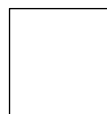
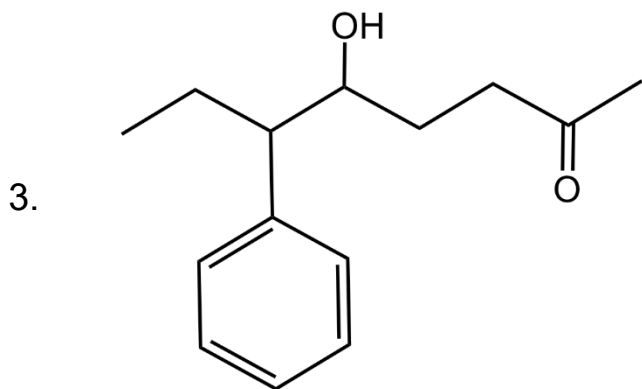
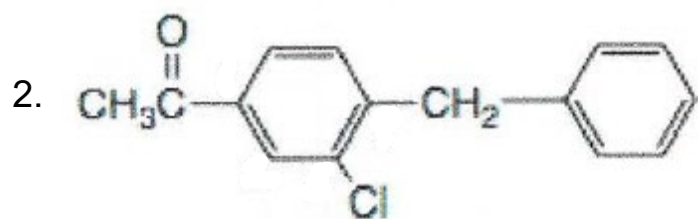
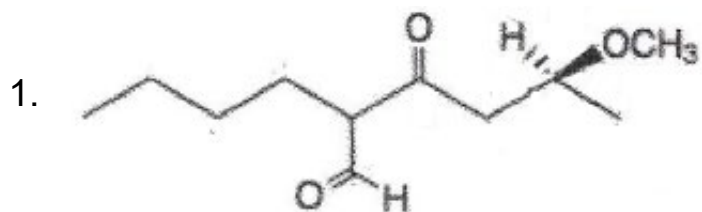


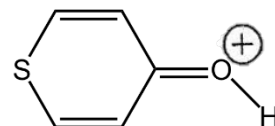
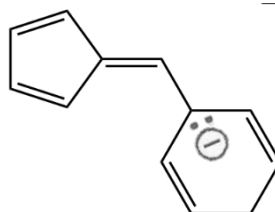
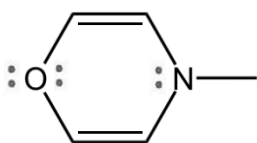
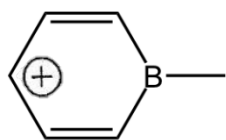
A. Nomenclature

Give an acceptable name for each of the following compounds. Be sure to note **stereochemistry** where appropriate.

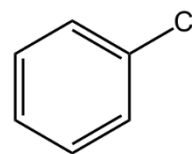
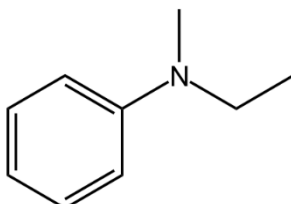
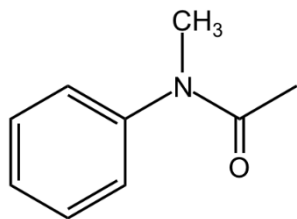


B. Facts

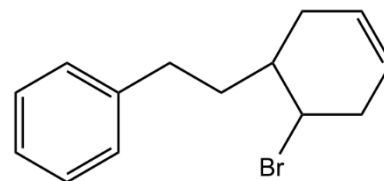
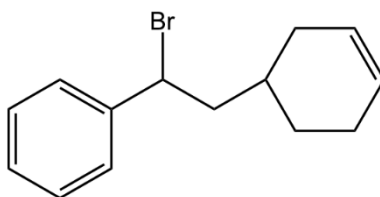
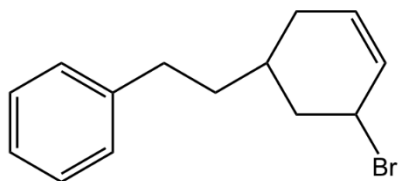
1. Label the molecules below as aromatic(**AR**), antiaromatic(**AA**), or nonaromatic(**NA**). Please assume all are planar.



2. Place the following compounds in order of increasing reactivity in a Friedel-Crafts acylation reaction. (1=slowest, 3=fastest).

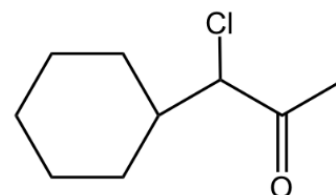
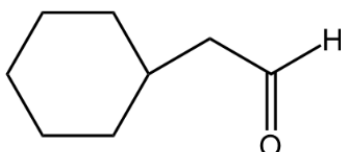
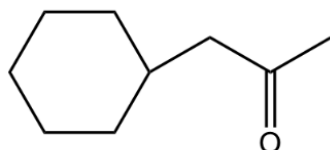


3. Place the following compounds below in order of increasing reaction rate in SN2 process (1=least reactive, 3=most reactive).



