CH 237-LC Summer 2010 Exam-III July 22, 2010

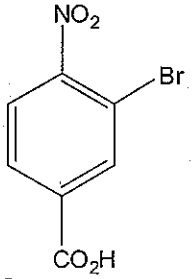
Name Key
(Last) *(First)*

BOO#_____

This exam is divided up into two parts, multiple choice and short answer questions. All work must be shown in order to receive full credit. Please turn off all electronic communication devices.

Multiple choice questions: Choose the correct answer and record it on the scantron provided. (2 points each)

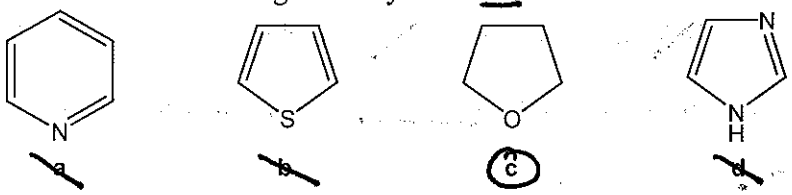
1. What is the IUPAC name of the following compound?



(a) 2-nitro-6-carboxybromobenzene (b) 2-bromo-1-nitro-4-benzoic acid
(c) 2-bromo-4-carboxynitrobenzene (d) 3-bromo-4-nitrobenzoic acid

2. What is the hybridization of the oxygen atom of furan?
(a) *s* (b) *sp* (c) sp^2 (d) sp^3

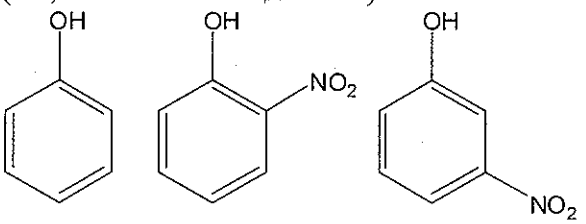
3. Which of the following heterocycles is *not* aromatic?



a b c d

4. Which of the following compounds is antiaromatic?
(a) ethane (b) cyclobutadiene (c) benzene (d) cyclohexadiene

5. Which of the following has the compounds shown in the correct order of decreasing acidity (i.e., more acidic > less acidic)?



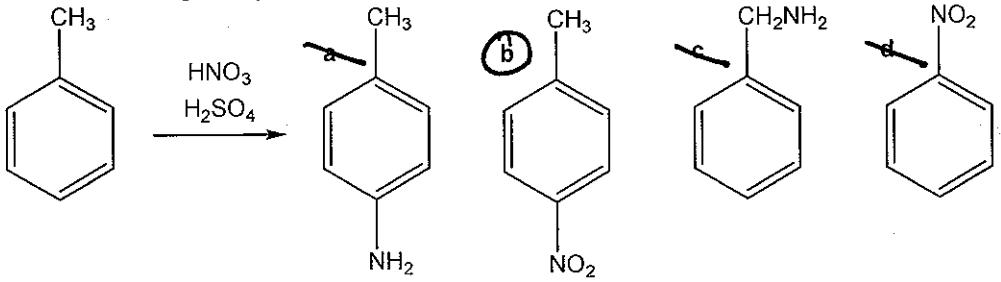
2 > 3 > 1

1 2 3

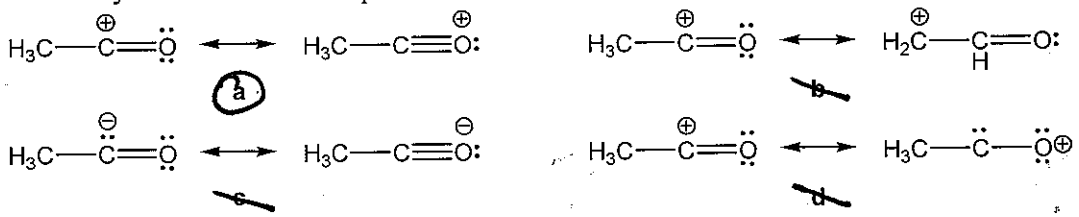
(a) 1 > 2 > 3 (b) 2 > 3 > 1 (c) 3 > 2 > 1 (d) 1 > 3 > 2

6. What is the intermediate in the reaction of ethylbenzene with NBS in the presence of benzoyl peroxide to give 1-bromo-1-phenylethane?
(a) Benzylic anion (b) Benzylic cation
(c) Benzylic radical (d) Benzylic carbene

7. What is the major organic product obtained from the following reaction?



8. Which of the following are valid resonance structures of the electrophile involved in Friedel-Crafts acylation of benzene upon treatment with CH_3COCl and $AlCl_3$?



9. What is the role of $AlCl_3$ in Friedel Crafts acylations using acid chlorides?
(a) Lewis acid (b) electrophile (c) base (d) nucleophile

10. Which of the following undergoes the most rapid acylation upon treatment with acetyl chloride and $AlCl_3$?
(a) benzene (b) toluene (c) chlorobenzene (d) 1,4-dichlorobenzene

