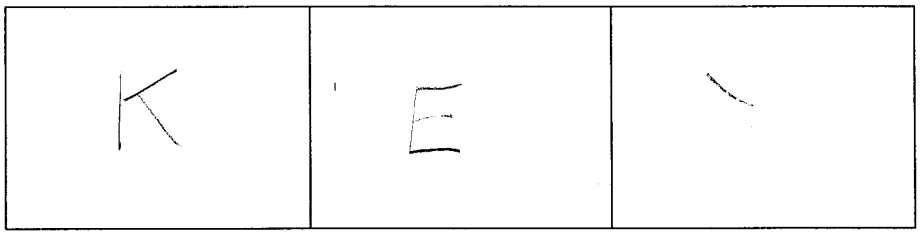
CH310N
Spring 2011

Anslyn

April 19, 2011

Exam 3

Please **PRINT** the first three letters of your last name in the three boxes.

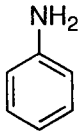


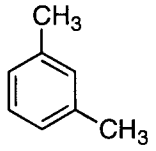
PRINT Name _____ **UT-EID** _____

1) _____ (8 pts)
2) _____ (9 pts)
3) _____ (4 pts)
4) _____ (6 pts)
5) _____ (5 pts)
6) _____ (20 pts)
7) _____ (10 pts)
8) _____ (4 pts)
9) _____ (6 pts)
10) _____ (6 pts)
11) _____ (8 pts)
12) _____ (6 pts)
13) _____ (8 pts)
Bonus) _____ (2 pts)

Total Score _____ (100 pts)

1. (a) (From the notes) Please give the **common names** for the following compounds. (8 points)

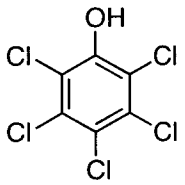


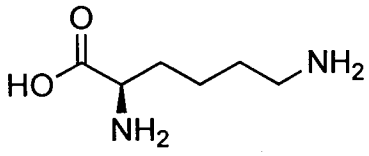


Aniline

m-xylenes

(b) (Partly from homework, problem 21.9h) Please give the IUPAC name for the following compound.



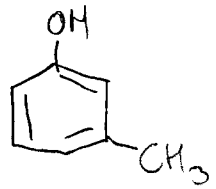


Pentachloro phenol

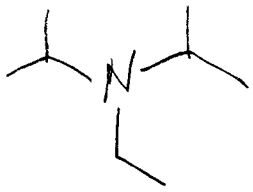
(R)-2,6-diaminohexanoic acid

(c) (Partly from the notes) Please draw the chemical structures for the following names.

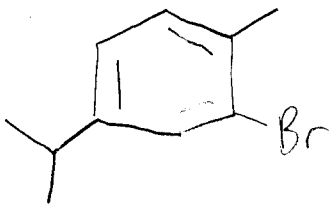
m-cresol



N,N-diisopropylethyl amine

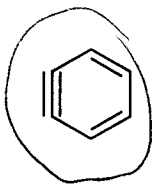


o-bromo-*p*-isopropyl toluene

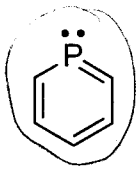


2. Please assign the number of electrons in p-orbitals for each of the following compounds. Then, **CIRCLE** the compounds that are designated **AROMATIC**. (9 points)

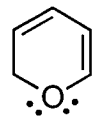
1



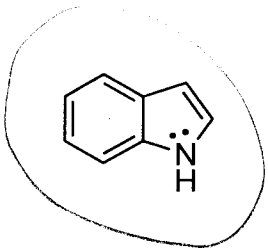
p-electrons: 6 or 8



p-electrons: 6

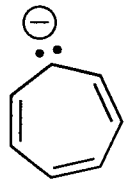


p-electrons: 4



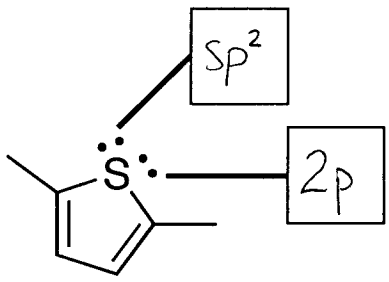
p-electrons: 10

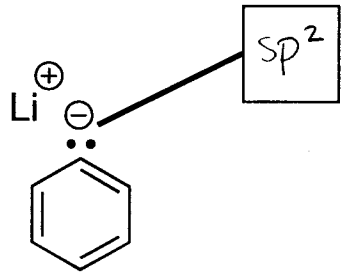
p-electrons: 4

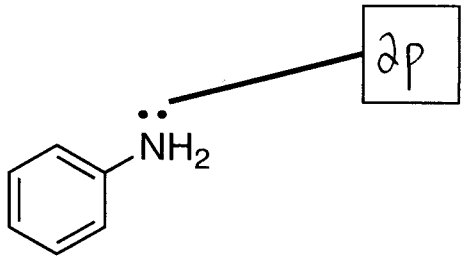


p-electrons: 8

3. For the compounds below, please indicate the type of orbital in which each lone pair resides. (4 points)

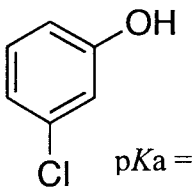




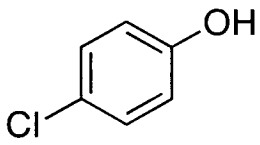


4. This question pertains to one of the topics we covered since the last exam, the acidity of phenols. Using arguments made in class, as well as any others you may have learned during your chemical education, please explain the noted differences in p*K*a values. (6 points)

a)



