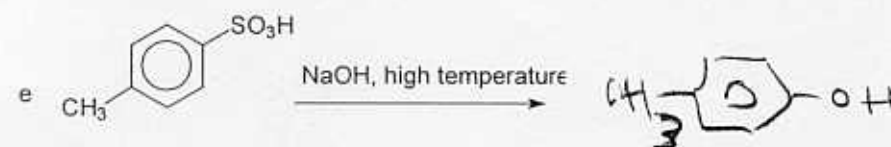
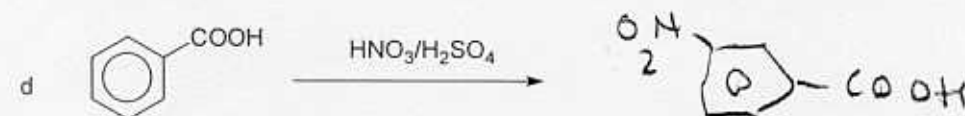
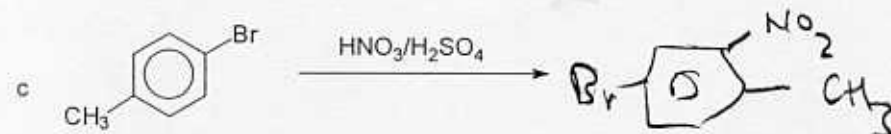
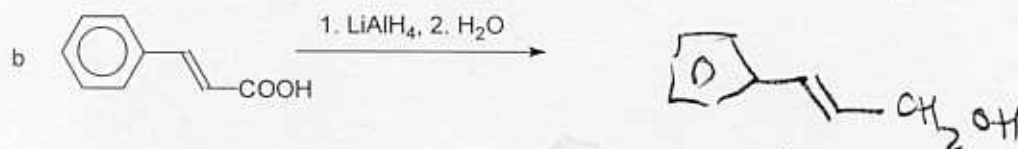
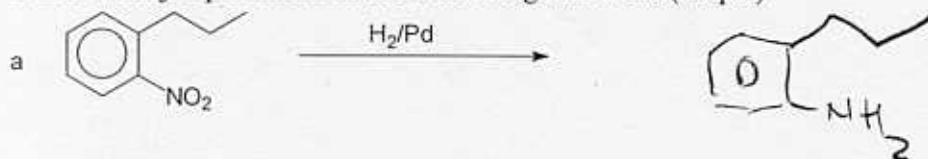
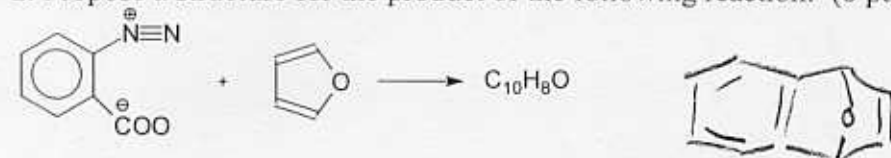
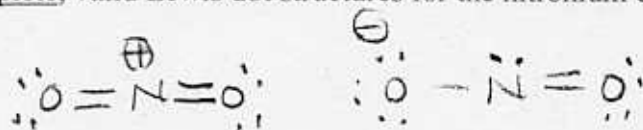
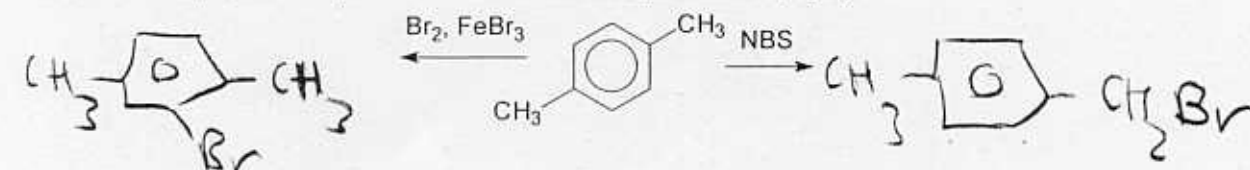


