1. Name the following two compounds. (10 pts)

(2R,4S)-4-phenyldeca-6,7-dien-2-ol

6-(tert-butyl)-2-isopropyl-1,8-dimethylnaphthalene

2. Draw 5-acetyl-2-bromo-3-hydroxybenzoic acid in bond line. (4 pts)
3. What are the starting material, reagents, or major product/s for the following reactions? If there is no reaction write No Reaction. (32 pts)

Don’t forget about stereochemistry.
Problem 3 Continued

\[ \text{Cyclohexane} + \text{MeO}_2\text{C} - \text{CO}_2\text{Me} \xrightarrow{\text{heat}} \text{(s)} \text{Product} \]

\[ \text{PhCHO} \xrightarrow{\text{Zn(Sn), HCl}} \text{PhCH}_2\text{Ph} \]

\[ \text{PhCHO} \xrightarrow{\text{H}_2\text{N-NH}_2, \text{KOH}, \Delta} \text{PhCH}_2\text{Ph} \]

\[ \text{PhCHCl} \xrightarrow{\text{AlCl}_3} \text{PhCHClPh} \]

\[ \text{PhNO}_2 \xrightarrow{\text{Br}_2, \text{FeBr}_3} \text{Product} \]
4. A timed Diels-Alder reaction is when each step relies on the completion of the previous step. Please draw the diene, the dienophile, the intermediate, and the product for the following timed Diels-Alder reaction sequence. (10 points)

\[
\begin{align*}
\text{Diene} & \quad \text{Chemical Formula: C}_6\text{H}_4\text{O}_2 \\
& \quad \xrightarrow{200 \, ^\circ\text{C}} \\
\text{Dienophile} & \quad \text{Chemical Formula: C}_7\text{H}_10\text{O}_2 \\
& \quad \xrightarrow{\text{Retro Diels-Alder Rx where CO}_2\text{ is lost from the reaction}} \\
\text{Intermediate} & \quad \text{Chemical Formula: C}_{11}\text{H}_{14}\text{O}_2 \\
& \quad \xrightarrow{\text{Intramolecular Diels-Alder}} \\
\text{Product} & \quad \text{Chemical Formula: C}_{11}\text{H}_{14}\text{O}_2
\end{align*}
\]

5. When imidazole is treated with acetic acid, only one nitrogen is protonated.

a. Draw the structure of the imidazolium ion. (2 pts)

\[
\text{imidazole} + \text{acetic acid} \quad \xrightarrow{\text{imidazolium ion}} \quad \text{imidazolium ion} + \text{acetate}
\]

b. Briefly explain why one nitrogen atom is protonated over the other in imidazole. Remember, a picture is worth a thousand words. ☺ (4 pts)
6. Draw the complete mechanism for the following reaction. (15 pts)
7. Design a synthesis of 1-(tert-butyl)-4-(prop-1-en-2-yl)benzene starting from benzene. You may use any reagents you have learned. You must show the reagents and product from the reactions. (11 pts)

1-(tert-butyl)-4-(prop-1-en-2-yl)benzene

**Hint:** this reaction does not work.
8. Provide a short explanation why an electron withdrawing group does not direct ortho or para in an electrophilic substitution reaction. Please draw the appropriate resonance structures to support your explanation. (8 pts)

9. Draw all the possible allylic bromide species (monobrominated) that could be produced from the radical bromination of (3R,6S)-3-ethyl-6-methylcyclohex-1-ene. Don’t forget about stereochemistry. (4 pts)
Provide the mechanism of how 1-methyl-3-phenyl-2,3-dihydro-1H-indene is produced from two equivalents of styrene in the presence of sulfuric acid. Do not worry about stereochemistry.