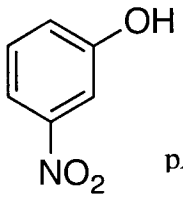
p*K*a = 8.85



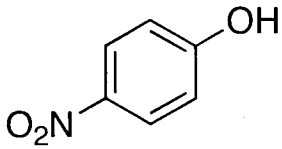
p*K*a = 9.18

Induction - the closer the electron withdrawing Cl is to the anion, the more it is able to stabilize that anion. This stabilization makes it easier to remove a proton, hence more acidic.

b)

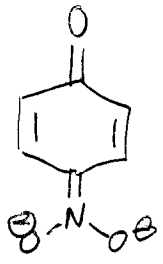


p*K*a = 8.28

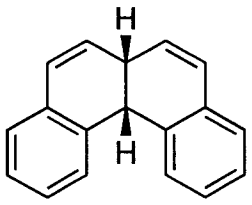


p*K*a = 7.15

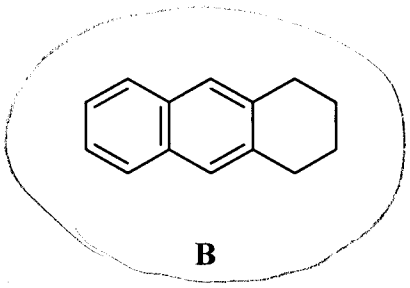
Resonance - when the nitro group is para to the phenol, an extra resonance structure (pictured at right) can be drawn. This extra delocalization stabilizes the anion, making this structure more acidic.



5. The following two molecules, **A** and **B**, contain conjugated systems of π-electrons. Circle the one that would absorb UV/vis light at a **LONGER** wavelength. Then, justify your answer in no more than three sentences. (5 points)



A

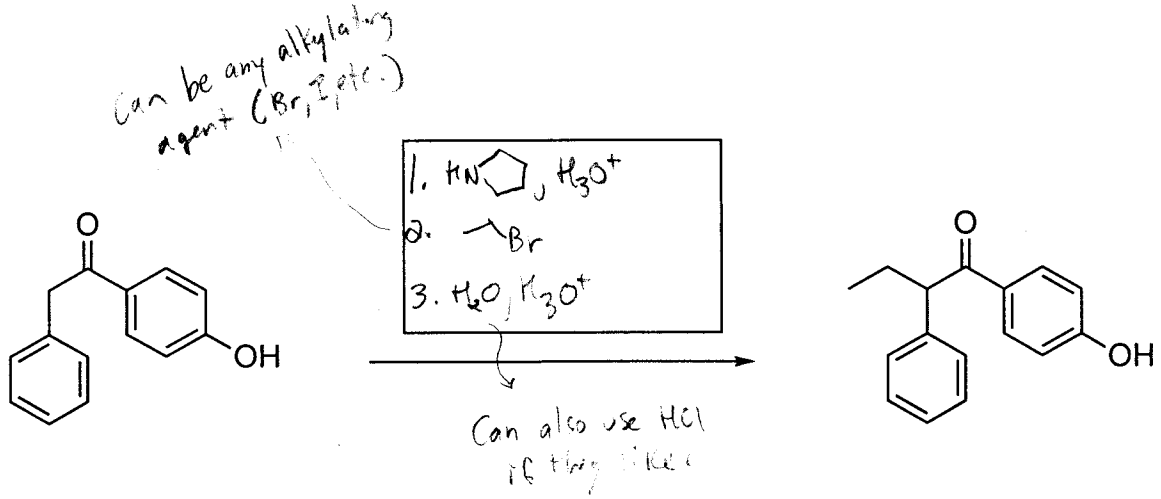


B

The longest conjugation we get for A is 4 π bonds, even though it has 8 total π bonds. In B, we have 5 bonds that are in conjugation. Longer conjugation means shorter HOMO LUMO gap, thus longer wavelength.

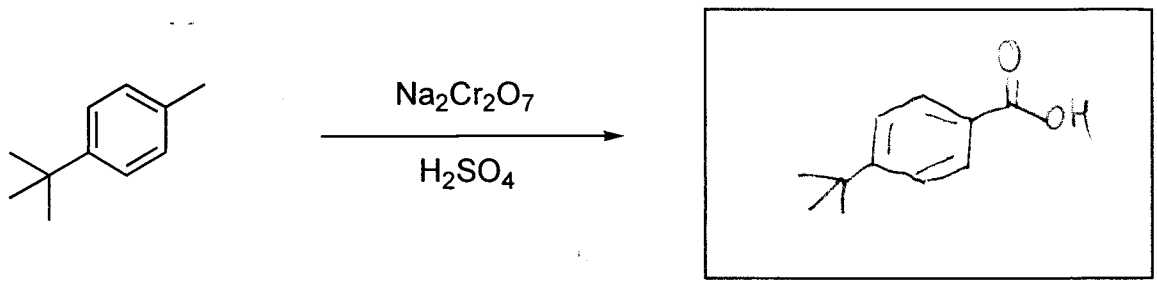
6. Fill in the box with the appropriate reactant, reagent, or product. Some boxes require more than one step. (20 points)

a)

