CHEM 3311 **Exam #2** **Name**_____
Dr. Minger **June 24, 2013**

Please read and sign the Honor Code statement 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 exam.

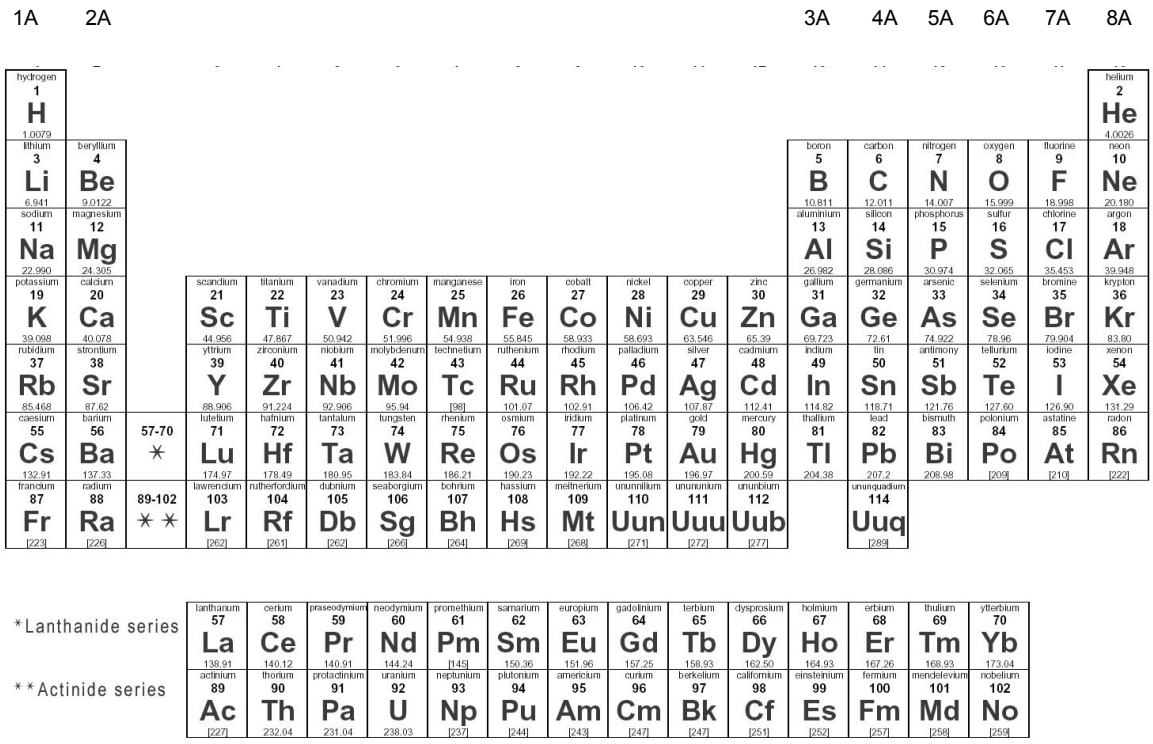
_____
Signature

General Instructions: There are 25 questions. Be sure you have them all. Read each question carefully so that you know exactly what is being asked.

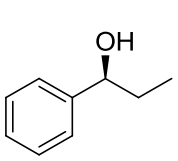
Each multiple choice question (1-25) is worth **4 points and has only one correct answer.** Bubble in your answers to these questions on the Scantron provided. **Only the Scantron will be graded, not anything that you write on the exam.**

At the end of the exam, turn in your Scantron and this signed cover sheet. You may keep the rest of the exam to check your answers against the key later.

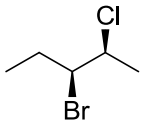
Good luck!



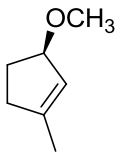
1. Which of these compounds has an asymmetric carbon with an absolute configuration of *R*?



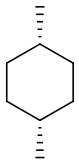
A



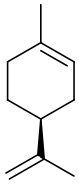
B



C

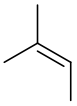


D

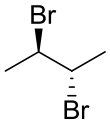


E

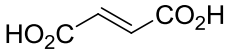
2. Which of these structures is achiral and meso?



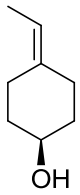
A



B

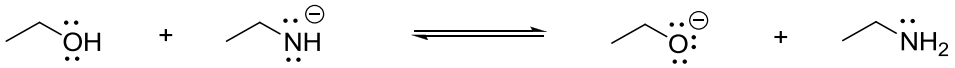


C



D

3. Which side of this Bronsted-Lowry acid base reaction is favored at equilibrium? (Spectator ions are omitted for clarity.)

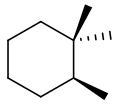


a. Reactants (left side of equation)
b. Products (right side of equation)
c. Neither side is favored. There are equal amounts of reactants and products present at equilibrium.
d. There is not enough information available to answer the question.

4. HF and HBr are both Bronsted acids. We have explored stabilization in the conjugate base to explain acidity. For this pair of acids, which of the following ideas is the best to explain which conjugate base is more stable?

