This homework assignment is due at the beginning of class on Tuesday, February 2, 2010. You may use your textbook and class notes in answering these questions but should not discuss these questions with anyone else. You may simply write the answers on these pages or you may securely attach additional pages. Please write clearly. Unintelligible answers will not be considered.
1. (4 pts) Provide an IUPAC name for the following compounds.

S-
4-ethyl-6-phenyl-3-heptanol

E-2-propyl-1-3-hexen-1-ol

2. (5 pts) Use resonance structures similar to the ones in class and a few short sentences to explain why the -OCH$_3$ group in the molecule below acts as 1) an activator and 2) an o, p-director of an electrophilic aromatic substitution reaction.

The -OCH$_3$ group is an activator because it adds an $\text{O}^-$ to the $\text{C}^+$ in the intermediate, increasing the rate of reaction in the electrophilic aromatic substitution.

For adding a group ortho (or para):

For $o$ or $p$ addition, the substituent adds a fourth resonance structure to stabilize the cation intermediate; the electron donor group cannot stabilize the product + there more electron donor groups act as o, p directors.
3. (6 pts) Provide the product or products for the following reactions. Show all stereochemistry. No reaction is a possible answer.
4. (5 pts) Provide a synthesis of the following molecules from the given starting materials and reactions discussed in class and the textbook.

\[
\text{Cl} \quad \text{CH}_3
\]

from benzene

\[
\text{Cl} \quad \text{OH}
\]

from \(\text{CH}_3\text{CHO}\)

and Grignard reagents

\[
\text{Cl} \quad \text{H}_2 \quad \text{Cl}_2
\]

\[
\text{Cl} \quad \text{H}_2\text{O}
\]

\[
\text{Cl} \quad \text{H}_2\text{O}
\]

\[
\text{Cl} \quad \text{H}_2\text{O}
\]

\[
\text{Cl} \quad \text{H}_2\text{O}
\]

\[
\text{Cl} \quad \text{H}_2\text{O}
\]
5. (5 pts) The pKa of the –OH group of phenol is about 10. Consider the two phenols shown below with added groups. The pKa of the proton of the –OH group is given for each. Use resonance structures and a few words to explain the observed difference in pKa’s between these compounds and phenol (why is one higher than phenol and why is one lower?)

\[
\begin{align*}
&\text{pKa = 10} & \text{pKa = 8} & \text{pKa = 12} \\
&\text{O-H} & \text{O-H} & \text{O-H}
\end{align*}
\]

For phenol (or any acid), look at anion to evaluate acidity; the more stable the anion (conjugate base), the more acidic; resonance stabilizes the anion; i.e., more \textit{a} better structure increases stability - acidity.

\[
\text{For p-nitrophenol}
\]

\[
\begin{align*}
&\text{has some 3 including} \\
&\text{one extra structure} \\
&\text{- put negative charge on} \\
&\text{nitro group is more stable} \\
&\text{more acidic}
\end{align*}
\]

\[
\text{For HNO}_2
\]

\[
\text{unfavorable - negative charge right by} \\
\text{electron donating alkyl group}
\]

\[
\text{has some 3 as phenol - but the structure} \\
\text{where negative charge is adjacent to the electron donating alkyl group is not good}
\]