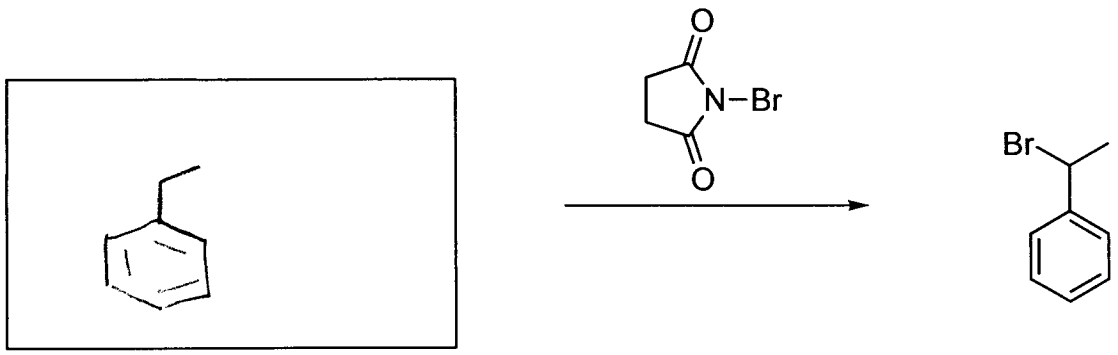


* Can't use a strong base because it would deprotonate the phenol.

