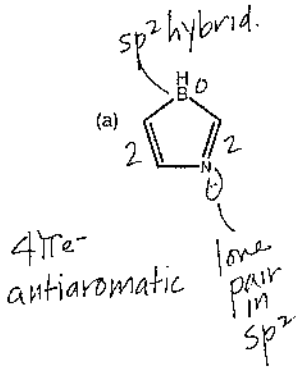
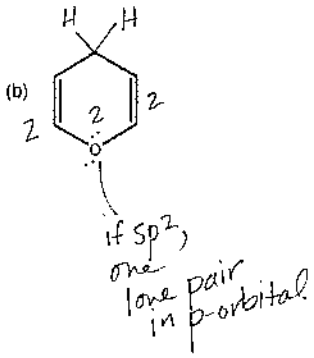
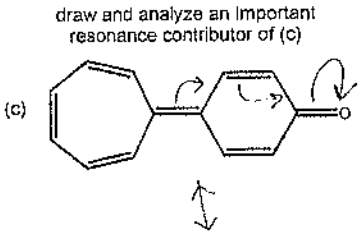
1. (16 pts) For each molecule below, report the total number of π electrons in the molecule below, and classify the molecule as aromatic, antiaromatic, or nonaromatic. You can assume the molecules are planar. Briefly explain your choice.

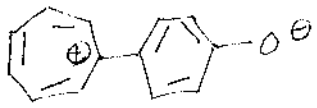




nonaromatic b/c of sp^3 C

draw and analyze an important resonance contributor of (c)

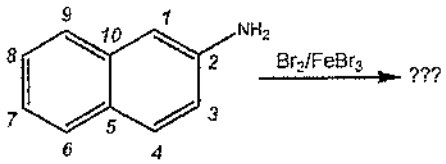




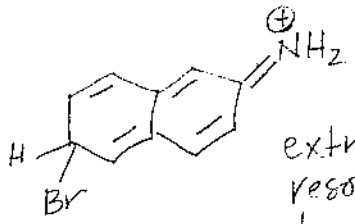
6πe⁻ 6πe⁻

both rings aromatic

2. (12 pts) Is 2-aminonaphthalene more likely to react with $Br_2/FeBr_3$ at C6 or C7? Explain your answer using a combination of words and important resonance structures. It is not necessary to draw all possible resonance structures.

