NAME _____

ID # _____

ORGANIC CHEMISTRY I (2301-003)

1:25 – 2:15 pm, October 1, 2007

Exam 1

When the exam begins, write your name at the top of the first two pages.

You may use pen or pencil. However, re-grades will be considered only for exams completed in pen.

Please write your answers in the boxes/spaces provided. If your answer is not in the appropriate space (say, for example, it's on the back of the page), draw us an arrow and/or note telling us where to look.

NAME _____

Scoring:

1. _____ / 12
2. _____ / 6
3. _____ / 16
4. _____ / 18
5. _____ / 18
6. _____ / 20
7. _____ / 10

Total Score: _____ / 100

1. (12 pts) Draw Lewis dot structures for each of the molecules below. Draw all valence electrons as dots. If there is a formal charge on the molecule, draw it on the appropriate atom.

(a) acetaldehyde, CH_3CHO

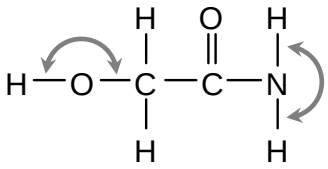
(b) ammonium cation, NH_4^+

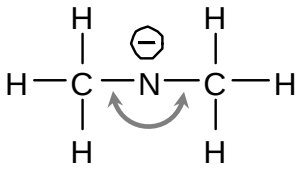
(c) methylisocyanate, CH_3NCO

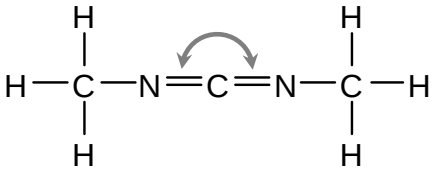
(d) lithium hypochlorite, LiOCl

2. (6 pts) Draw Lewis dash-bond structures for two constitutional isomers with formula CH_3NO. Draw all atoms and lone pairs of electrons.

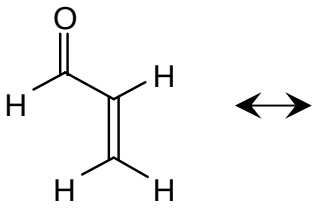
3. (16 pts) For each of the Lewis structures drawn below, in the boxes provided:
   - Draw Lewis wedge/dashed-bond structures that illustrate the three-dimensional structure of the molecule. Draw all atoms, but feel free to omit lone pairs.
   - Write the hybridization state on any atom heavier than hydrogen.
   - On your drawing, provide any bond angle indicated by curved arrows in the original Lewis structure.







4. (18 pts) For each of the molecules on the left, draw as many Lewis dash-bond resonance structures as there are boxes. (Feel free to omit lone pairs and C-H's.) Then, below each structure, describe whether each would be a major or minor contributor, or equal in contribution with another resonance structure. Finally, draw a consensus structure that illustrates partial charges and multiple bonds.



resonance structure

resonance structure

contribution:

contribution:

contribution:

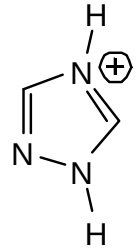
(major/minor? equal to another?)

consensus structure

consensus structure

resonance structure

resonance structure



contribution:

contribution:

contribution:

(major/minor? equal to another?)

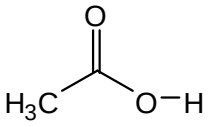
5. (18 pts) For each of the sets of molecules below:
   - Using "electron pushing" (with double-barbed arrows), show how the molecules on the left would react in an acid-base reaction to transfer a proton from one to the other.
   - In the box on the right, draw the conjugate acid and base products of each reaction.
   - In the middle, draw an equilibrium arrow that shows whether you feel the acid-base equilibrium would lie on the left or the right.

+

products

or

?



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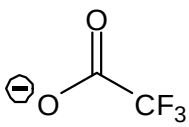
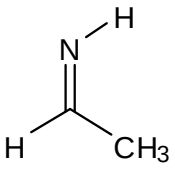


products



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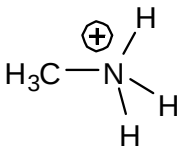
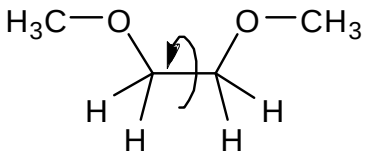


products

6. (20 pts) For the molecule 1,2-dimethoxyethane (below):



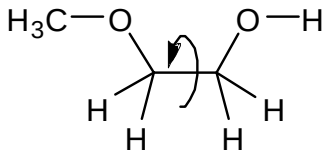
(a) Draw Newman projections for the six conformers—three staggered and three eclipsed—accessed by rotation of the central C-C bond.

(b) Label which conformer you would expect to be most stable, and which you would expect to be least stable. If there are multiple conformations that are equally most or least stable, label them all.

Staggered conformers
Eclipsed conformers

(continued on next page)

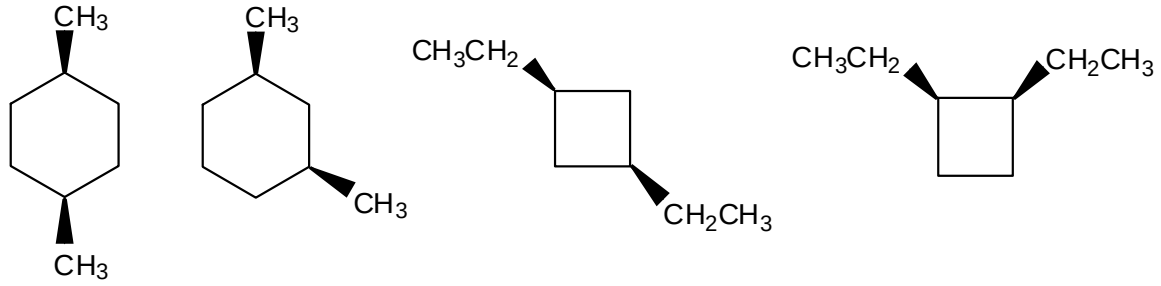
(c) The most stable conformer of 2-methoxyethanol (below) is not the same as that of 1,2-dimethoxyethane, even though the two molecules differ only by a methyl group on one oxygen.



Draw the most stable conformer (or conformers, if there are multiple ones that are equally stable) of this molecule. Then, explain why this conformer is more stable than the one (or ones) you chose in part (b).

Most stable conformer(s)
Why different from (b)?

7. (10 pts) Each of the four isomers of C_8H_{16} shown below has its own heat of combustion (ΔH_c^0), corresponding to the enthalpy of burning one mole of the substance to CO_2 and H_2O. Combustion is exothermic, so $\Delta H_c^0 < 0$ for all four isomers.



A **B** **C** **D**

(a) In the boxes below, rank the molecules (**A**-**D**) in terms of their heats of combustion, from most exothermic to least exothermic.

most exothermic (lowest ΔH_c^0) ☐ ☐ ☐ ☐ least exothermic (highest ΔH_c^0)

(b) For each of the substituted cyclohexanes **A** and **B**, draw <u>one</u> chair conformation. On each drawing, label each (non-hydrogen) ring substituent as axial ("ax") or equatorial ("eq").

one chair conformation for **A**	*one chair conformation for* **B**