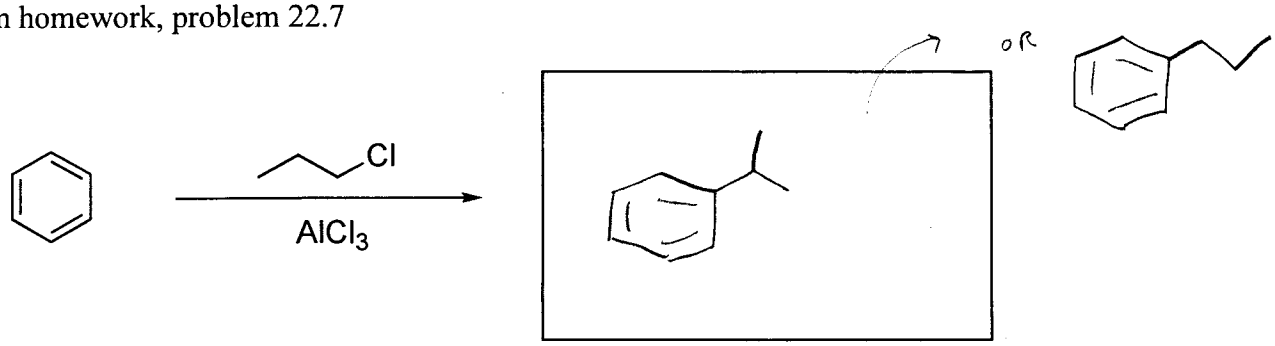
b) From class notes



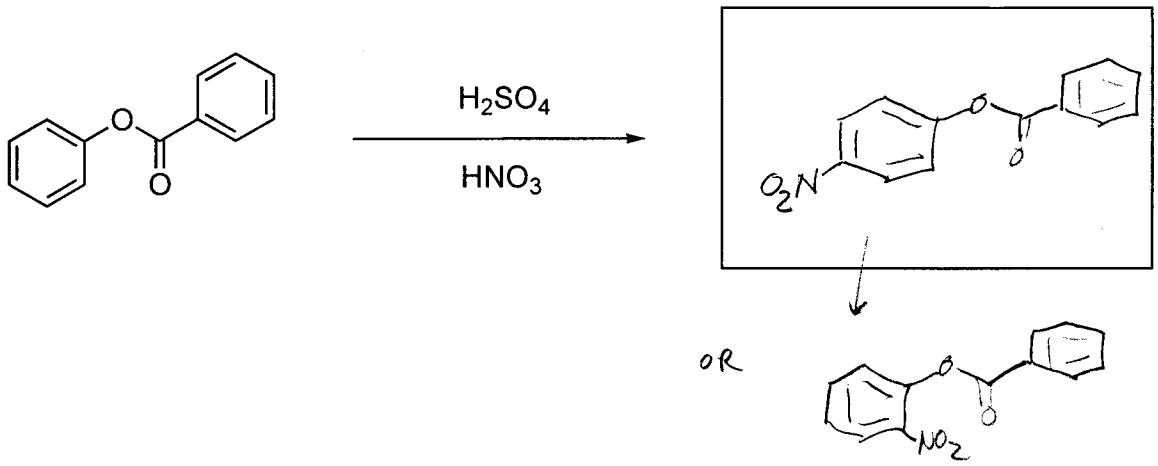
c) From class notes



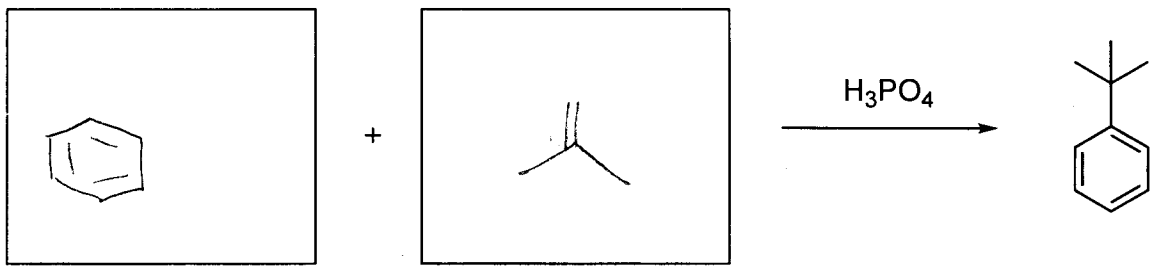
d) From homework, problem 22.7



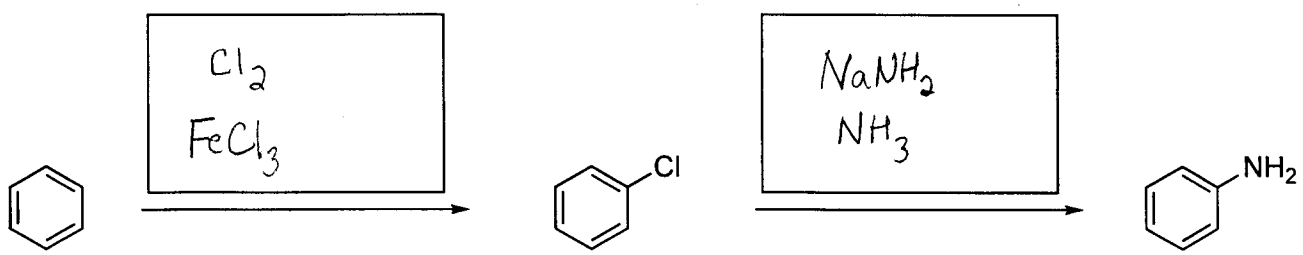
e) From homework, problem 22.21a



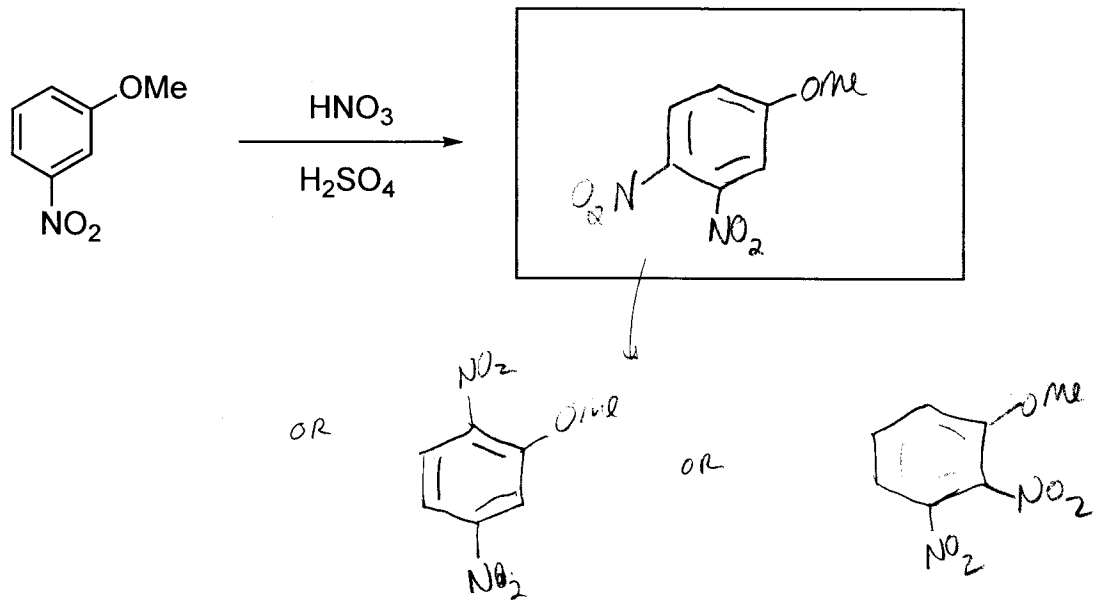
f) From class notes



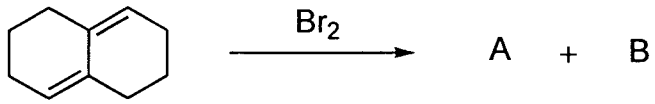
g) From class notes



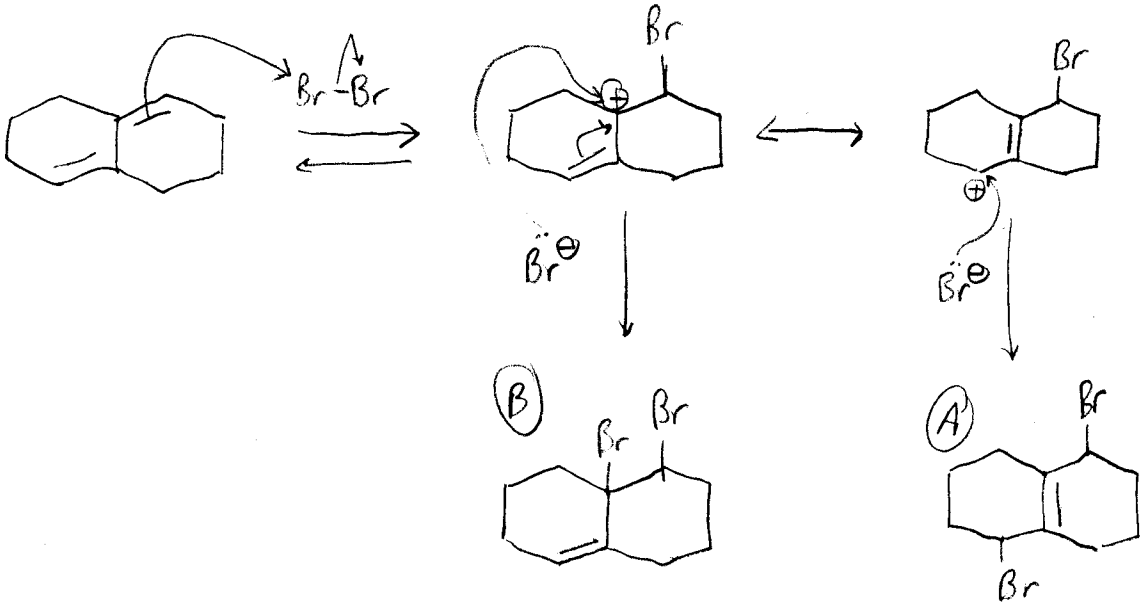
h) From homework, problem 22.15a



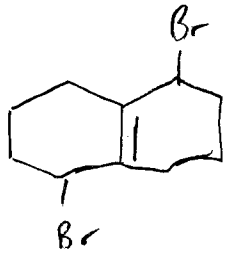
7. Partly from homework, problem 20.14. One mole of Br_2 can add to the hexahydronaphthalene reactant shown below, yielding two different products A and B. This question pertains to those products. (10 points)



