

# Chemistry 35

## Exam 1

### February 27, 2006

Print your name and SISD number on **EVERY PAGE** of the exam.

Write all answers on the exam.

There are two blank pages at the end of the exam for you to use as scratch paper.

1. (20 points) \_\_\_\_\_

2. (15 points) \_\_\_\_\_

3. (12 points) \_\_\_\_\_

4. (8 points) \_\_\_\_\_

5. (16 points) \_\_\_\_\_

6. (14 points) \_\_\_\_\_

7. (15 points) \_\_\_\_\_

Total (100 points) \_\_\_\_\_

IA	IIA	IIIA	IVA	VA	VIA	VIIA	GASES
1 <b>H</b> 1.00797						1 <b>H</b> 1.00797	2 <b>He</b> 4.0026
3 <b>Li</b> 6.939	4 <b>Be</b> 9.0122	5 <b>B</b> 10.811	6 <b>C</b> 12.0112	7 <b>N</b> 14.0067	8 <b>O</b> 15.9994	9 <b>F</b> 18.9984	10 <b>Ne</b> 20.183
11 <b>Na</b> 22.9898	12 <b>Mg</b> 24.312	13 <b>Al</b> 26.9815	14 <b>Si</b> 28.086	15 <b>P</b> 30.9738	16 <b>S</b> 32.064	17 <b>Cl</b> 35.453	18 <b>Ar</b> 39.948

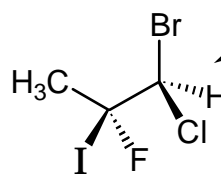
Name \_\_\_\_\_

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1) (20 points)

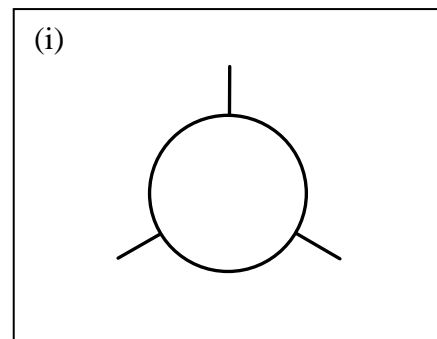
Part A

(i) Draw a Newman Projection along the indicated bond (C1-C2) for the conformation of the molecule shown at the right(→).



View along the C-C bond from here

(Use the template at the right to draw the Newman Projection



(ii) Provide the IUPAC (systematic name) of the structure in part A(i).

(ii)

(iii) **If this is an eclipsed conformer**, identify the pairs of eclipsing groups (or atoms) along the C-1 - C-2 bond.

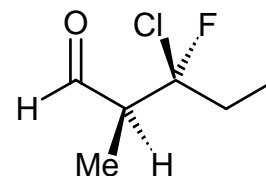
**If this is a staggered conformer**, identify the pairs of anti-periplanar groups (or atoms) along the C-1 - C-2 bond.

(iii)

Part B.

(i) Provide the IUPAC (systematic name) of the structure to the right

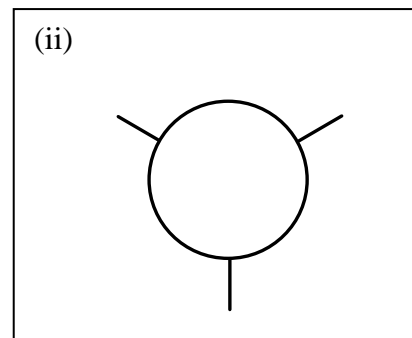
(i)



(ii) Draw a Newman Projection along the Carbon-2 -- Carbon 3 bond for the specific conformation of the molecule in Part B(i). (your eye should be closer to carbon 2. Use the template (right) to draw the Newman projection.)

(iii) **If this is an eclipsed conformer**, identify the pairs of eclipsing groups (atoms) along the C-2 - C-3 bond (use the conformation of the molecule shown above).

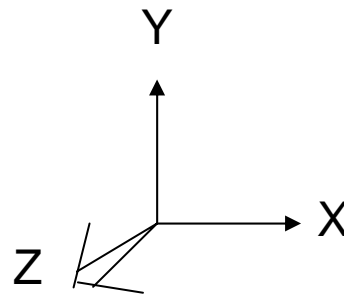
**If this is a staggered conformer**, identify the pairs of anti-periplanar groups (atoms) along the C-2 - C-3.



