2. Draw the $^1H$ NMR spectrum of benzoic acid. Show chemical shifts, relative areas and splitting patterns including correct relative heights of the peaks in each multiplet. Assume the aromatic H's show first-order splitting. Neglect long-range coupling. Label the hydrogens and identify them on the spectrum.

4.5 2. Give the product(s) of the following reactions.

(a) $\text{CH}_3\cdot\text{C}_6\text{H}_5 + \text{CH}_3\cdot\text{CH}_2\cdot\text{CH}_2\cdot\text{OH} \xrightarrow{\text{H}_2\text{SO}_4} \text{product} + \text{product}$

(b) $\text{C}_6\text{H}_5\cdot\text{C}_6\text{H}_4\cdot\text{N}_2 + \text{HNO}_3 \xrightarrow{\text{H}_2\text{SO}_4} \text{product} + \text{product}$

(c) $\text{C}_6\text{H}_5\cdot\text{C}_6\text{H}_4\cdot\text{OCH}_3 + \text{CH}_2\cdot\text{Cl} \xrightarrow{1.\text{O}} \text{product} \xrightarrow{2.\text{H}_2\text{O}} \text{product}$

1.5 3. Show how you would accomplish the following synthesis. Show all reagents over the arrow and intermediate isolable compounds.

2. 4. Draw the mechanism for the alkylation of benzene. Show all intermediates including resonance structures and electron-pushing arrows.