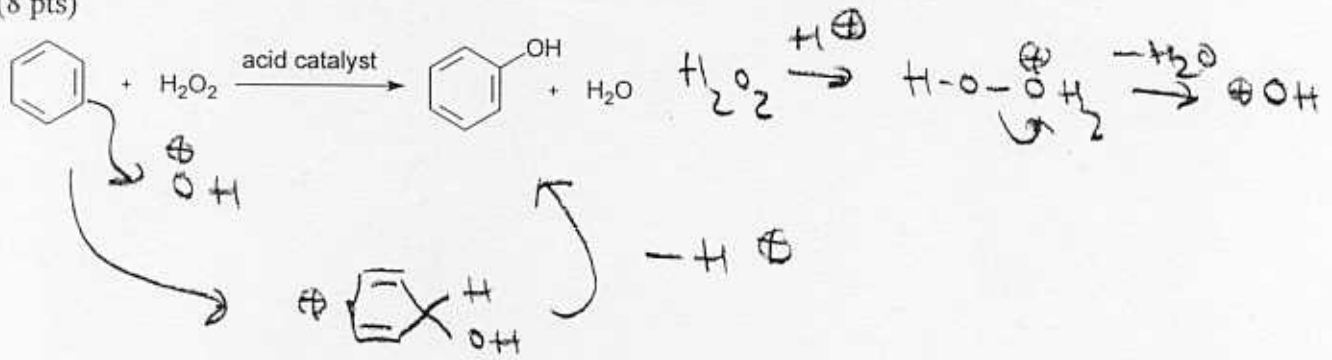
1. Show major products for the following reactions (12 pts)



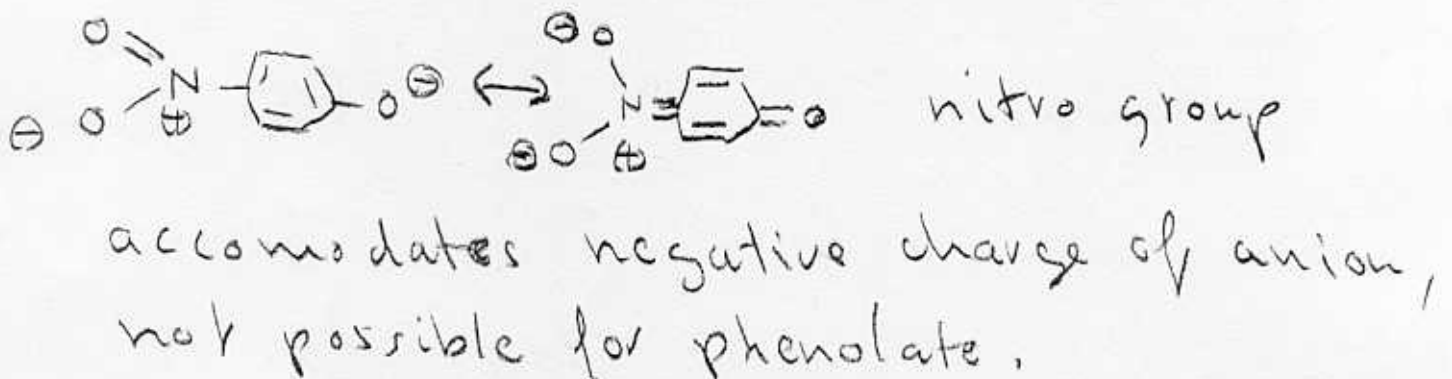
2. Propose a structure for the product of the following reaction: (6 pts)

3. Show complete, valid Lewis dot structures for the nitronium cation NO_2^+ and the nitrite anion NO_2^- . (6 pts)4. Bromination of p-xylene under the conditions shown below leads to different products, both with sum formula $\text{C}_8\text{H}_9\text{Br}$. Propose structures for both products! (8 pts)

5. Benzene can be hydroxylated with H_2O_2 under acid catalyzed conditions. What is the active electrophile in this case? Show a plausible mechanism for this electrophilic aromatic substitution! (8 pts)



