NAME _____

UM Internet ID_____

# ORGANIC CHEMISTRY I (2301-001)

9:05 – 9:55 am, February 18, 2008

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. _____ / 9
2. _____ / 6
3. _____ / 16
4. _____ / 18
5. _____ / 15
6. _____ / 22
7. _____ / 14

**Total Score: _____ / 100**

1. (9 pts) **Draw Lewis dot structures** for each of the molecules below. Draw all valence electrons as dots. If there are formal charges, draw them on the appropriate atoms.

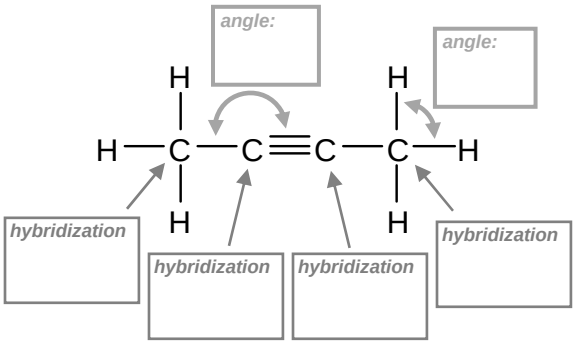
(a) acetonitrile, $CH_3CN$

(b) methoxyamine, $CH_3ONH_2$

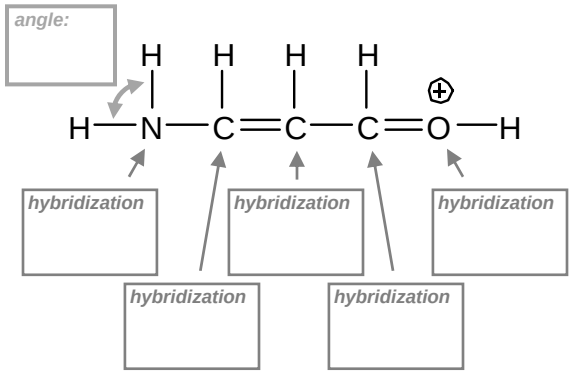
(c) sodium hydroxide, NaOH

2. (6 pts) **Draw Lewis dash-bond structures** for two constitutional isomers that have molecular formula $\mathbf{C_2H_4O_2}$, and that have **no formal charges** on any atom. 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.
   - In the boxes provided, write the hybridization state for any atom heavier than hydrogen.
   - In the boxes provided, give any bond angle indicated by curved arrows in the original Lewis structure.

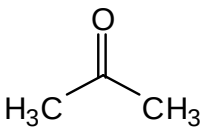



*wedge/dashed-bond (3D) structure*




*wedge/dashed-bond (3D) 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, or draw them—your choice.) Then, below each resonance structure, describe whether each would be a major or minor contributor. Finally, draw a consensus structure that illustrates partial charges and multiple bonds.