a) Write the mechanism of this reaction, including any intermediate structure(s), and show all arrow pushing necessary. Your mechanism should account for the formation of the two products.

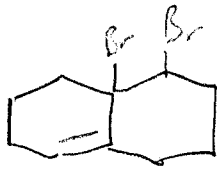


b) Product A is the thermodynamic product. Draw its structure, and note which reaction conditions favor its formation.



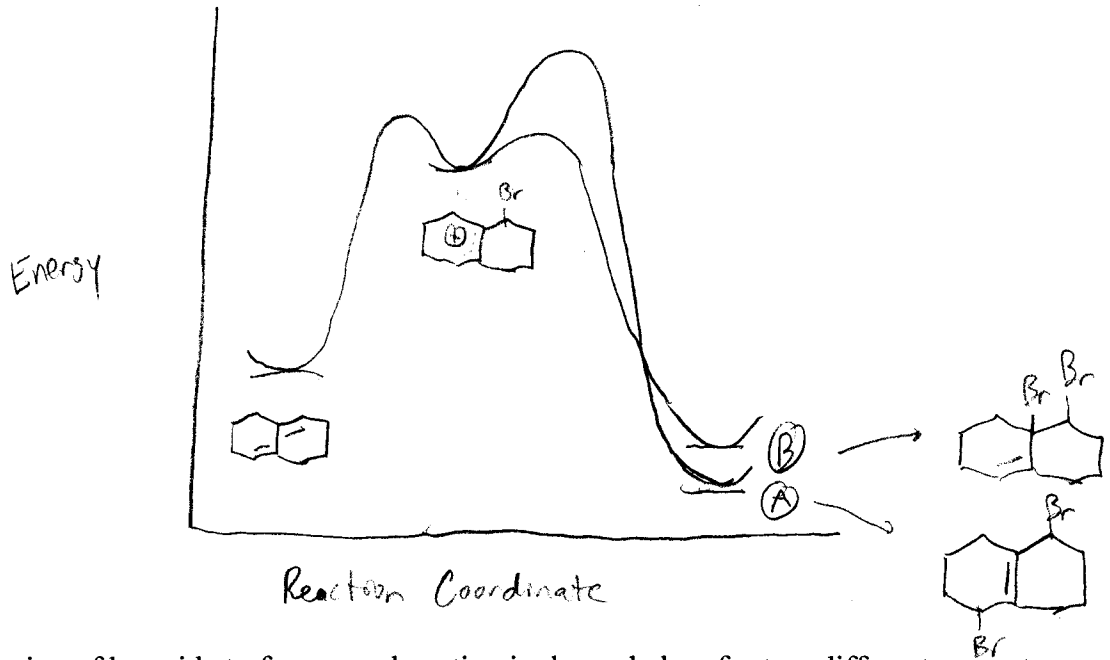
Higher Temperatures

c) Product B is the kinetic product. Draw its structure, and note which reaction conditions favor its formation.

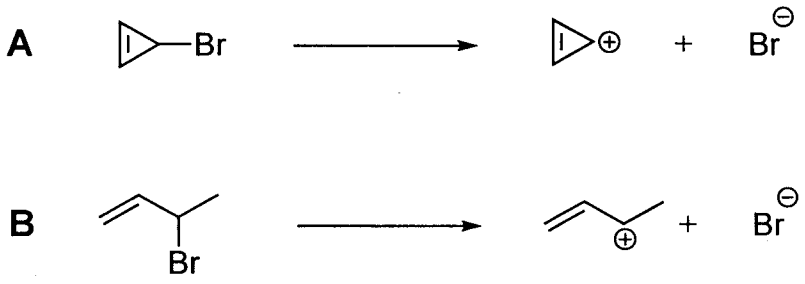


Lower Temperatures

d) Draw the reaction coordinate diagram for this reaction. Your diagram should include the relative energies and structures of the starting material, intermediate(s), and products.