(iii)

2) (15 points)

Use the coordinate system shown at the right to answer questions about the following molecule (formal charges not shown).



(i) Sketch the p-orbitals used by each atom to form the  $\pi$  bonds in the molecule shown above. Indicate which p-orbitals overlap to make each  $\pi$ -bond.

(ii) Label the p-orbitals in your answer to part (i) as ( $p_x$ ,  $p_y$  or  $p_z$ )

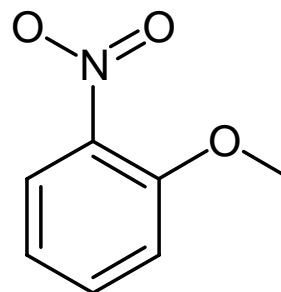
(iii) Use wedge dash notation to show the three dimensional structure of the molecule.

(iv) Provide the hybridization of every non-hydrogen atom in the molecule.



(v) Provide the formal charge of all non-hydrogen atoms in the molecule.

3) (12 points) For the molecule to the right



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(a) Indicate the formal charge of every atom other than hydrogen in the structure (every atom has a complete octet).

(b) Draw four **ADDITIONAL** contributing resonance structures for the molecule.

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(c) What is the hybridization of the nitrogen in the  $-\text{NO}_2$  group ?

(c)

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Extra space for part (b)

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4) (8 points) Draw and provide an IUPAC (systematic name) for

(a) A molecule with the formula  $C_6H_{12}$  having only  $2^\circ$  (secondary) hydrogens.

Structure	Name

(b) A molecule with the formula  $C_4H_9Cl$  having only  $1^\circ$  (primary) hydrogens.

Structure	Name

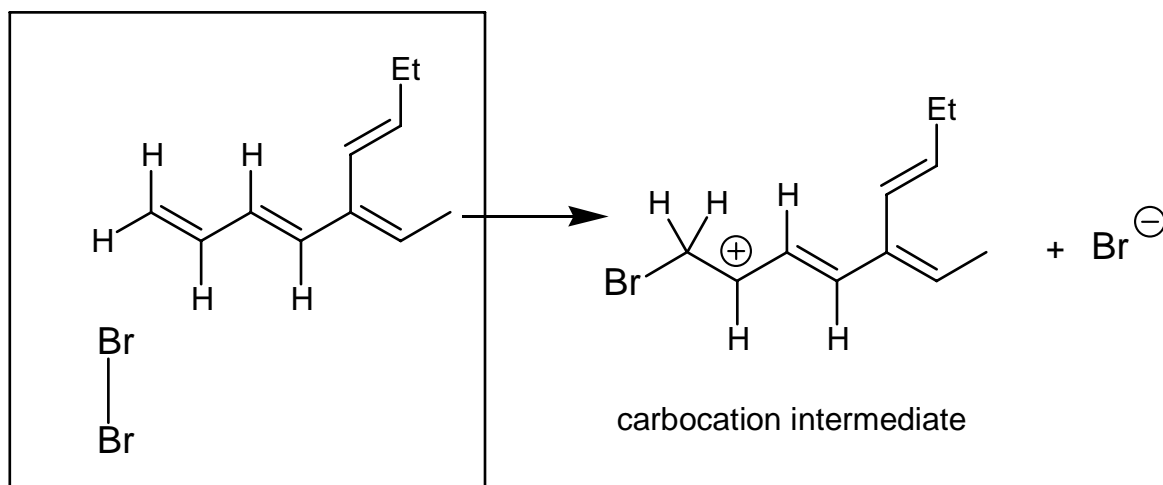
(c) A molecule with the formula  $C_8H_{18}$  having two  $4^\circ$  (quaternary) carbons

Structure	Name

(d) A carboxylic acid with the formula  $C_5H_9ClO_2$  that has a chloride group on a primary carbon.

Structure	Name

5) (16 points)

Alkenes react with  $\text{Br}_2$  to form a carbocation intermediate and bromide ( $\text{Br}^-$ ).

