1. Provide the Name of Structure for the following. (7 points)
   
   a. 3-nitroaniline
   
   b. 6-isopropyltoluene
   
   c. Pyrrole

2. Circle the aromatic molecules. (7 points)

3. The molecule has 3 different nitrogens. For each of them, classify the hybridization of the nitrogen atom, the hybridization of the nitrogen lone pair, and whether the basicity of the nitrogen is "normal" or "low". (6 points)

<table>
<thead>
<tr>
<th>Nitrogen</th>
<th>Lone-Pair Hybridization</th>
<th>Nitrogen Basicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>N\text{a}</td>
<td>sp³</td>
<td>(\rho)</td>
</tr>
<tr>
<td>N\text{b}</td>
<td>sp³</td>
<td>sp³</td>
</tr>
<tr>
<td>N\text{c}</td>
<td>sp²</td>
<td>sp²</td>
</tr>
</tbody>
</table>
4. Draw the major products of the following reaction (4 points).

\[
\text{H-Br} \quad \xrightarrow{\text{(no peroxides)}} \quad \text{H-Br}
\]

\[
\begin{align*}
\text{br} & \\
\text{br}
\end{align*}
\]

5. Draw the Major Product of the Following Reactions. Note: I want one major product in each case. (3 points each)

- \[
\text{CH}_3 \quad \xrightarrow{\text{Br}_2, \text{FeBr}_3} \quad \text{br}
\]

- \[
\text{br} \quad \xrightarrow{1. \text{HNO}_3, \text{H}_2\text{SO}_4} \quad \text{br}
\]

- \[
\text{1. Br}_2, \text{hv} \quad \text{br} \quad \text{2. NaOH}
\]

- \[
\text{OMe} \quad \xrightarrow{1. \text{Cl}} \quad \text{OMe}
\]

- \[
\text{Br} \quad \xrightarrow{1. \text{Cl}, \text{AlCl}_3} \quad \text{br}
\]

- \[
\text{OME} + \quad \text{heat} \quad \text{OME}
\]

- \[
\text{OH} \quad \xrightarrow{1. \text{SO}_3, \text{H}_2\text{SO}_4} \quad \text{OME}
\]

- \[
\text{KMnO}_4 \quad \xrightarrow{3. \text{H}_2\text{O, H}_2\text{SO}_4} \quad \text{OME}
\]

(partial credit for E2, S_N2 wins with benzylic)
6. Rank the following, with 1 being highest/most. (2 points each)

- Reactivity toward Br₂, FeBr₃
- Heat of hydrogenation
- Stability
- Ring strain
- Combined Diels-Alder Reactivity
- Cation Stability
- Reactivity toward NaOMe

7. Outline the π-molecular orbitals of cyclopentadiene cation (use a Frost diagram), indicate which are occupied by electrons, and indicate whether the species is unusually stable or not. (6 points)
8. Treatment of an alkyl halide with methanolic AgNO₃ often promotes ionization, via the following:

\[ \text{R-XY} \xrightarrow{\text{Ag}^+} \text{R}^+ + \text{AgX} \]

When 3-bromo-1-butene undergoes this reaction, two isomeric products A and B are formed. Draw the structure for product B and the detailed mechanism for formation of product B. (7 pts)

9. Draw the product for the following reaction and draw the mechanism for its formation. Identify the slow step. Draw all the resonance structures for the cation intermediate and circle the most important contributor. (7 points)
10. (6 pt) When comparing cyclopentadiene (A) versus 1,3-pentadiene (CH₂=CH-CH=CH-CH₃, B),

a. One is much more acidic. Which is it, and why?

A. gives aromatic anion

b. One is a much more reactive diene. Which is it, and why?

A. Cisoid. B is only cisoid a little bit.

11. Draw the Reactants for the Following Reactions (7 points)

12. Provide reagents for the following transformations. (5 points each)