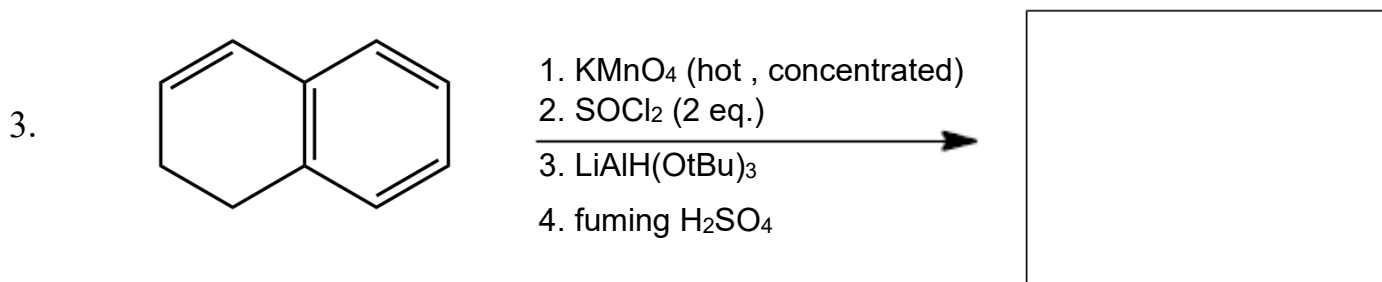
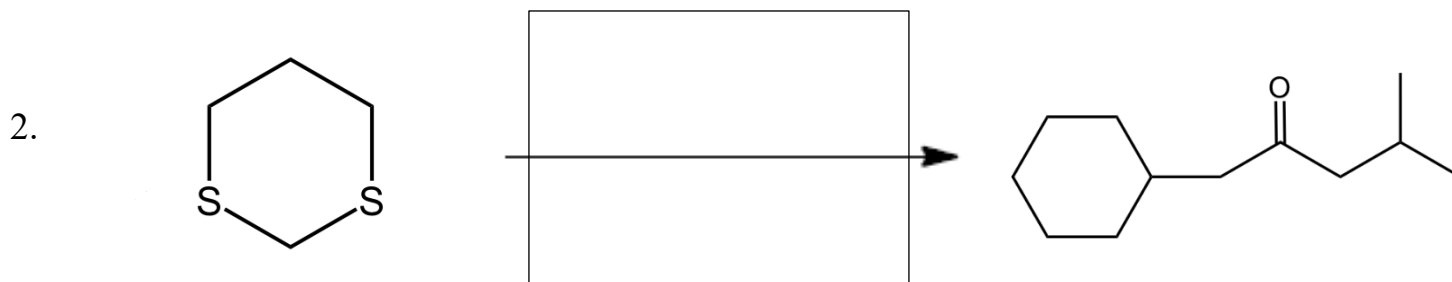
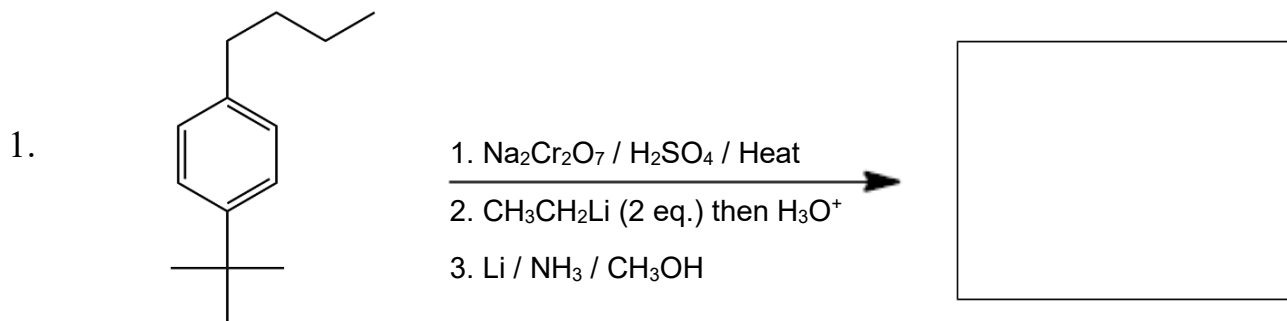
4. With brief statements about transition states, intermediates, and activation energies, explain why a nitro group (NO_2^-) substituent decreases the rate of electrophilic aromatic substitution.

5. Place the following compounds in order of increasing amount of hydrates present at equilibrium in their reactions with water. (1=least amount, 3=greatest amount).