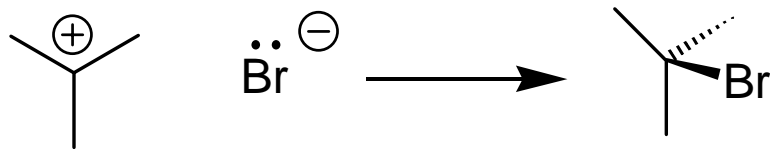
(a) Use curved arrows to show the **change in electrons** that converts the reactants (in the box) to the products. (Draw the arrows directly on the structures above).

(b) Write all contributing resonance structures of the carbocation intermediate.

(c) A carbocation can react with bromide to make a C-Br bond. (continue on next page)

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Use curved arrows to show the electron changes that produce the C-Br bond.  
(Draw arrows directly on the above structure).

(d) Select one response for each of the following statements.

In part (a), the alkene is reacting as an **electrophile** **nucleophile**.

(CIRCLE ONE OF THE ABOVE)

In part (c), the carbocation is reacting as an **electrophile** **nucleophile**.

(CIRCLE ONE OF THE ABOVE)

(e) Provide structures of all the products formed by the reaction of bromide with the carbocation intermediate discussed in parts (a) and (b)

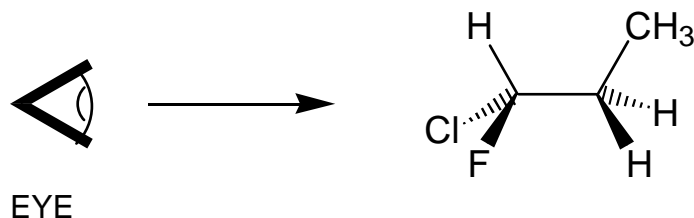
6) (14 points) (Be sure to complete parts (i), (ii) and (iii))

Potential Energy curve for 1-chloro-1-fluoropropane

**Start with the conformation below as the  $0^\circ$  dihedral angle**

(use H-C-C-CH<sub>3</sub> to define the dihedral angle).

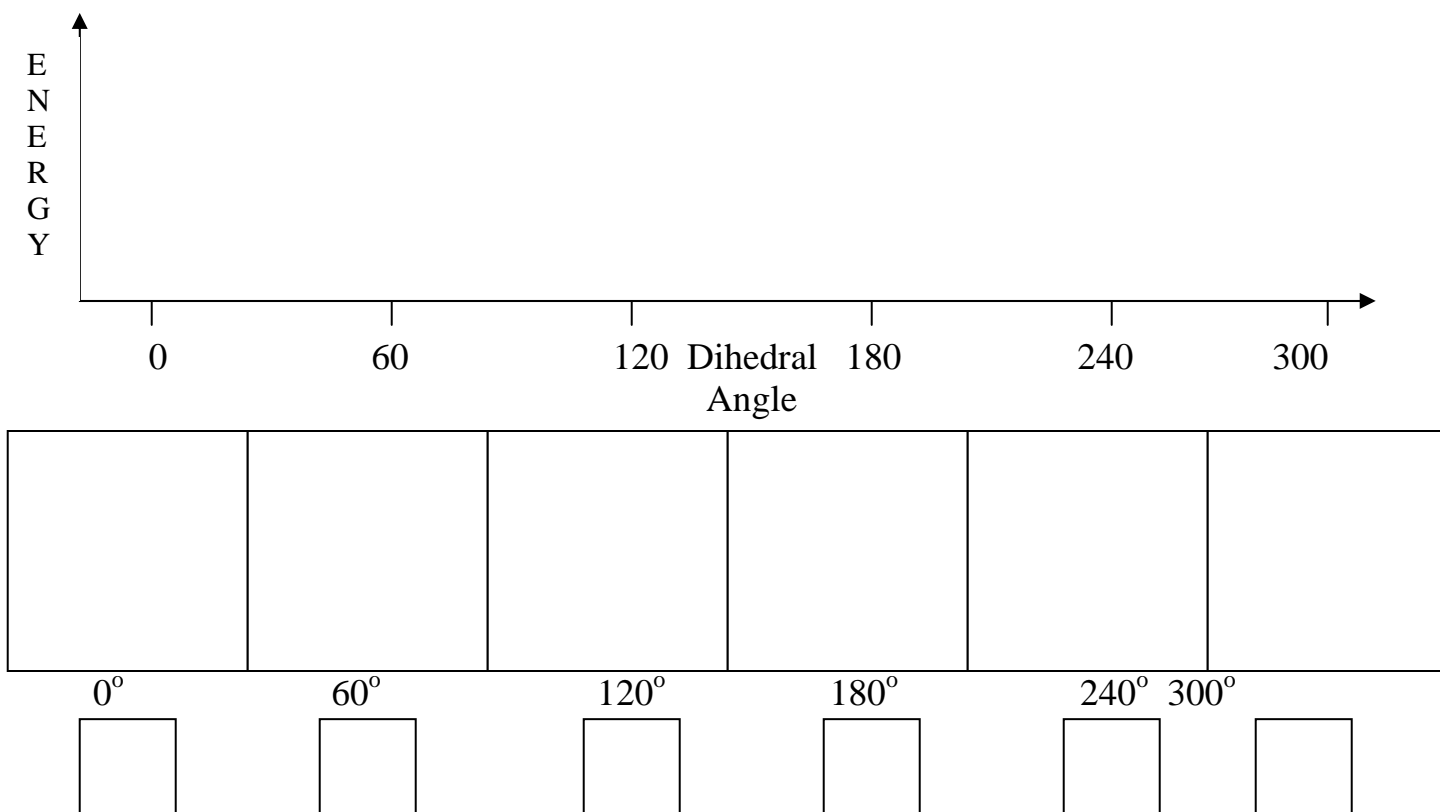
(Rotate the back carbon **CLOCKWISE** to generate the series of Newman Projections)