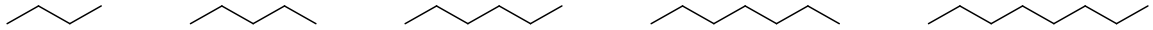
a. Resonance
b. Electronegativity
c. Polarizability/Size
d. Luminescence
e. Hybridization

5. What is the approximate difference in energy between the two chair conformations of this molecule?



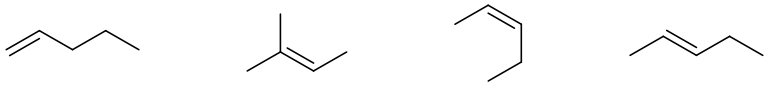
a. 0.8 kcal/mol
b. 1.6 kcal/mol
c. 2.4 kcal/mol
d. 3.2 kcal/mol
e. There is no energy difference between the two chair conformers.

6. Which of the following molecules is heptane?



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

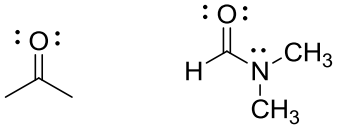
7. Which of these alkenes releases the least amount of energy on formation from its elements (all substances in the standard state)?



R **S** **T** **U**

a. R
b. S
c. T
d. U
e. Cannot be determined

8. Which of these molecules cannot be a hydrogen bond donor?

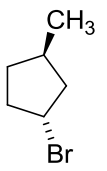


All of these molecules can be hydrogen bond donors

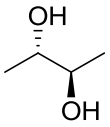
None of these molecules can be hydrogen bond donors

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

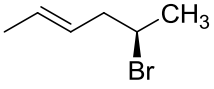
9. Which of these compounds is chiral?



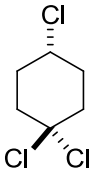
J



K



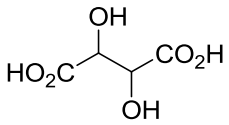
L



M

a. J
b. J, L
c. J, K, L
d. J, L, M
e. J, M

10. Select the correct statement about the set of stereoisomers that can be generated from this constitution.



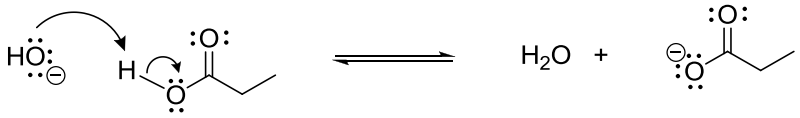
a. The set contains 4 chiral molecules
b. The set contains 2 chiral molecules and 2 achiral molecules
c. The set contains 2 chiral molecules and 1 achiral molecule
d. The set contains 1 chiral molecule and 1 achiral molecule
e. The set contains 2 achiral molecules

11. Use the table of energies provided to calculate the barrier to rotation around C1-C2 in 1-bromopropane.

Interaction	**Energy (kcal/mol)**
H-H eclipse	1.0
CH_3-H eclipse	1.3
Br-H eclipse	1.5
Br-CH_3 gauche	1.0
Br-CH_3 eclipse	3.0
Br-CH_3 anti	0

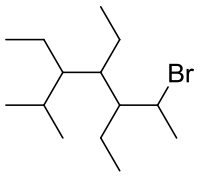
a. 2.8 kcal/mol
b. 3.8 kcal/mol
c. 4.0 kcal/mol
d. 5.0 kcal/mol
e. None of these values

12. The frontier orbitals are the ones that interact in a chemical reaction. Which of these statements correctly identifies the frontier orbitals in this reaction? (The name of the carboxylic acid is propanoic acid.)



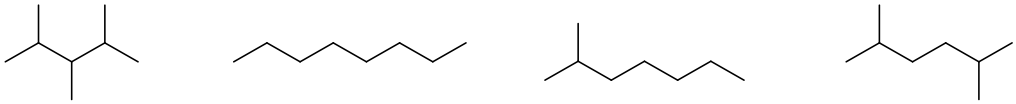
a. HOMO: sp^2 on O in hydroxide
   LUMO: *p* on O in propanoic acid
b. HOMO: sp^3 on O in hydroxide
   LUMO: *p* on O in propanoic acid
c. HOMO: sp^3 on O in propanoic acid
   LUMO: sp^3 on O in hydroxide
d. HOMO: sp^3 on O in hydroxide
   LUMO: O-H σ* in propanoic acid
e. None of these choices is correct

13. What is the correct IUPAC name for this molecule?



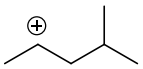
a. 2-bromo-3,4,5-triethyl-6-methylheptane
b. 2-bromo-3,4-diethyl-5-isopropylheptane
c. 6-bromo-3,4,5-triethyl-2-methylheptane
d. 6-bromo-4,5-diethyl-3-isopropylheptane
e. None of these

14. Which of these compounds do you expect to have the lowest boiling point?

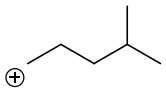


A **B** **C** **D**

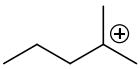
15. Place these three carbocations in order of *increasing* stability.