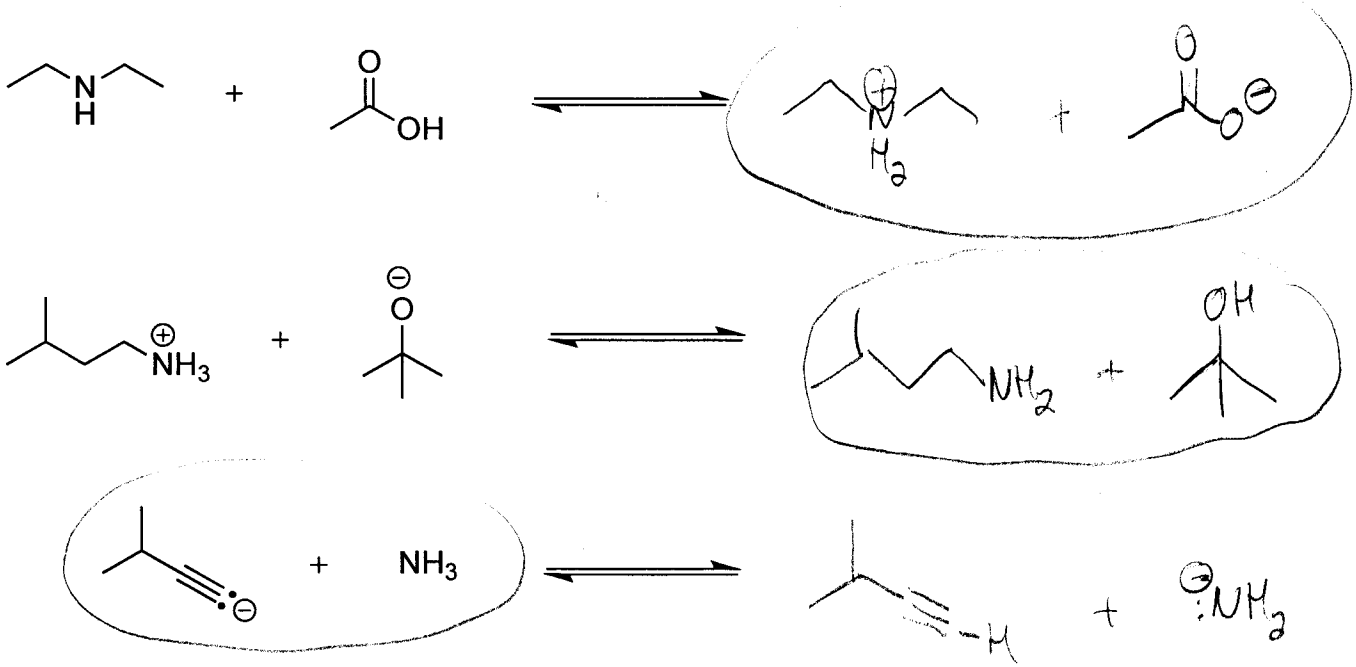


8. Elimination of bromide to form a carbocation is shown below for two different reagents: cyclopropene (A), and 3-bromopropene (B). This elimination occurs much more readily for cyclopropene A, than for 3-bromopropene B. Please explain this observation in 3 sentences or less. (4 points)

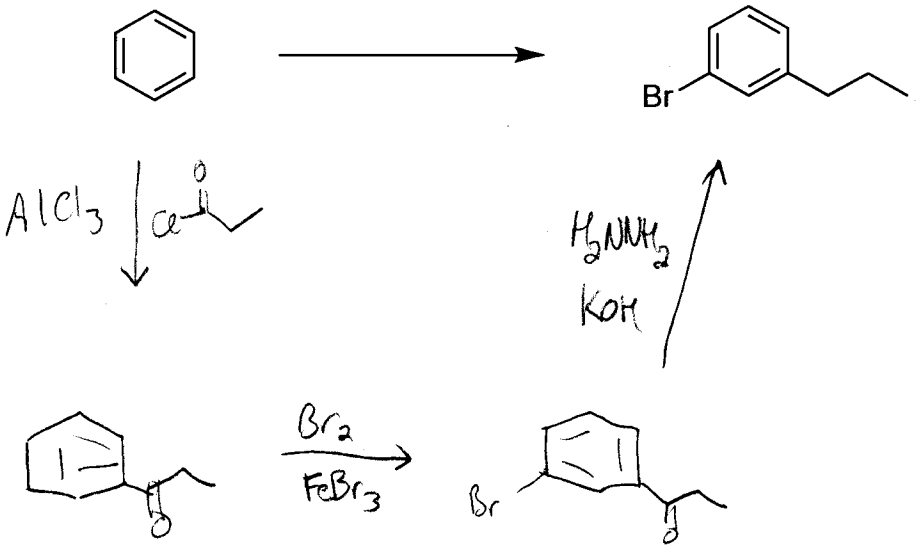


Br leaving A gives an aromatic structure, making this cation more stable. B is not cyclic, so can't have this same aromatic stabilization.

