CHE 232 - Organic Chemistry
Exam 1, February 8, 2006

Name_________________  Student ID No._________________

Before you begin this exam: First: You are allowed to have a simple model set at your seat. Please put away all other materials. Second: Place your student identification on your desk. A proctor will come around to check everyone’s ID. If you do not have ID, tell the proctor and Third: Read through the entire exam. Your goal, as always, is to score as many points as possible. Do not waste time on problems that you can’t do if there are others that look easy. Fourth: It is critically important that your answers be written in a clear, unambiguous manner. Answers in which your intentions are unclear will not receive credit. Fifth: READ THE INSTRUCTIONS FOR EACH PROBLEM. You have until 12:50 to complete this exam. There will be no extensions, so budget your time carefully.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
1. (10 points) Classify each of the following as either aromatic, antiaromatic, or neither. Assume that all are planar.

2. (10 points) The structure of the natural product nicotine is shown below. Determine whether each ring is aromatic, anti aromatic, or neither.
3. (6 points) For each lone pair of electrons on nitrogen in the compound N-phenyl traizolinedione (PTAD, below), indicate whether that lone pair of electrons is part of the π-system or not.

4. (9 points) Provide reagents suitable for the following reactions. If more than 1 step is required, be sure to specify each step (i.e. 1. Reagent A; 2. Reagent B).

a) 

b) 

c) 

5. (20 points) Provide the major organic product from each of the following reactions. If you believe that significant amounts or 2 products will be formed (like ortho and para isomers), show both. If you believe that no reaction will occur, write “no reaction.”

a)

\[
\begin{align*}
\text{Ph} & \quad \text{O} \\
& \quad \text{Cl} \\
& \quad \text{AlCl}_3 \\
\end{align*}
\]

b)

\[
\begin{align*}
\text{Ph} & \quad \text{CO}_2\text{H} \\
& \quad \text{Li, NH}_3 \\
& \quad \text{t-BuOH} \\
\end{align*}
\]

c)

\[
\begin{align*}
\text{Ph} & \quad \text{CH}_3 \\
& \quad \text{O} \\
& \quad \text{SO}_3, \text{H}_2\text{SO}_4 \\
\end{align*}
\]

d)

\[
\begin{align*}
\text{Ph} & \quad \text{SO}_3\text{H} \\
& \quad \text{KMnO}_4 \\
\end{align*}
\]
6. (10 points) a) Which of the following isomeric compounds (both are C\textsubscript{10}H\textsubscript{14}, M\textsuperscript{+}=134) would be expected to show a strong peak in the mass spectrum at a mass of 91? (Circle one)  
   b) Circle the fragment with mass 91.

\[ \text{[Diagram of isomeric compounds]} \]

7. (5 points) A colorless organic liquid produces M\textsuperscript{+} of 58 mass units and a strong absorption in the IR spectrum at 1720 cm\textsuperscript{-1}. Circle a structure that is consistent with this data.

\[ \text{[Diagram of structures]} \]

8. (10 points) A key intermediate in the synthesis of ibuprofen (below) is isobutylbenzene. Show how would you make isobutylbenzene from benzene, organic reagents of 4 carbons or less, and any inorganic reagents needed.

\[ \text{[Diagram of ibuprofen and isobutylbenzene]} \]

\textit{Ibuprofen}
9. (10 points) An annoying side reaction that sometimes occurs when t-butylbenzene is treated with strong acid is *dealkylation*. This side reaction is not a problem when the alkyl group is secondary or primary (that’s a bit of a hint as to what is going on).

Draw a mechanism for the dealkylation of t-butylbenzene. Please note that while a strong acid is required, the specific type of strong acid isn’t important.

![Mechanism diagram](image-url)
10. (10 points) Design a viable synthesis of one of the following compounds. You do not need to show a retro synthesis, but doing one may help you plan your synthesis. You may use benzene, other organic compounds of 4 carbons or less, and any inorganic reagents that you need. **Do any one of the problems given below.** If you do more than one, only the first two will be graded.

a) ![Chemical structure](attachment:structure_a.png)

b) ![Chemical structure](attachment:structure_b.png)