

Exam 1

Professor R. Hoenigman

I pledge to uphold the CU Honor Code:

Signature _____

Name (printed) _____

Last four digits of your student ID number _____

Recitation TA _____

Recitation number, day, and time _____

You have 1 hour and 30 minutes to complete this exam.

No model kits or calculators allowed.

Periodic table and scratch paper are attached.

DO NOT TURN THIS PAGE UNTIL INSTRUCTED TO DO SO.

Recitation Sections:

#	Day	Time	TA	SCORE:	
121	Tuesday	8 am	Kelly	Page 1 _____/14	Page 5 _____/18
131	Tuesday	1 pm	Kelly	Page 2 _____/14	Page 6 _____/14
141	Wednesday	8 am	Greg	Page 3 _____/12	Page 7 _____/10
151	Wednesday	12 pm	Greg	Page 4 _____/18	
153	Wednesday	12 pm	Kelly		
152	Wednesday	5 pm	Kelly		
171	Thursday	12 pm	Greg		
				TOTAL _____/100	

1. (8 pts) Ammonia can act as either an acid or a base.

A. Draw the Lewis structure of ammonia.

B. What is the pK_a of ammonia?

C. Fill in the equation below to relate the pK_a of ammonia to its K_a .

$$K_a =$$

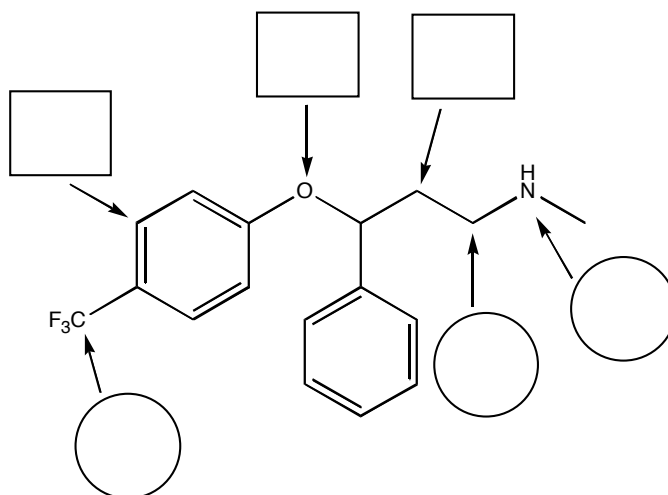
D. Draw the Lewis structure of the conjugate base of ammonia.

E. Draw the Lewis structure of the conjugate acid of ammonia.

2. (6 pts) Prozac®, shown below, is a widely prescribed antidepressant.

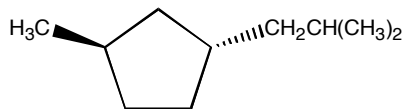
A. Label each atom indicated by a box as sp^3 , sp^2 , sp , or none of these.

B. Label each atom indicated by a circle as 1° , 2° , 3° , or 4° .



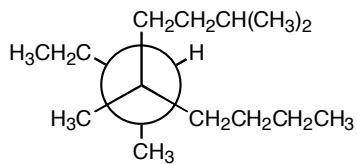
3. (9 pts) Give the IUPAC name for each of the following compounds.

A.



B. $(\text{CH}_3\text{CH}_2)_2\text{CHCH}_2\text{CH}(\text{CH}_3)_2$

C.



4. (5 pts) Circle the compounds below that have a dipole moment.

HCN

H₂O

BF₃

CH₃CH₂COOH

CCl₄

CH₃Cl

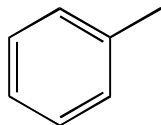
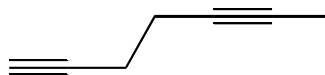
CH₂O

NCCH₂CH₂CN

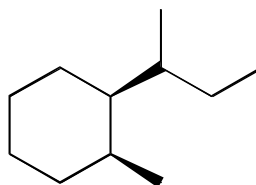
cyclobutane

5. (12 pts) State whether the following pairs of compounds are constitutional isomers, stereoisomers, conformers, resonance structures, identical structures, or have no relation. Place your answer in the box.