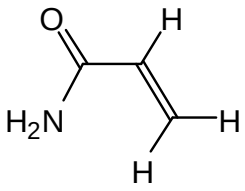

*contribution:*

*(major/minor?)*

*resonance structure*

*contribution:*

*consensus structure*




*contribution:*

*(major/minor?)*

*resonance structure*

*contribution:*

*resonance structure*

*contribution:*

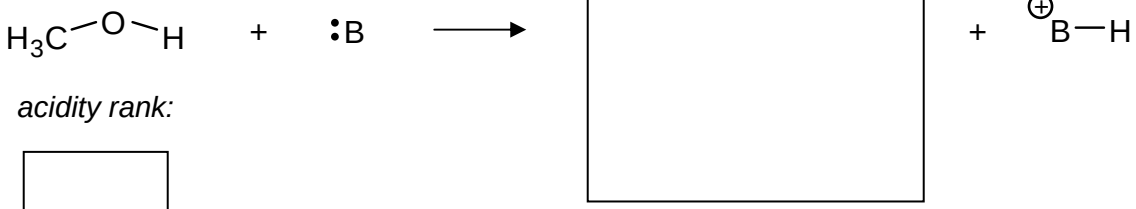
*resonance structure*

*contribution:*

*consensus structure*

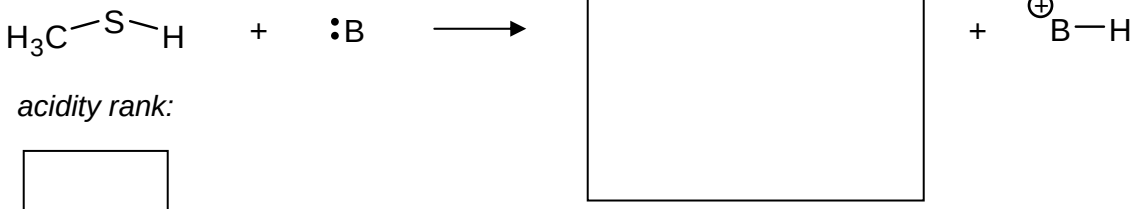
5. (15 pts) For each of the acid-base reactions below:
   - Using "electron pushing" (with double-barbed arrows), show how each acid on the left would react with a generic base "B:".
   - In the box on the right, draw the conjugate base product of each reaction.
   - Rank the acids in terms of acidity, from "1" for the most acidic to "3" for the least acidic.

*acids* *conjugate bases*



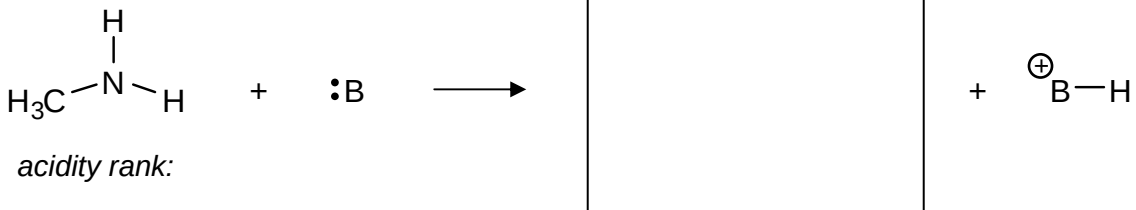

*acidity rank:*

(1, 2 or 3?)




*acidity rank:*

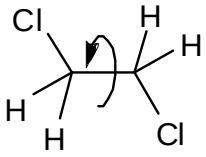
(1, 2 or 3?)




*acidity rank:*

(1, 2 or 3?)

6. (22 pts) For the molecule 1,2-dichloroethane (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) Different conformations can contribute different polarities to the overall, average polarity of a molecule. In the boxes below, re-draw two of your most stable (and thus most prevalent) Newman projections from the previous page. Then, circle whether the molecule is polar or non-polar when it is in that conformation. If you circle "polar", also draw a dipole arrow ( ⟶ ) that shows the total dipole moment for that conformer.

*When the molecule is in this conformation*

*it is (circle one)*

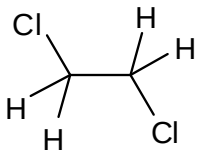
**POLAR** *or* **NON-POLAR**

*When the molecule is in this conformation*

*it is*

**POLAR** *or* **NON-POLAR**

(d) Would you say that 1,2-dichloroethane should be more or less polar than, or equally polar compared to, *trans*-1,2-dichloroethene? (Circle one answer.) Then, *briefly* explain why.

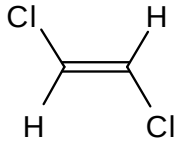



*should be*

**MORE POLAR** *than*

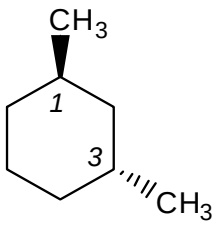
**LESS POLAR** *than*

**EQUALLY POLAR** *compared to*

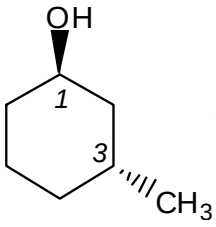



*Why?*

7. (14 pts) For each of the 1,3-disubstituted cyclohexanes below,
   - Circle whether you would call the substitution pattern "*cis*" or "*trans*".
   - Draw two chair conformations that interconvert via chair flipping. On your chairs, label carbons 1 and 3 with the appropriate numbers.
   - Circle one of the three equilibrium arrows to indicate which conformation would be more stable, or to indicate they are equally stable.




***cis*** *or* ***trans*** ?




***cis*** *or* ***trans*** ?

*chair conformer*

*chair conformer*

*or* *or*

*(circle one each side)*

*or* *or*

*chair conformer*

*chair conformer*