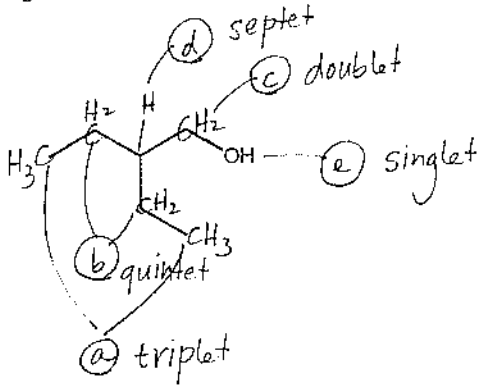


C7: NH_2 is o/p director so

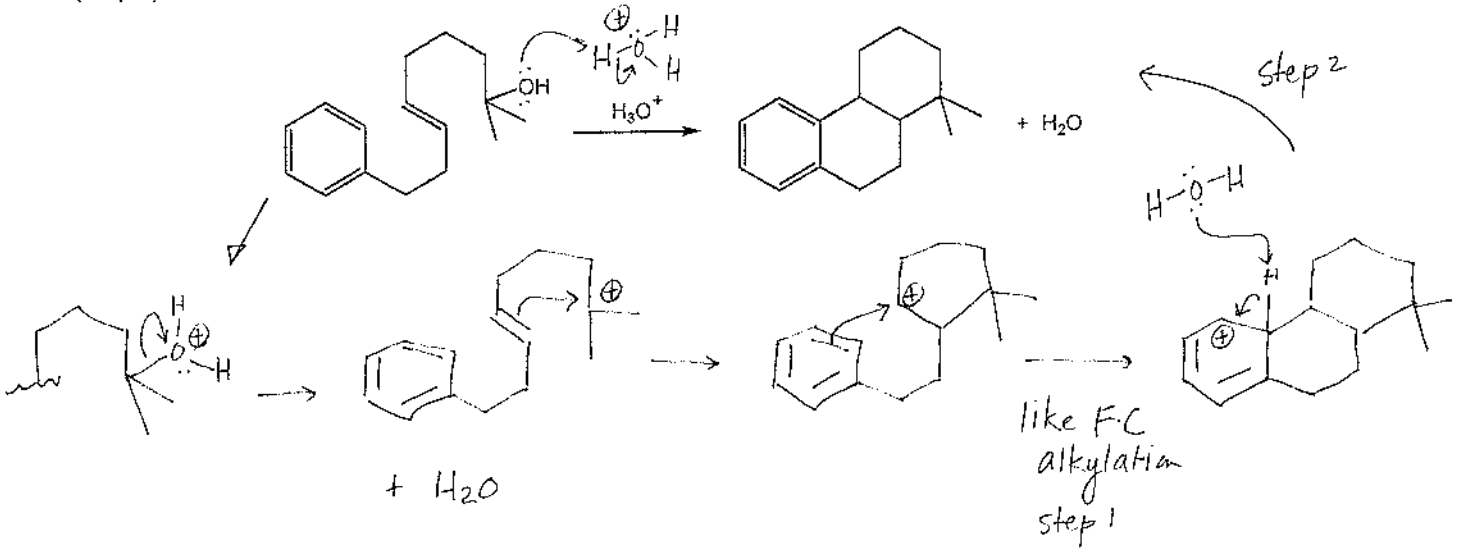


extra resonance using N lone pair if Br is added to C7.

3. (8 pts) Predict what the ^1H NMR spectrum will look like for the molecule shown below:
   (i) Label the magnetically different H's as a, b, ...
   (ii) Indicate the splitting pattern (singlet, doublet, etc) expected for each signal

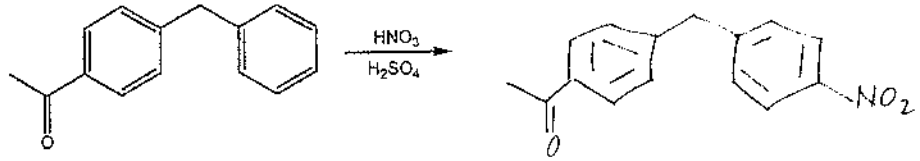


4. (12 pts) Provide a complete mechanism for the following reaction.

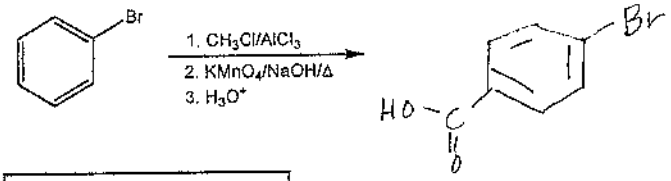


5. (12 pts) Predict the major product for each of the following aromatic reactions.

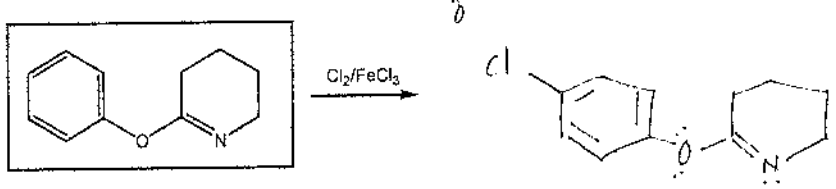
a.



b.

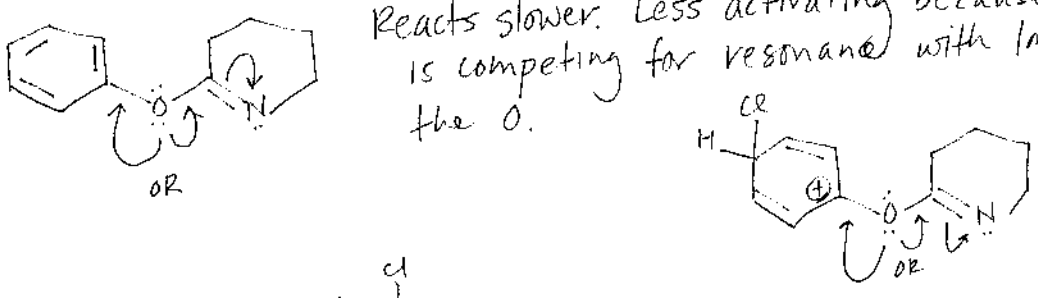


c.



