

CHEM 3311-200

Exam 1

Fall 2008

By printing my name below, I pledge that  
"On my honor, as a University of Colorado at Boulder student, I have neither given nor  
received unauthorized assistance on this work."

Name \_\_\_\_\_

Recitation TA's Name \_\_\_\_\_ (Bailey, Meylemans)

Recitation Day & Time \_\_\_\_\_

**Grading Information**

Page #	Points Possible	Your Score
2 (Question 1)	12	—
3 (Question 2)	20	—
4 (Question 3)	12	—
5 (Questions 4 & 5)	21	—
6 (Question 6)	15	—
7 (Question 7)	20	—

\_\_\_\_\_ TOTAL (out of 100)

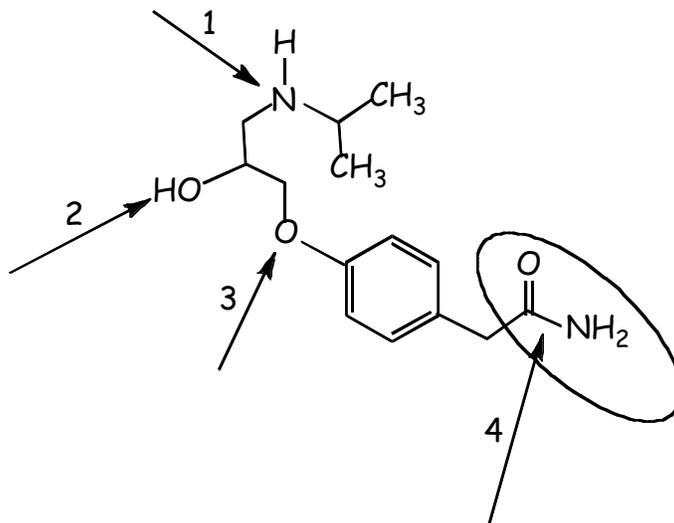
General Instructions

- (1) This is a CLOSED BOOK exam! No notes and molecular models are allowed.
- (2) You have 2 hours to complete the exam.
- (3) Write your name at the top of each page, starting with page 2.
- (4) Use the back of exam pages for scratch paper.
- (5) **Cell phones must be turned off; cell phones, headsets, and Bluetooth devices must be placed in a backpack or on the floor, and may not be accessed during the exam.** Students violating this policy will be asked to leave and will receive a zero for the exam.
- (6) If caught cheating, you will receive at best an F for this exam. The instructor reserves the right to proceed further, in compliance with university policies.

Name: \_\_\_\_\_

1. **(12 points)** Atenolol, a beta blocker, is a substance that affects the heart and the circulatory system by slowing the heart rate and relaxing the blood vessels.

Identify the functional groups (lone pairs are not shown) and write the name of the functional group at the lower end of the arrow. Label alcohols and amines as 1°, 2°, or 3°.



(A) The hybridization at the nitrogen atom (**arrow 1**) is:

$sp^3$                        $sp^2$                        $sp$                       Circle your response

(B) The hybridization at the oxygen atom (**arrow 2**) is:

$sp^3$                        $sp^2$                        $sp$                       Circle your response

(C) The hybridization at the oxygen atom (**arrow 3**) is:

$sp^3$                        $sp^2$                        $sp$                       Circle your response

(D) The hybridization of the carbon atoms in the aromatic ring is:

$sp^3$                        $sp^2$                        $sp$                       Circle your response

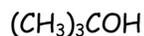
(E) The hybridization of the carbon atom in the functional group (**arrow 4**) is:

$sp^3$                        $sp^2$                        $sp$                       Circle your response

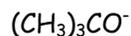
Name: \_\_\_\_\_

2. Acids, Bases, and Acid-Base Equilibria (**20 points**)

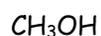
(A) Circle the strong acid.



(B) Circle the strong base.



(C) Circle the strongest acid in this group.



(D) Circle the strongest base in this group.



(E) Predict the products of the reaction of  $\text{HCO}_2\text{H}$  with  $\text{CH}_3\text{NH}_2$ .

Write a COMPLETE equation (reactants and products) showing ALL bonds (**expanded structural formula**), lone pairs, formal charges, and arrow pushing formalism.

What is the magnitude of the equilibrium constant for this reaction?

$K < 1$

$K = 1$

$K > 1$

Circle your response

Identify the HOMO and LUMO for this reaction.

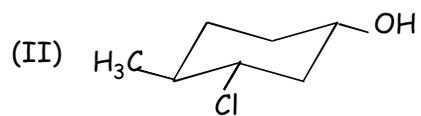
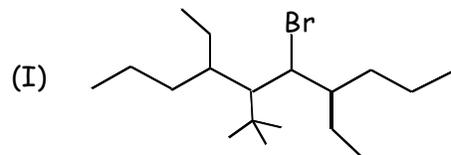
HOMO \_\_\_\_\_

LUMO \_\_\_\_\_

Name: \_\_\_\_\_

3. (12 points)

(A) Give the IUPAC names for the following compounds:



