.6$$



$$E = 2(0.9) = 1.8$$



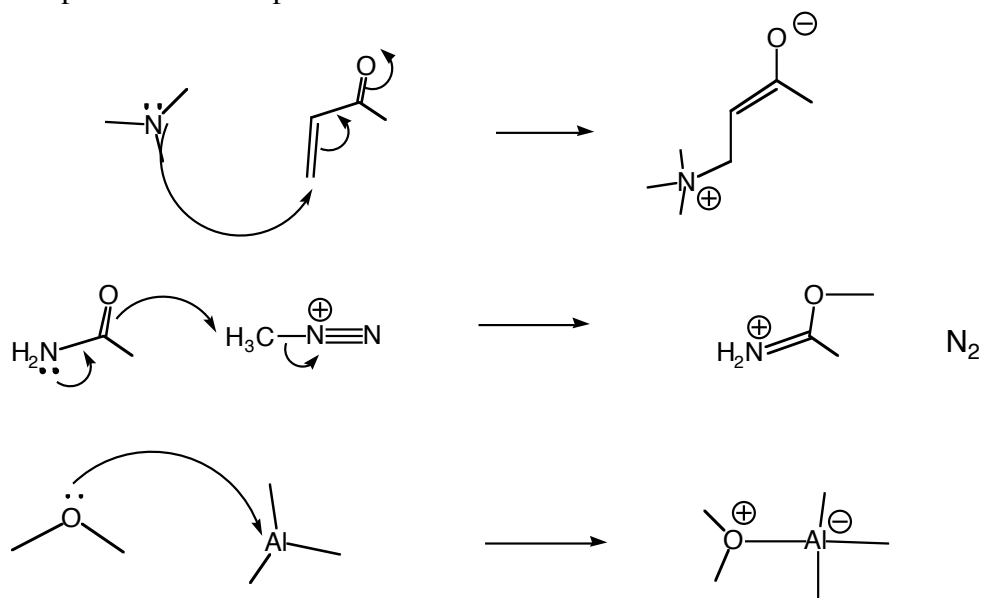
$$E = 1.3 + 1.3 + 3 = 5.6$$



$$E = 3(0.9) = 2.7$$

5

9. (12 Points) Use the "curved arrow formalism" to show how the following reactions proceed. Label the electrophile and nucleophile in each reaction.



10. (10 points) Nitrous acid has the formula HONO. Draw the Lewis structure for this compound, predict its geometry including all angles between bonded atoms, draw and note the hybridization of the orbitals on nitrogen and oxygen, and locate the valence electrons in these orbitals.