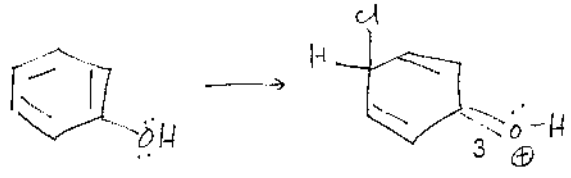
6. (10 pts) Compare the boxed molecule in question 5c to phenol (C_6H_5OH). Under identical experimental conditions ($Cl_2/FeCl_3$), would the boxed molecule be expected to react faster, slower, or at an identical rate compared to phenol? Clearly explain <u>using structures</u> where appropriate.

Reacts slower. Less activating because the $=N$ is competing for resonance with lone pair of the O.

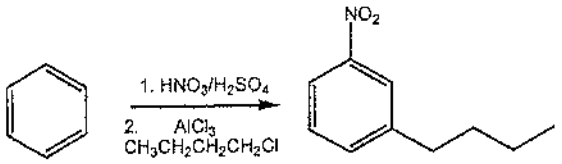


VS.

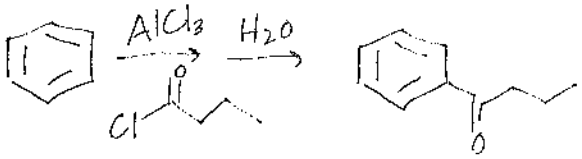
phenol

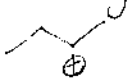


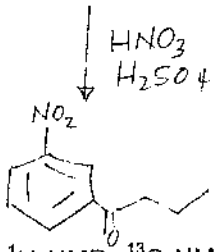
7. (12 pts) (a.) Provide two specific reasons for why the synthesis shown below will fail to produce the desired target. (b.) Design a successful synthesis of the target molecule starting from benzene.



1. Ar ring is very deactivated by NO_2 so no F-C reactions will occur subsequent to nitration



2. Rearrangent of  to 

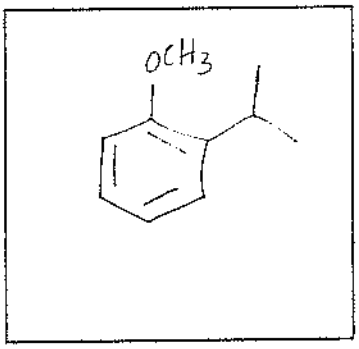


$\frac{Zn(Hg)}{HCl}$ Target.

8. (18 pts) Shown below are ^1H NMR, ^{13}C NMR, for an unknown compound **SHINA** that has the molecular formula $C_{10}H_{14}O$. Propose a structure for **SHINA** using the data provided. Draw your proposed structure in the box below.

For full credit, you must do the following:

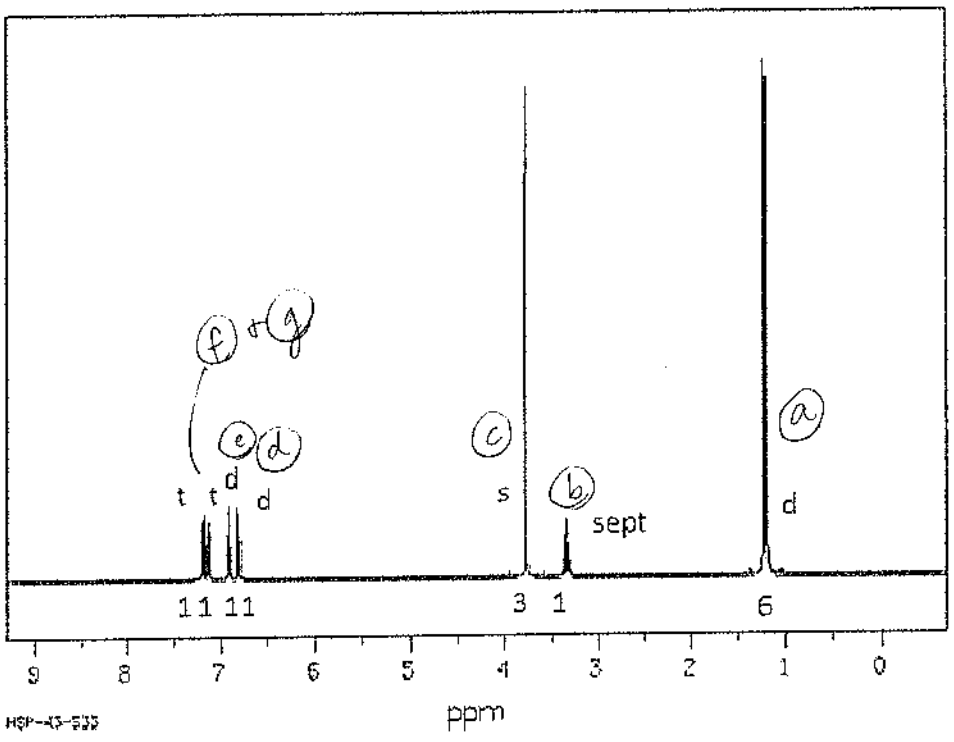
a. Calculate the IHD.
b. Assign all signals in the ^1H NMR spectrum (a, b, etc) to labeled protons in the structure.
c. Show that the splitting pattern of two of the signals is consistent with your structure.
d. Assign all signals in the ^{13}C NMR spectrum (a, b, etc) to labeled carbons in the structure.