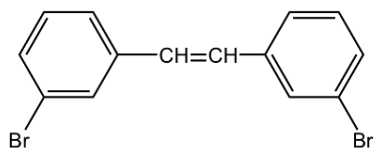


C. Reactions

Please provide the starting material or the major products in the answer box unless otherwise indicated. Be sure your drawing indicates **stereochemistry** if applicable. **Full credit is awarded only when the product of each step in a multi-step reaction is shown below the reaction.**



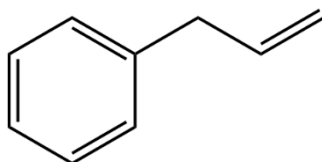
4.



1. O_3 then $(\text{CH}_3)_2\text{S}$
2. $\text{HNO}_3 / \text{H}_2\text{SO}_4$
3. $\text{CH}_3\text{O}^-\text{Na}^+ / 100^\circ\text{C}$



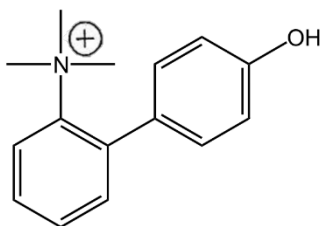
5.



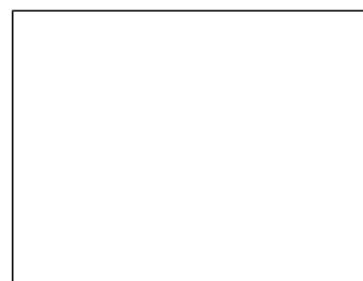
1. NBS/ light , 65°C
2. NaCN / DMSO
3. $(\text{CH}_3)_2\text{CHMgBr}$
4. then H_3O^+
5. NaCN, H^+



6.

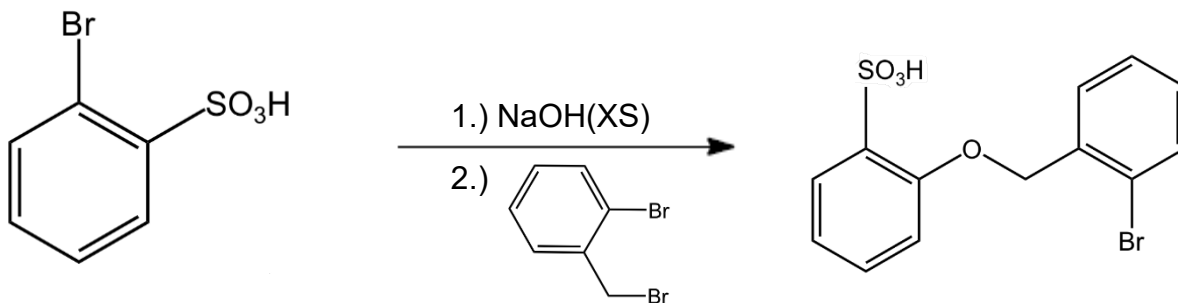


1. $\text{CO} / \text{HCl} / \text{AlCl}_3 / \text{CuCl}$
- 2.
3. Ra-Ni (excess)



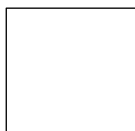
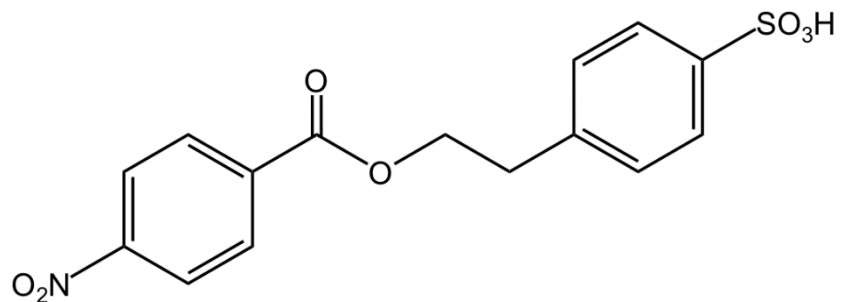
D. Mechanism:

Provide a clear mechanism to explain the formation of the product. Use curved arrows to indicate "electron flow." Remember to show only one step at a time. **Show all intermediates and all formal charges.** Do not show transition states! When more than one resonance contributor may be drawn, be sure to draw the most stable contributor.



E. Synthesis:

Synthesize the molecule below using any of the following reagents: **Benzene**, and **alcohols of two carbons or less**, any inorganic reagents, any oxidizing or reducing agents, and any peroxyacids.



F. Spectroscopy:

A compound with the formula C_9H_8O exhibits the IR, 1H NMR, and ^{13}C NMR spectra shown below. Please identify this compound and draw the structure in the box provided below.