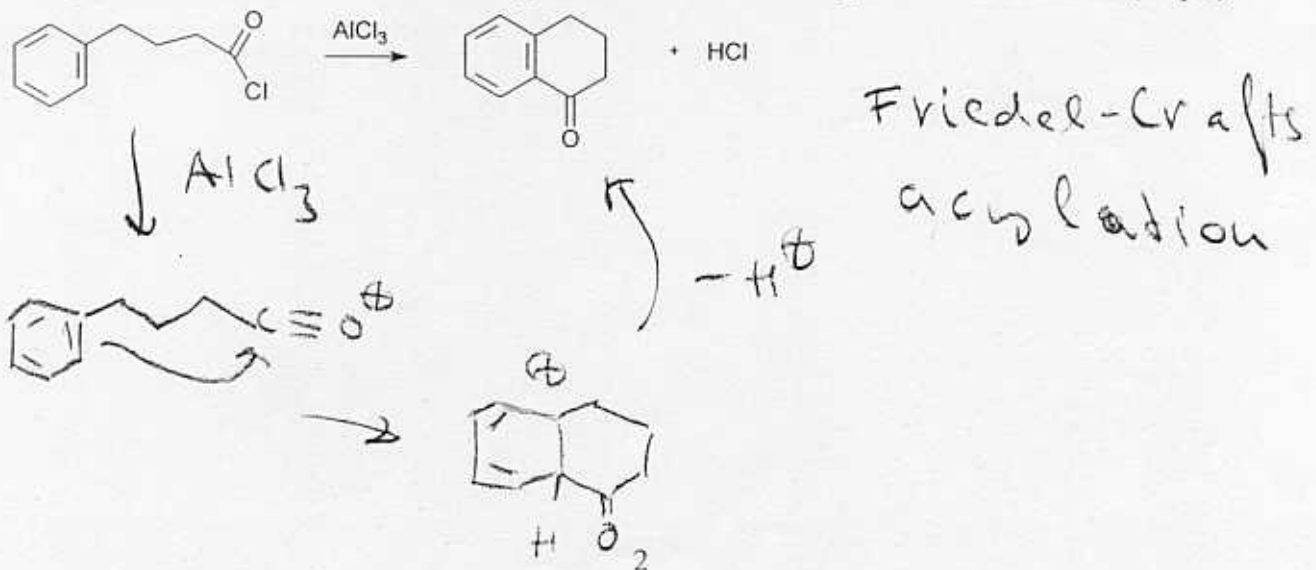
6. Explain with resonance forms why 4-nitrophenol is much more acidic than phenol! (5 pts)



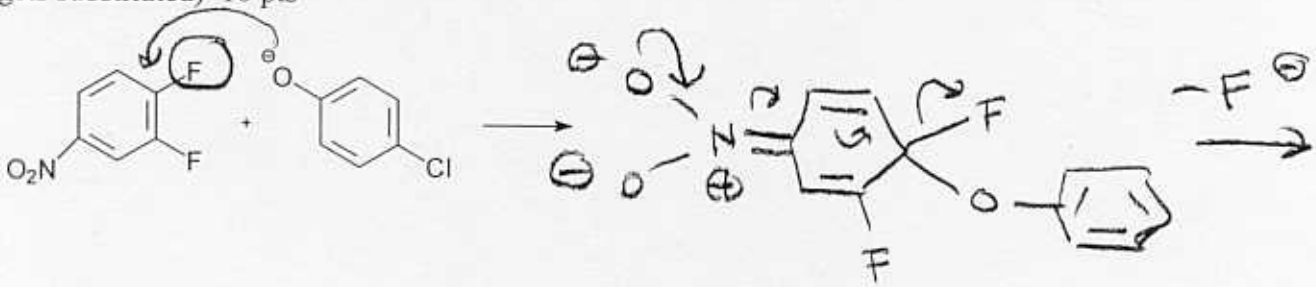
7. Rank the following by acidity, left to right, lowest to highest: 1. acetic acid, phenol, water, ethanol, tert-butanol (5 pts)