L



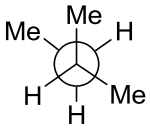
M



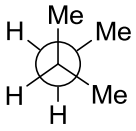
N

a. L < M < N
b. L < N < M
c. M < L < N
d. N < L < M
e. N < M < L

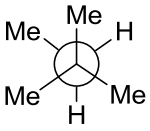
16. Which of the following is the ***most stable staggered conformation*** of 2-methylbutane, looking down the C2-C3 bond? (Me = Methyl, CH_3)



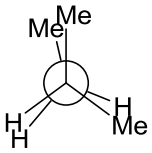
A



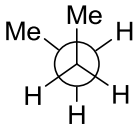
B



C



D

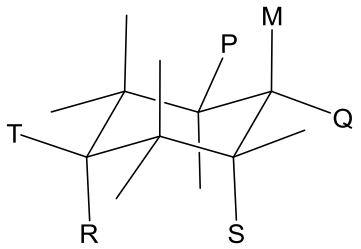


E

17. The carbon-carbon bonds in cyclopropane are described as

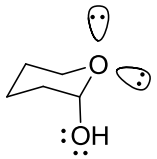
a. Grande Decaf Latte bonds
b. New Mountain Berry Blast®™ bonds
c. X-Treem Mango Splash™ bonds
d. Banana bonds
e. Bieberbonds

18. In this structure, what is the relationship between the groups P and M?



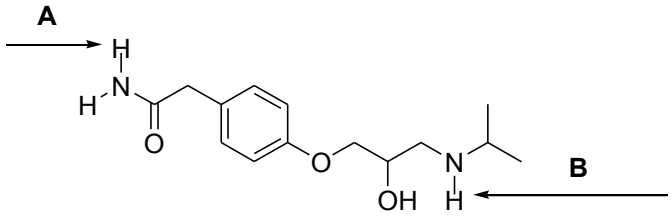
a. gauche
b. anti
c. eclipsed
d. none of these

19. Alkyl groups prefer to occupy equatorial bonds on cyclohexane rings to avoid the steric strain present in the axial conformer. However, in the structure shown below, the OH group prefers to occupy the axial position. One theory for this preference involves hyperconjugation. Recalling that hyperconjugation involves the interaction of a filled orbital and an empty orbital, what two orbitals are involved in this structure that would account for the preference of the OH group to be axial?



a. Lone pair on O (sp^3) and O-H σ*
b. Lone pair on O (sp^3) and C-C σ
c. Lone pair on O (sp^3) and *p*
d. Lone pair on O (sp^3) and C-O σ*
e. C-H σ and O-H σ*

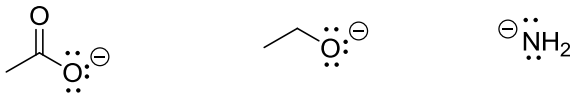
20. Atenolol is a beta blocker used to treat high blood pressure. Which of the indicated H atoms, “A” or “B”, is more acidic?



atenolol

a. A
b. B
c. They are equally acidic

21. Which statement correctly describes the relative base strengths of these three bases?



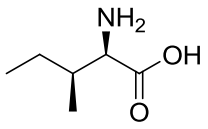
F **G** **H**

a. G is the weakest base, F is the strongest base
b. H is the weakest base, F is the strongest base
c. F is the weakest base, H is the strongest base
d. G is the weakest base, H is the strongest base
e. H is the weakest base, G is the strongest base

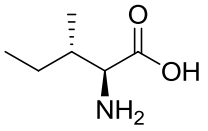
22. Select the weakest acid from these choices.

a. H_2O
b. CH_4
c. NH_3
d. HBr
e. CH_3OH

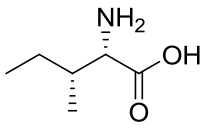
23. Which of the following is a pair of diastereomers?



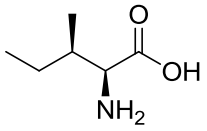
P



Q



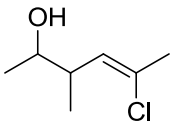
R



S

a. P and R
b. R and S
c. P and S
d. P and Q
e. None of these combinations are diastereomers

24. What is the correct name for this molecule?



a. (*Z*)-3-chloro-4-methyl-2-hexen-5-ol
b. (*E*)-3-chloro-4-methyl-2-hexen-5-ol
c. (*Z*)-5-chloro-3-methyl-4-hexen-2-ol
d. (*E*)-5-chloro-3-methyl-4-hexen-2-ol
e. None of these

25. Gas chromatography (GC) is an analytical tool that separates compounds based on their boiling points. Each compound that has a unique boiling point will generate one peak in the GC spectrum. You are using GC to analyze a mixture that contains equal parts of each of the four isomers of dimethylcyclopropane:

What is the maximum number of peaks that will appear in the GC spectrum? (Hint: You do not have to be taking the lab to answer this question.)

a. None
b. 1
c. 2
d. 3
e. 4