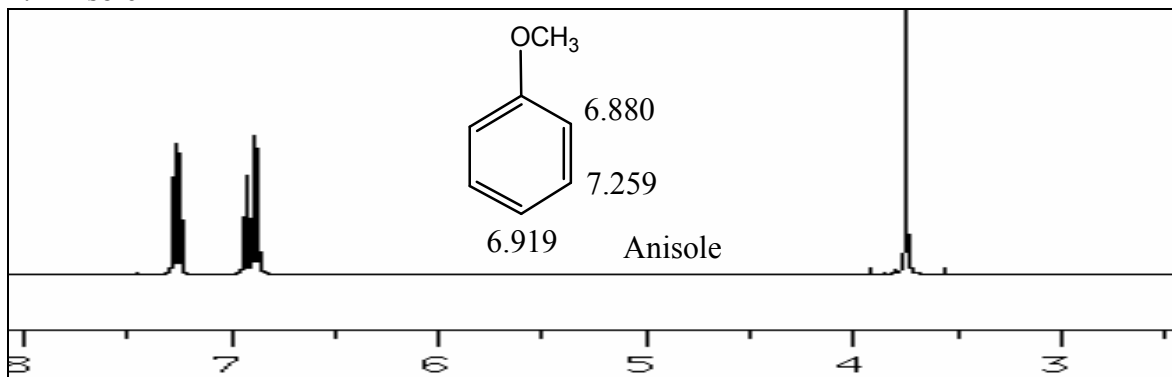


## Project 2 of Chem 2320

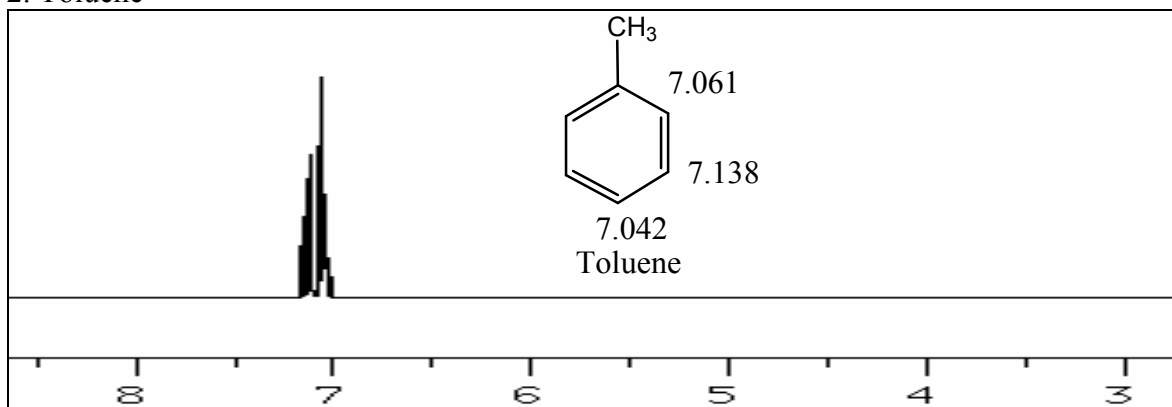
### Honorary

I. Explain the difference of observed chemical shifts among the aromatic protons (ortho/para vs. meta positions) for the following compounds.

