CHEM 5.12
PROBLEM SET #8 Due in Friday April 25th at 4 pm

1. (4 points) For the following cyclic compounds:
   a) Designate whether each is aromatic or not aromatic
   b) Draw structures of the molecule (as illustrated in the box) labeling the
      hybridization state at each atom in the ring, the unhybridized p orbitals and any non-
      bonding electrons.

   AROMATIC
   yes

   STRUCTURE
   \[
   \begin{align*}
   &\text{sp}^2 \quad \text{sp}^2 \\
   &\text{p} \quad \text{p} \\
   &\text{b} \quad \text{b} \\
   &\text{o} \quad \text{o} \\
   &\text{n} \quad \text{d} \\
   &\text{H} \\
   \end{align*}
   \]

   \[
   \begin{align*}
   &\text{H} \\
   &\text{O} \\
   \end{align*}
   \]

   \[
   \begin{align*}
   &\text{H} \\
   &\text{B} \\
   &\text{N} \quad \text{NH} \\
   \end{align*}
   \]

   \[
   \begin{align*}
   &\text{H} \\
   \end{align*}
   \]
2. (6 points) Design synthesis of the compounds shown on the left. You may use the compounds shown in the square brackets and any other standard reagents.

Hint: think back to how you can introduce a halide into an alkane.....
3. (3 points) When compound I is treated as shown below, a mixture of isomeric products of identical molecular formula are obtained. EXPLAIN

![Chemical Structure](image)

1. Na^+OMe^-/MeOH
2. neutralize to pH 7

4. (3 points) For the following reactions show the stepwise mechanism leading to the formation of the product indicated.

![Chemical Structure](image)
5. (4 points) Below are listed five different phenols and the pKa of the phenolic -OH proton. Explain why the pKa values are so different using resonance and inductive effect arguments (AND DRAWING STRUCTURES TO ILLUSTRATE THESE) as necessary.

<table>
<thead>
<tr>
<th>Structure</th>
<th>pKa</th>
</tr>
</thead>
<tbody>
<tr>
<td>OH</td>
<td>10</td>
</tr>
<tr>
<td>Cl</td>
<td>9.38</td>
</tr>
<tr>
<td>NO₂</td>
<td>7.15</td>
</tr>
<tr>
<td>NO₂</td>
<td>8.4</td>
</tr>
<tr>
<td>NO₂</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Hint - write out the full structure of the -NO₂