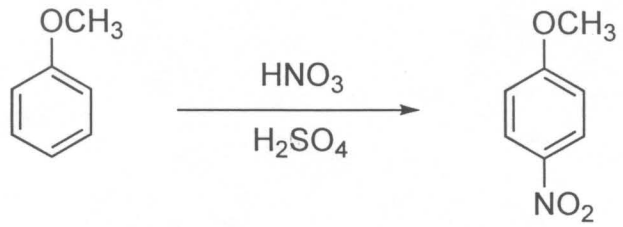
9. For the following acid-base reactions, complete the reaction by providing the conjugate acid and conjugate base. Then, **circle** the side of the reaction that is favored at equilibrium. (6 points)



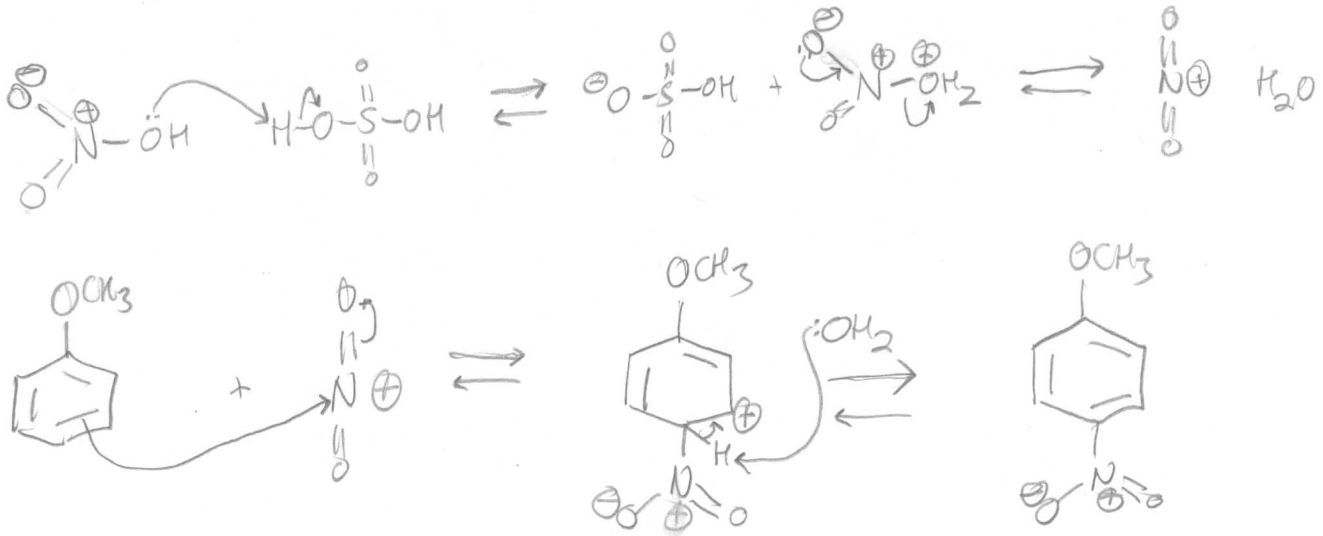
10. Please show how you would bring about the following transformation, using benzene and any reagent containing 4 carbons or less. Note that you do NOT need to show arrow pushing for each step. (6 points)



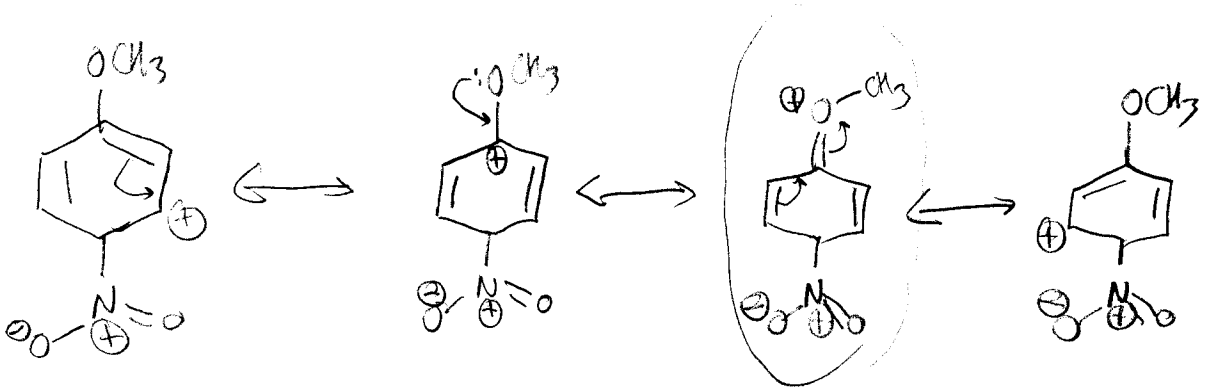
11. From your notes. Nitration is a form of electrophilic aromatic substitution. This question pertains to the nitration of anisole, as shown below. (8 points)



a) Draw the mechanism for this reaction, using arrow pushing to indicate the flow of electrons. Your mechanism should only show one resonance structure of the carbocation intermediate.