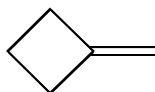
A.

*and*

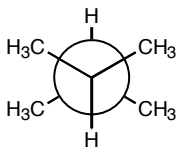
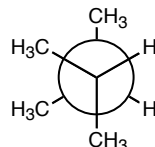
B.

sec-butylcycloheptane*and*

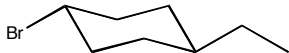
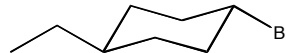
C.

*and*

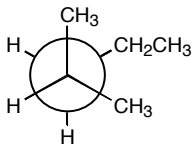
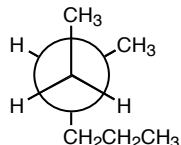
D.

*and*

E.

*and*

F.

*and*

6. (18 pts) For each of the following pairs, circle the more stable compound or ion. In the box, give a brief reason for your choice.

A.

1,1-dimethylcyclopentane

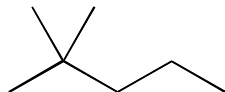
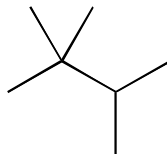
or

1-ethyl-3-methylcyclobutane

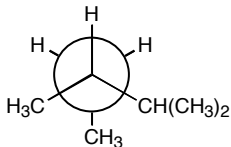
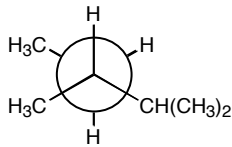
B.

cis-1-methyl-2-(1-methylethyl)cyclohexane*or**trans*-1-methyl-2-(1-methylethyl)cyclohexane

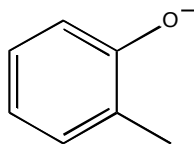
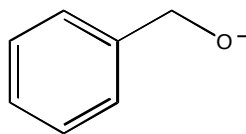
C.

*or*

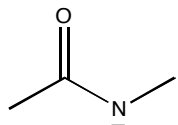
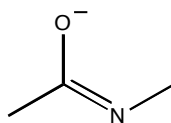
D.

*or*

E.

*or*

F.

*or*

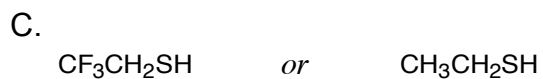
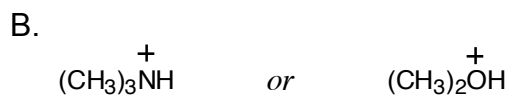
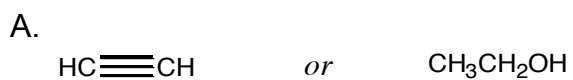
7. (9 pts) The following is a three-part question. Be sure to draw neat chair cyclohexanes.

A. Draw the most stable conformer of *cis*-1-*tert*-butyl-4-methylcyclohexane.

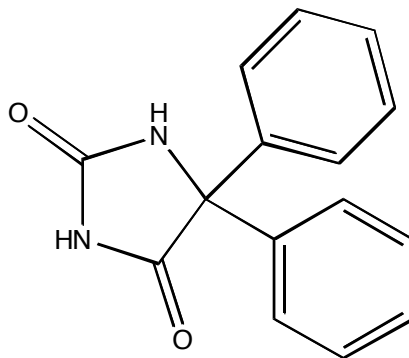
B. Draw the most stable conformer of *trans*-1-*tert*-butyl-4-methylcyclohexane.

C. Which of the isomers (*cis* or *trans*) is more stable? Why?

8. (9 pts) Circle the more acidic compound in the following pairs. In the box, give a brief reason for your choice.



9. (4 pts) Circle the most acidic hydrogen in phenytoin, an anti-seizure drug.



phenytoin

10. (10 pts) Carbonate (CO_3^{2-}) is a very common polyatomic ion.

A. Draw all of the resonance structures of the carbonate ion. Be sure to show any non-zero formal charges. Label each structure as a major or minor resonance contributor.

B. Explain why all of the carbon–oxygen bonds in the carbonate ion have the same bond length.

11. (10 pts) Complete the following acid-base reactions. Show all non-zero formal charges. If no reaction occurs write NR.

