103 points

1. (6 pts) Draw the appropriate molecules. Answer 3 of 4 and cross one out or graded in order.

Benzyl alcohol propylene glycol Isobutyl alcohol diisopropyl ether

2. (12 pts) For a and b, pick the most acidic compound of the two. Predict the pKa. Explain. For c, draw the acid base reaction and predict the direction and Keq.

Given the following pKa ranges:

<table>
<thead>
<tr>
<th></th>
<th>C-H</th>
<th>Cl-H</th>
<th>N-H</th>
<th>R3N*-H</th>
<th>R2O*-H</th>
</tr>
</thead>
<tbody>
<tr>
<td>pKa</td>
<td>25</td>
<td>60</td>
<td>30</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>-7</td>
<td></td>
<td>35</td>
<td>5-9</td>
<td>-5-0</td>
</tr>
</tbody>
</table>

a. Circle most acidic compound predict pKa = 
Explain:

b. Circle most acidic compound predict pKa = 
Explain:

c. Draw the equilibrium, showing the reaction proton transfer reaction between methanol + HCl. Predict the direction and the Keq.

Direction? Keq
3. (8 pts) When 3-methyl-2-butene shown is made into an alcohol, depending on the reagents chosen, two different alcohols are formed.

**Draw the alcohols formed.**

\[ \text{CH}_3\text{CH} = \text{CH}_2 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}_2\text{OH} \]

\[ \text{Hg(OAc)}_2, \text{aqueous acid} \]

\[ \text{CH}_3\text{CH} = \text{CH}_2 + 1\text{NaBH}_4 \rightarrow \text{CH}_3\text{CH}_2\text{OH} \]

b. Name the alcohols formed in the boxes.

4. (15 pts) Draw arrows to account for the course of the reaction and resonance as drawn from left to right. You may need to draw LPs.

b. What is the name of the mechanism of this reaction?

c. What is the name of the intermediate?

d. What is the functional group of the product?
5. (12 pts) Provide the major organic products for the following reactions. If no reaction occurs, write NR. Do 4 out of 5 and cross one out or graded in order.

a. \[ \text{CH}_3 \text{CH}_3 \text{CH}_3 \text{KMnO}_4 \rightarrow \]

b. \[ \text{CH}_3 \text{OH} \rightarrow \text{HBr} \]

c. \[ \text{CH}_3 \text{CH}_3 \text{OH} \rightarrow \text{PCC} \]

d. \[ \text{CH}_3 \text{OH} \rightarrow \text{Jones} \]

e. \[ \text{CH}_3 \text{CH}_3 \text{OH} \rightarrow \]

6. (14 pts) Provide reagents over the arrows for the following transformations.

\[ \text{C}_6\text{H}_5 \rightarrow \text{BrC}_6\text{H}_4 \rightarrow \text{BrCH}_3\text{C}_6\text{H}_4 \rightarrow \text{BrCH}_3\text{C}_6\text{H}_4 \rightarrow \text{BrCH}_3\text{C}_6\text{H}_4 \rightarrow \text{BrCH}_3\text{C}_6\text{H}_4 \]

separated from meta, which was also formed
7. (8 pts) Devise two unique synthetic schemes that involves any Grignard reagent and any aldehyde or ketone to make the alcohol below:

\[
\text{Grignard} + \text{Ketone/Aldehyde}
\]

\[
\text{Grignard} + \text{Ketone/Aldehyde}
\]

8. (18 pts) Use the following list of reagents to carry out the following transformations. Place the letter or reagent in the box.

- a. KMnO₄, H₃O⁺
- b. Br₂, FeBr₃
- c. NaOH(aq) 300°C
- d. HNO₃, H₂SO₄
- e. CH₃Cl, AlCl₃
- f. \(\text{H}_2\text{C} \begin{array}{c} \text{Cl} \\ \text{CH}_3 \end{array}\) AlCl₃
- g. CH₃CH₂CH₂CH₂Cl, AlCl₃
- h. H₂, Pd
- i. NBS, peroxides
- j. NaOH, H₂O
9. (10 pts) Identify the organic compound that matches most closely to the spectra on the page. Draw the structure and then draw lines from the H's to the peaks in the NMR. Identify any peaks you can in the IR. \( C_9H_{12}O \)