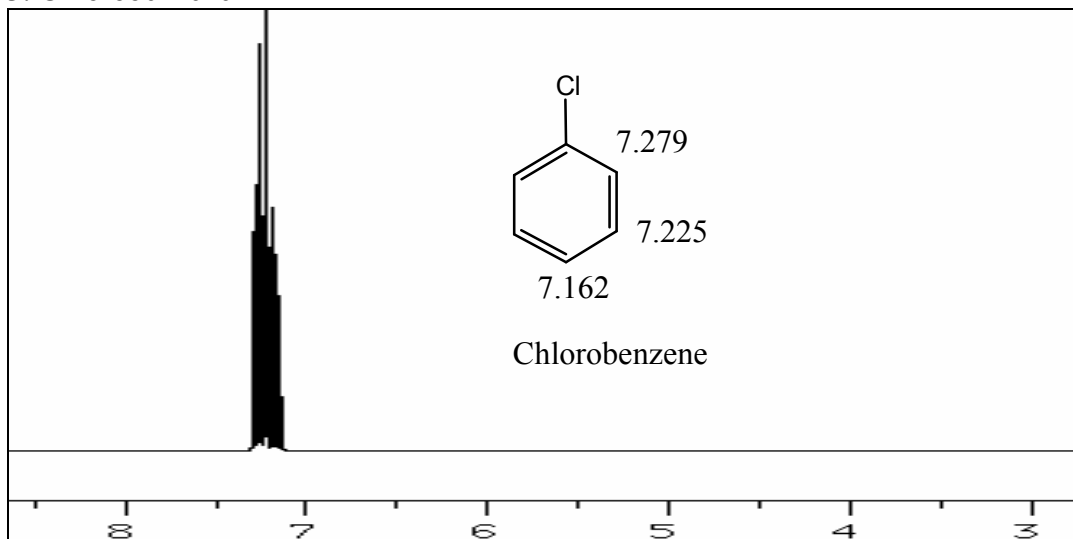
#### 1. Anisole



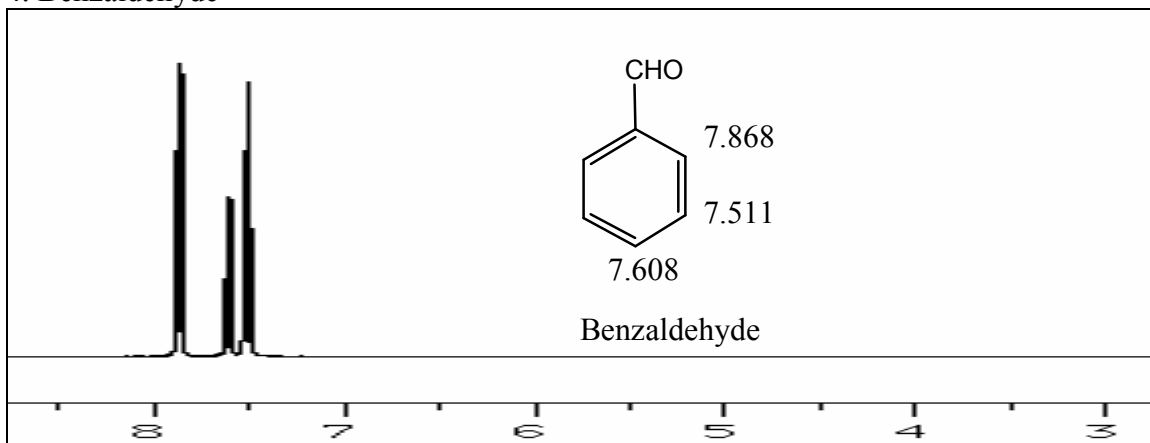
#### 2. Toluene



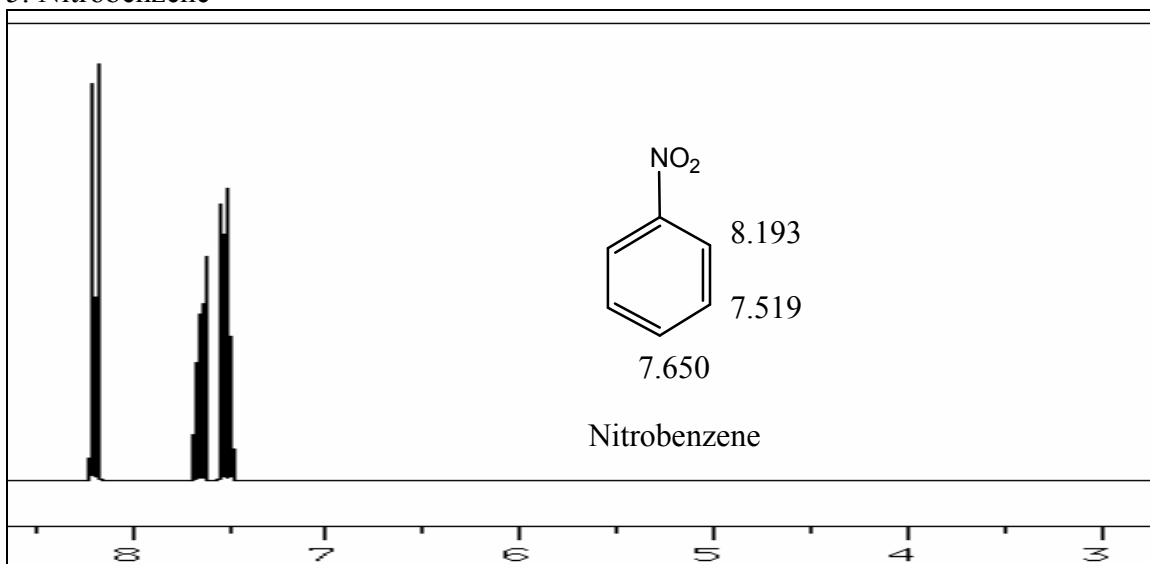
#### 3. Chlorobenzene



#### 4. Benzaldehyde

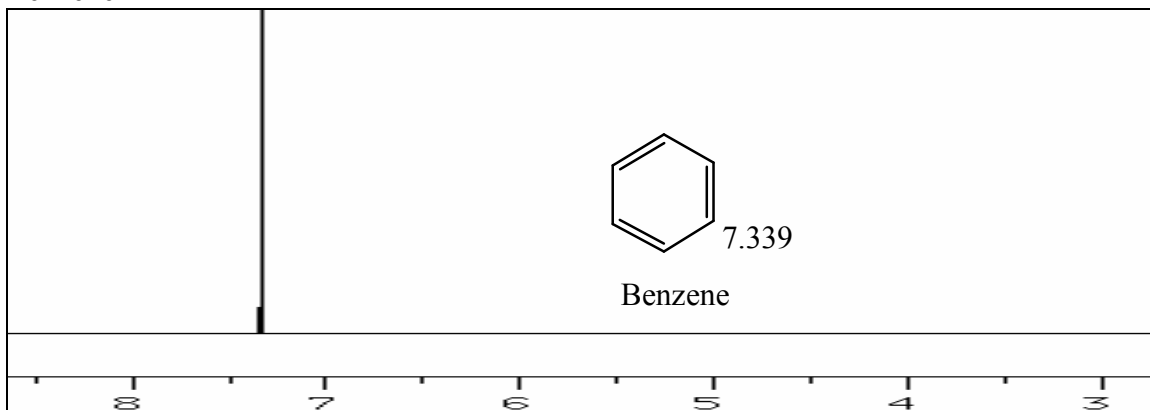


#### 5. Nitrobenzene



II. Based on the effects of substituents ( $\text{CH}_3\text{O}-$ ,  $\text{CH}_3-$ ,  $\text{Cl}-$ , formyl, and  $\text{O}_2\text{N}-$ ) on the chemical shifts as compared to that of benzene, provide an explanation for the relative reactivity of these substituted benzene derivatives (anisole, toluene, chlorobenzene, benzaldehyde, and nitrobenzene) toward the electrophilic aromatic substitution.

#### Benzene



III. Propose an electron-pushing mechanism for each of the reactions listed below. Provide an explanation for the regioselectivity based on the resonance structures of the reaction intermediates. Indicate **clearly** the pivotal resonance structures that will support your prediction on the regioselectivity of the reactions.