tert-butanol < ethanol < water < phenol < acetic acid

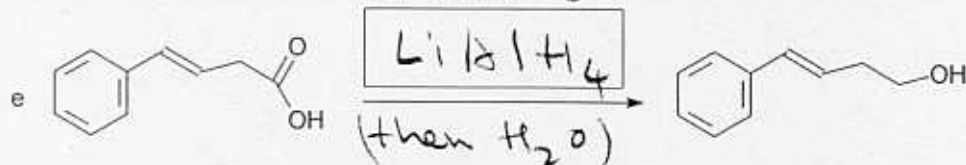
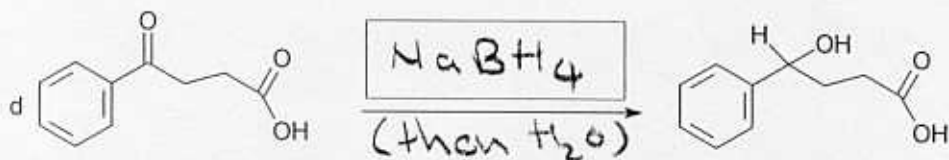
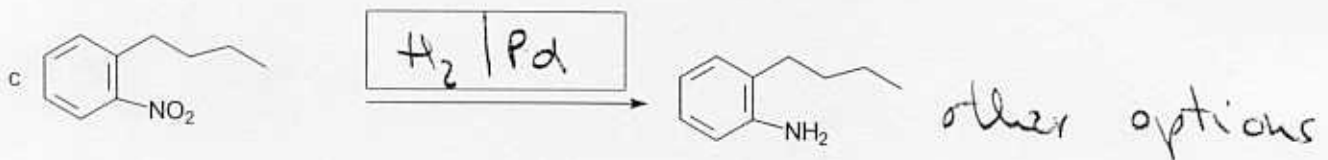
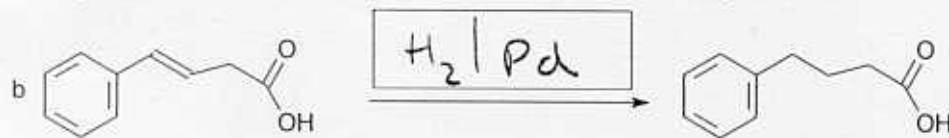
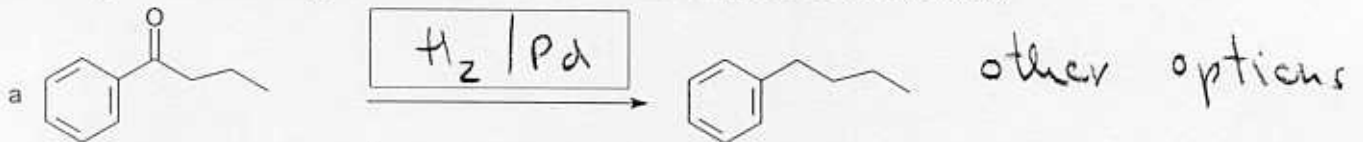
8. Propose a mechanism for the following transformation. What type of reaction is this? (10 pts)



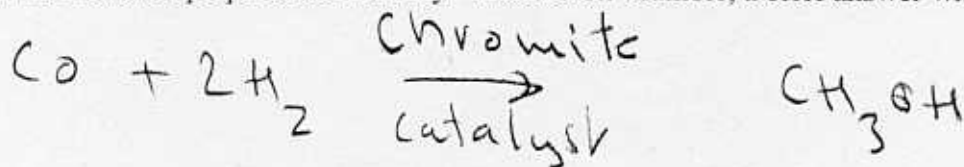
9. Diphenyl ethers can be made by reaction of fluorobenzenes and phenolates, as shown below. Show a reasonable mechanism and product for this reaction! (Hint: decide first which halogen atom gets substituted) 10 pts



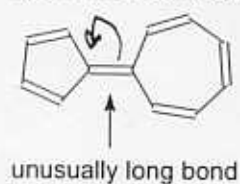
11. Propose suitable reagents/conditions for the following conversions (10 pts)



12. How is methanol prepared industrially? Please don't ramble, a brief answer will suffice (5 pts)

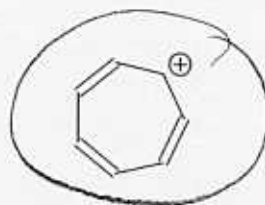
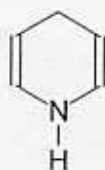
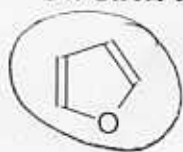


13. The compound below has a large dipole moment, and the central bond is much longer than a regular double bond. Show a plausible resonance form that explains this! (5 pts)



both sides aromatic!

14. Circle all aromatic compounds (5 pts)



15. 3-Aminobenzoic acid can be prepared from toluene, by nitration, oxidation of the methyl group, and reduction of the nitro group (but not necessarily in this sequence!). Outline this synthesis by showing the proper sequence of steps, structural formulas of intermediates, and reagents/conditions needed. (5 pts)

