I. Nomenclature

1. Circle and identify all functional groups in the following molecule. (8 points)

2. Given that compound I has a molecular formula of C_{7}H_{10}O_{2}, contains alkene and ester functional groups, and a resonance structure, predict a possible structure for compound I. (5 points)

3. Identify the correct IUPAC name for each compound shown below. (6 points)

a) 2-bromo-3-sec-butyl-4-ethylhexane  
b) 2-bromo-4-ethyl-3-sec-butylhexane  
c) 3-(1-bromoethyl)-2,4-diethylhexane  
d) 4-(1-bromoethyl)-3-ethyl-5-methylheptane  
e) 4-(1-bromoethyl)-5-ethyl-3-methylheptane

a) 1-tert-butyl-2-chloro-5-bromocycloheptane  
b) 5-bromo-1-tert-butyl-2-chlorocycloheptane  
c) 1-bromo-4-chloro-5-tertbutylcycloheptane  
d) 1-bromo-4-tert-butyl-5-chlorocycloheptane  
e) 1-tert-butyl-4-bromo-7-chlorocycloheptane

4. What is the common name for a 2-methylpropyl group? (3 points)
5. Name the following bicyclic compound. (3 points)

6. What functional group generally has a foul smell? (2 points)
   a) amine    b) aldehyde    c) amide    d) ether    e) ketone

II. Conformations and Structure

1. Convert CH₂CH(CH₃)CH₂C(CH₂CH₃)₂CHO to a line-angle structure. Then place a star by all 3° carbons. (4 points)

2. A bond angle of 120° corresponds to which hybridization? (2 points)
   a) sp     b) sp²     c) sp³     d) p³

3. Molecular orbitals result from overlap of atomic orbitals on ______________ atom(s), while hybridization orbitals result from overlap of atomic orbitals on ______________ atom(s). (4 points)

4. Circle all of the following that contribute to the ring strain of cyclopropane. (3 points)
   a) steric hindrance    b) angle strain    c) transannular strain    d) torsion strain

5. The preferred conformation of cyclobutane is: (2 points)
   a) bent    b) planar    c) chair    d) envelop
6. Draw all isomers of C₃H₆O and rank them in order of increasing boiling point. 
(1 = isomer with lowest boiling point, 5 points)

7. Which solvent would salt be most soluble in? (2 points)
   a) CH₃C(O)CH₃   b) CH₃CH₂OCH₂CH₃   c) CH₃OH   d) CH₃(CH₂)₃OH

8. Draw all resonance structures for the structure below. Include any formal charges. 
   Circle the major resonance contributor. (8 points)

9. Draw both chair structures for cis 1-bromo-2-methylcyclohexane. Label each 
   group as equatorial or axial. Circle the most stable chair. (8 points)
10. Translate the following Newman projection to a perspective structure without changing conformations. (3 points)

11. Name the conformation shown above and predict its relative energy value compared to the anti conformation. (4 points)

12. Circle any structure below that is polar. (4 points)

13. Draw cis CH\textsubscript{2}CH=CHNH\textsubscript{2} in a Lewis structure and circle all atoms that lie in the same plane. (4 points)

III. Reactivity

1. Given the following pKa values, predict which direction equilibrium favors in the acid-base reaction below. (2 points)

\[
\begin{array}{c}
\text{H-}A + B^- \rightleftharpoons \text{H-B} + A^- \\
pKa \quad 5 \quad 8
\end{array}
\]
2. Name 2 other hydrocarbon based fuels besides gasoline. (2 points)

3. Which sequence correctly ranks the following protons in order of increasing acidity? (Least acidic listed first, 3 points)

![Chemical Structure]

a) 1-2-3  
   b) 2-3-1  
   c) 3-1-2  
   d) 3-2-1  
   e) 2-1-3  
   f) 1-3-2

4. Which is the stronger base? (2 points)

:PH$_3$ or :NH$_3$

5. A Lewis acid is defined as: (3 points)

   a) A substance that generates H$^+$ ions when dissolved in water.
   b) Any compound that can donate a pair of electrons.
   c) Any compound that can donate a proton.
   d) Any compound that can accept a pair of electrons.
IV.  **IR spectroscopy**

1. From the following list of structures, identify which compounds are represented in the two IR spectra below. Justify your answer by labeling key peaks in each spectra. (8 points)

\[
\begin{align*}
\text{\includegraphics{structure1.png}} & \quad \text{\includegraphics{structure2.png}} & \quad \text{\includegraphics{structure3.png}} & \quad \text{\includegraphics{structure4.png}} & \quad \text{\includegraphics{structure5.png}}
\end{align*}
\]
V. Extra Credit (5 points)

1. Decalin is a fused bicyclic structure consisting of two cyclohexane rings. Draw both cis and trans decalin in their chair formations. Indicate which is more stable.

\[ \text{cis decalin} \quad \text{trans decalin} \]

You received __________ points out of 100 points possible. To check your overall performance in lecture see http://courses.weber.edu/.