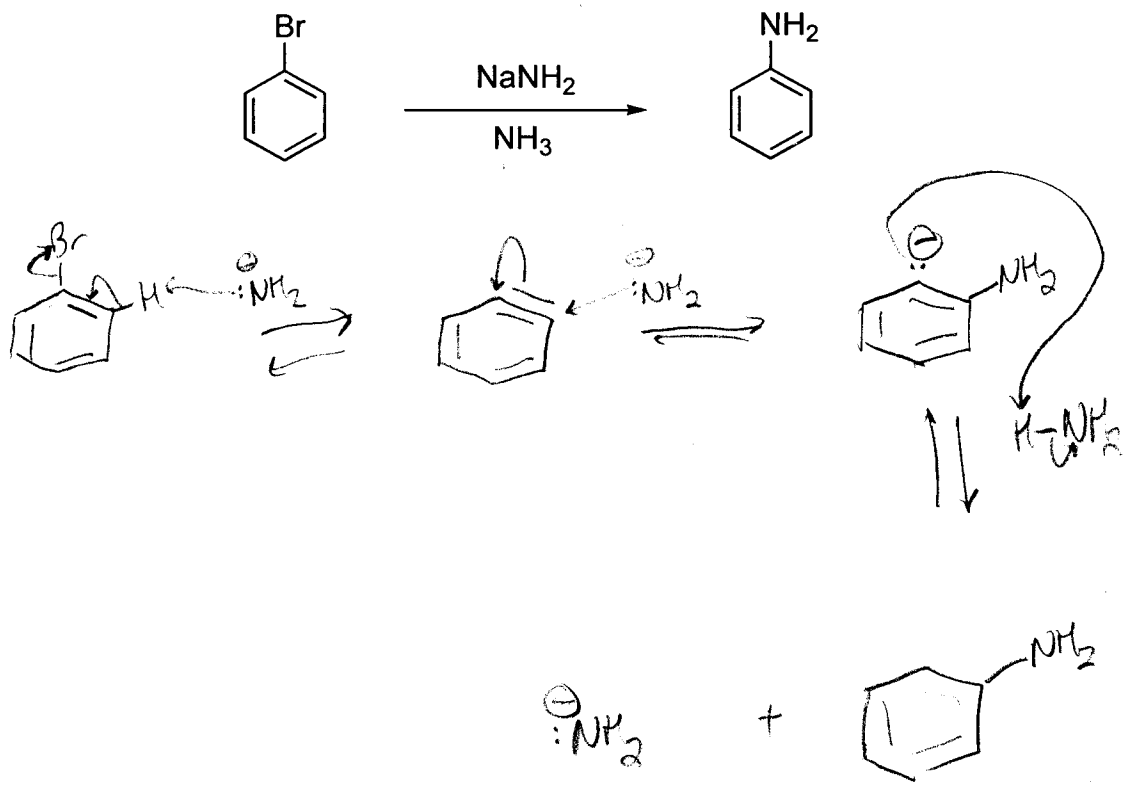


b) Now, write all of the resonance structures for the carbocation intermediate. Then, using these structures, explain why the $-OCH_3$ group is para (as well as ortho) directing.

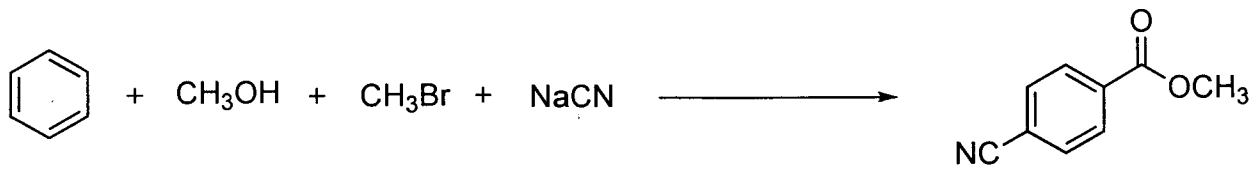


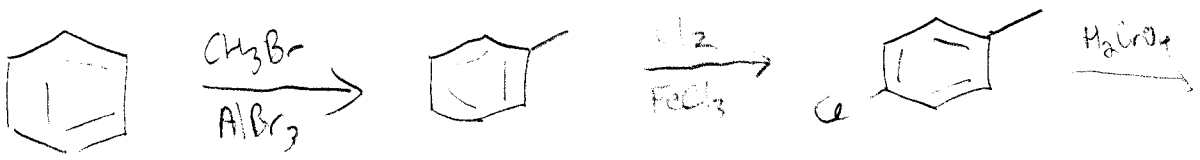
When the group is added para (or ortho) the lone pair on the donating group can stabilize the carbocation through creation of an additional resonance structure. This circled structure further delocalizes this positive charge, and is not available to the meta compound. For these reasons we get the para (or ortho) product.

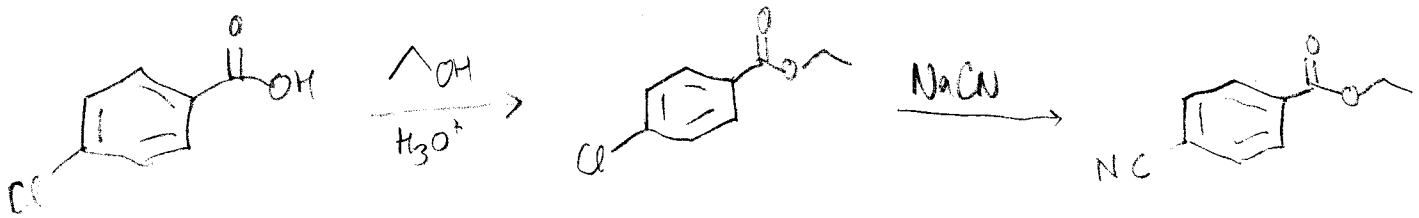
12. From your notes. Nucleophilic aromatic substitution of bromobenzene proceeds according to the reaction shown below. Please draw the mechanism for this transformation, including all participating lone pairs, applicable formal charges, and required arrow pushing to indicate flow of electrons. (6 points)



13. Using the reagents shown as the only source of carbon atoms, please show how you would bring about the following transformation. Note that you do NOT need to show arrow pushing for each step. (8 points)







BONUS QUESTION: What region of the country is the awesome progressive rock band YES touring in this upcoming summer?

Northern