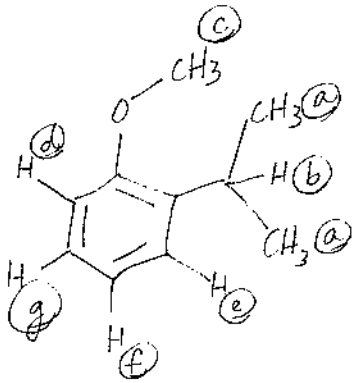


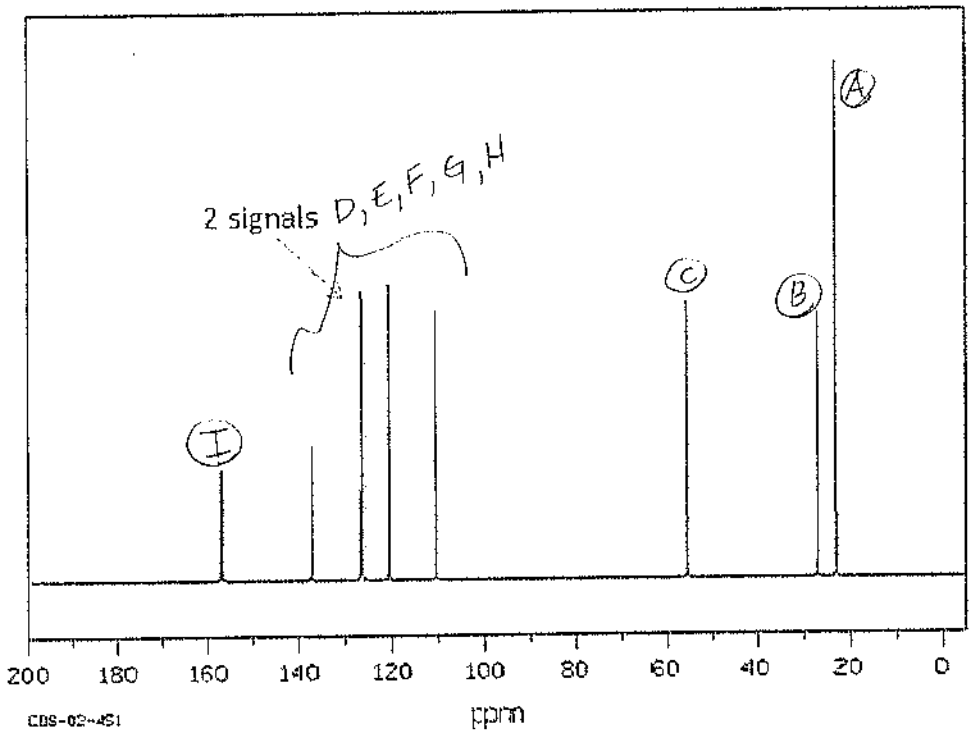
SHINA

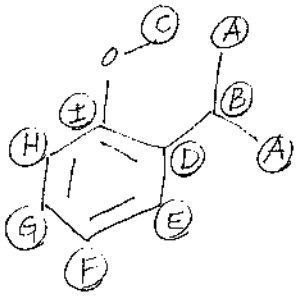
$$IHD = \frac{(2\times 10 + 2) - 14}{2} = 4$$

SHINA


f & g
e
d
c
b
a
t t d d
s
sept
d
1 1 1 1
3 1
6
9 8 7 6 5 4 3 2 1 0
ppm


c
CH3
O
CH3 a
H d
H b
CH3 a
H g
H e
H f


2 signals D, E, F, G, H
A
B
C
I
200 180 160 140 120 100 80 60 40 20 0
ppm


C
A
B
A
I
H
D
G
E
F