Please read through each question carefully and answer in the spaces provided.

A good strategy is to go through the test and answer all the questions you can do easily. Then go back and tackle the more difficult problems.

Please make sure your structures are drawn clearly and indicate any necessary stereochemistry with bold or dashed bonds.

Finally, think about what you know. Common sense and reason can often help you out.

You may use the back of the pages for scratch paper.

Problem 1  10 pts  

Problem 2  12 pts  

Problem 3  12 pts  

Problem 4  12 pts  

Problem 5  20 pts  

Problem 6  15 pts  

Problem 7  15 pts  

Problem 8  4 pts  

TOTAL  100 pts  

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North Dakota State University
1. In the boxes below place the correct substituents or hydrogens to show the lowest energy conformation of trans-1-isopropyl-3-methylcyclohexane (left) and the highest energy conformation for cis-1-isopropyl-3-methylcyclohexane (10 pts).

![Chemical Structures]

2. For each of the following molecules, draw another correct resonance form (12 pts).

![Resonance Forms]

3. For each pair of molecules, circle the one that is the strongest acid (12 pts).

![Acid Comparisons]
4. The structure of sildenafil is shown below. You've seen this compound appear in your email I'm sure. This is a drug sold under the name of Viagra. Please answer the following questions about this structure (12 pts).

\[
\text{Sildenafil}
\]

- a) How many sp\(^3\)-hybridized CARBONS are present? \[\text{11}\]
- b) How many pi bonds are present? \[\text{9}\]
- c) How many sp\(^3\)-hybridized OXYGENS are present? \[\text{1}\]
- d) How many sp\(^2\)-hybridized CARBONS are present? \[\text{11}\]
- e) How many sp-hybridized CARBONS are present? \[\text{0}\]
- f) How many lone pairs are present in the molecule? (note: there are none on sulfur) \[\text{14}\]

5. Draw the structure for the following molecules (20 pts).

a) \textit{trans}-1-ethyl-3-fluorocyclobutane

b) 6-ethyl-2,3,4-trimethyloctane

c) 4-(1,2-dimethylpropyl)decane

d) 1-bromo-3-ethyl-2,3-dimethylpentane

e) \textit{cis}-1,4-dichlorocycloheptane
6. Provide the correct IUPAC name for the following compounds (15 pts).

a) ![Image](image1)
   - 3-cyclopropyl-2,4-dimethylhexane

b) ![Image](image2)
   - trans-1-methyl-3-propylcyclopentane

c) ![Image](image3)
   - 2-methyl-5-(1,2-dimethylpropyl)nonane

7. Identify the relationship between the following pairs of molecules as Identical, Resonance Forms, Constitutional Isomers, Stereoisomers, Conformers or completely Different compounds (check the appropriate box) (15 pts).

<table>
<thead>
<tr>
<th></th>
<th>Identical</th>
<th>Resonance Forms</th>
<th>Constitutional Isomers</th>
<th>Stereoisomers</th>
<th>Conformers</th>
<th>Completely Different</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) <img src="image4" alt="Image" /></td>
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<tr>
<td>b) <img src="image5" alt="Image" /></td>
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<td>c) <img src="image6" alt="Image" /></td>
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<td>d) <img src="image7" alt="Image" /></td>
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<td>e) <img src="image8" alt="Image" /></td>
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<td>X</td>
<td></td>
</tr>
</tbody>
</table>
8. In the boxes below, indicate whether the carbon is primary (1°), secondary (2°), tertiary (3°) or quaternary (4°) (4 pts).