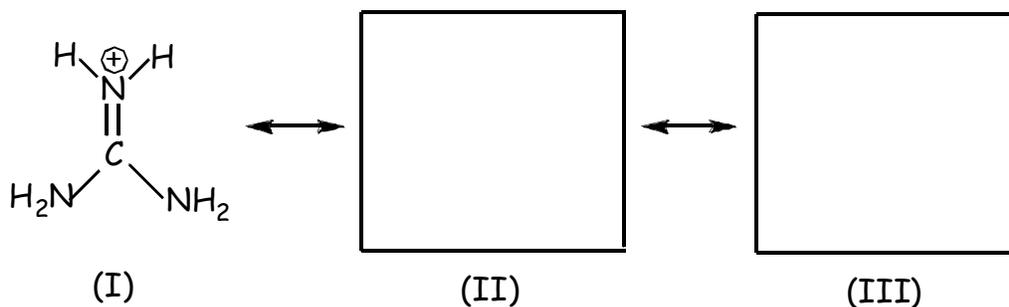
(B) Draw bond-line structural formulas for the following compounds:

(I) 2,7-Dibromo-4-isopropyloctane

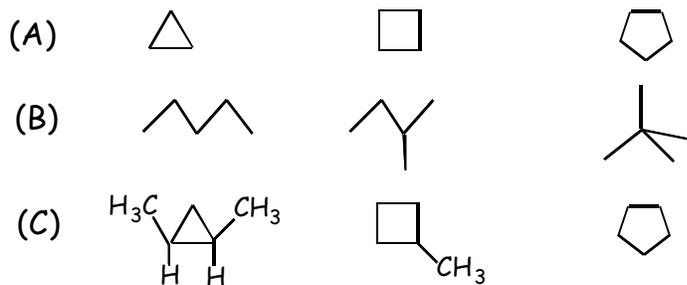
(II) 2-Chloro-7-iodo-5-isobutyldecane

Name: \_\_\_\_\_

4. (12 points) Use the arrow formalism to write structures for the resonance forms contributing to the structure of the guanidinium ion. You MUST SHOW all lone pairs and arrows to convert from contributing structure I to II to III.



5. (9 points) Circle the compound with the largest magnitude for  $\Delta H_{\text{combustion}}$  in each group.

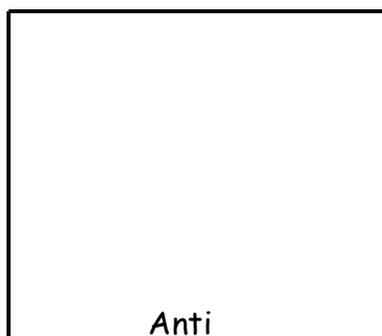
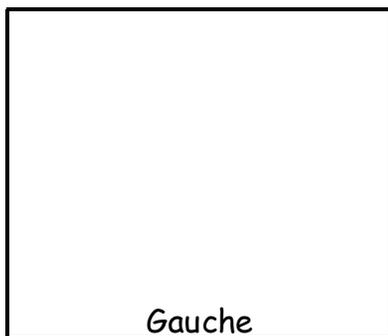


Name: \_\_\_\_\_

6. (15 points)

(A) Draw the **expanded structural formula** for 1, 2-dichloroethane.

(B) Draw Newman projections for a gauche conformation and the anti conformation of 1,2-dichloroethane.



(C) Which conformation shown above has a net dipole moment?

Gauche

Anti

Circle your response

(D) The measured dipole moment is 1.12 D. Which of the following statements about 1,2-dichloroethane are true or false?

\_\_\_(i) It may exist entirely in the anti conformation.

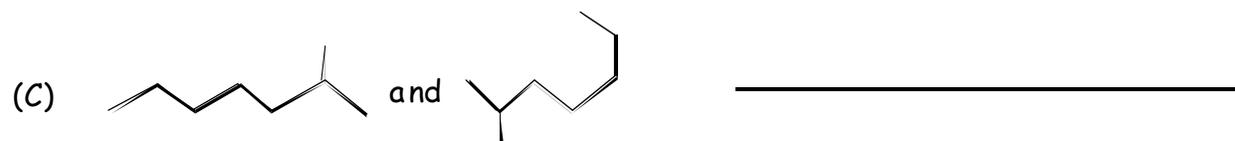
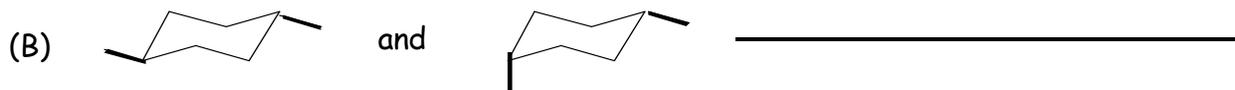
\_\_\_(ii) It may exist entirely in the gauche conformation.

\_\_\_(iii) It may exist as a mixture of anti and gauche conformations.

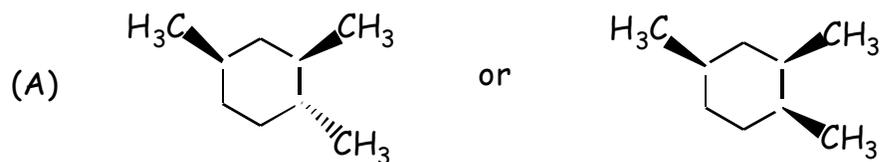
Name: \_\_\_\_\_

7. (20 points)

(i) Identify the relationship between each pair of compounds as identical, constitutional isomers, stereoisomers, or not related.



(ii) Circle the more stable stereoisomer in each pair. You **MUST** draw for each compound the **most stable CHAIR conformation** to receive all the assigned points.



(B) *cis*-1-Isopropyl-3-methylcyclohexane or *trans*-1-Isopropyl-3-methylcyclohexane