(i) Place Newman projection diagrams in the large boxes below the energy-dihedral angle diagram.

(ii) In the smaller boxes give the **Relative Ranking** of the conformer energy for each Newman structure: **6 (highest energy)** to **1 (lowest energy)**.

(iii) Draw a **qualitative** energy-dihedral angle diagram.

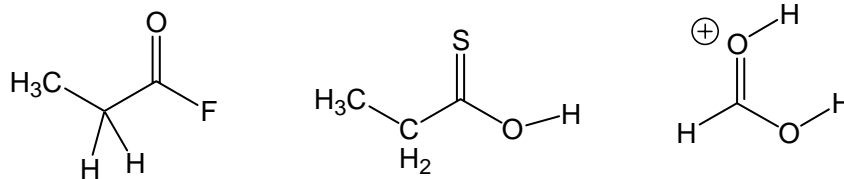


**\*\*Assume sizes are CH<sub>3</sub> > Cl > F > H**

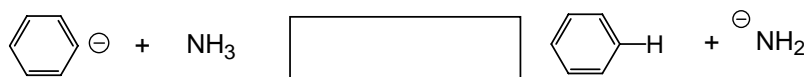
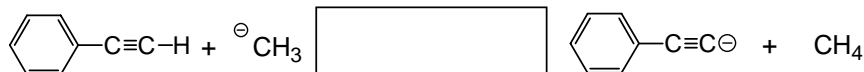
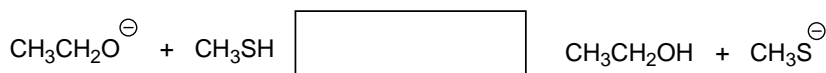
**\*\*Assume gauche interactions involving one or two Hydrogen atoms are negligible.**

7) (15 points)

(a) Circle the most acidic proton or protons in each molecule. Cross out (X) the least acidic proton or protons in each molecule.



(b) For each reaction, indicate, by drawing an arrow in the box, which molecules (reactant or product) predominate at equilibrium. Under your arrow, write what effect: atom size, resonance, electronegativity, hybridization or inductive effects controls the position of equilibrium.



(c) For each trio of acids or bases, rank each entry as strongest (1), intermediate (2) or weakest (3). (Be sure to compare compounds in the same horizontal row)