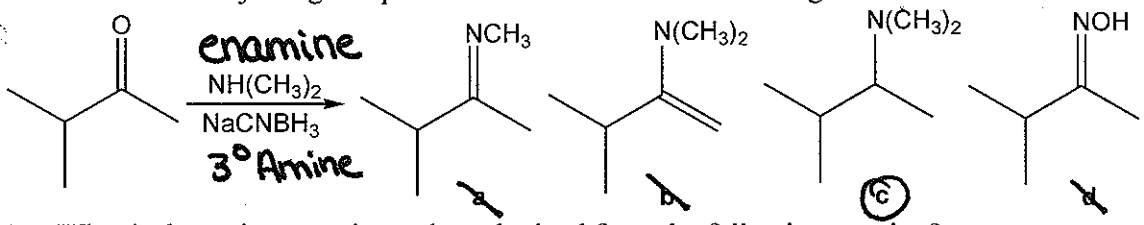
11. Which of the following sets of substituents are all *deactivating groups* in electrophilic aromatic substitution reactions?
(a) $COCH_3$, NO_2, Br (b) Cl, OH, CH_2CH_3
(c) CH_3, Br, $COCH_3$ (d) CH_3, NH_2, OH

12. Which of the following is *not* true about Meissenheimer complexes?

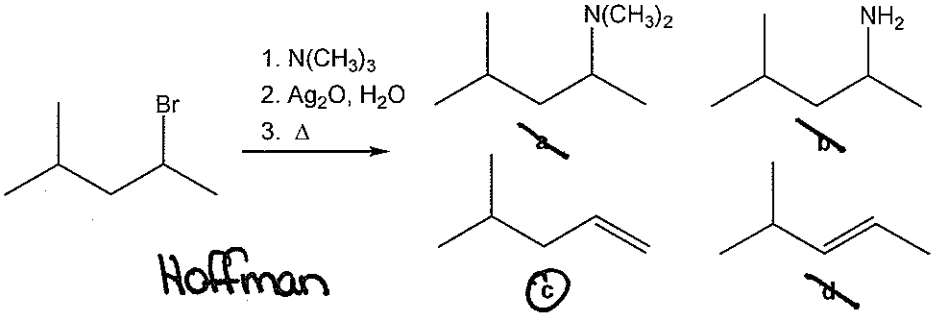
(a) They are resonance-stabilized anions T
(b) They are formed upon addition of a nucleophile to aryl halides T
(c) They are aromatic F
(d) They are intermediates in nucleophilic aromatic substitution reaction which take place by an addition-elimination mechanism T

13. Which of the following is the weakest base?
(a) 4-methylaniline (b) 4-nitroaniline
(c) aniline (d) 4-chloroaniline

14. What is the major organic product obtained from the following reaction?

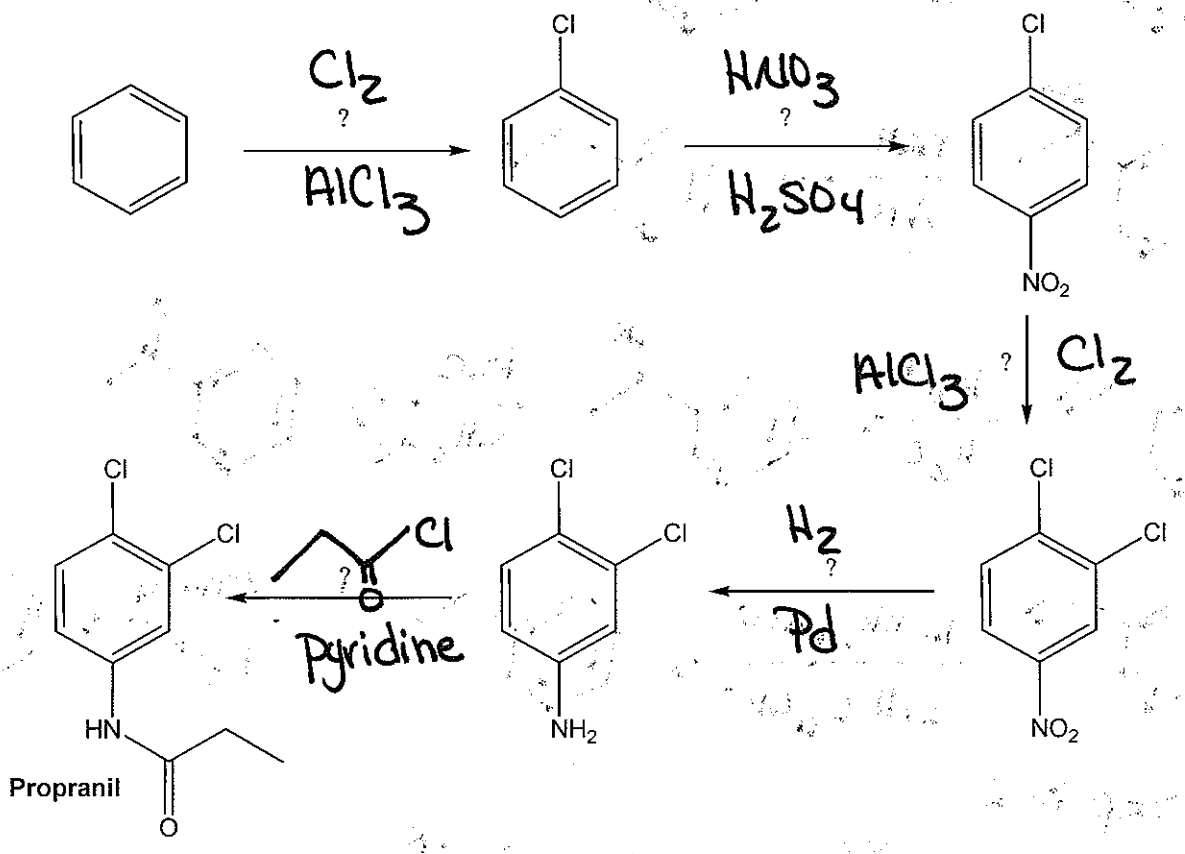


15. What is the major organic product obtained from the following reaction?

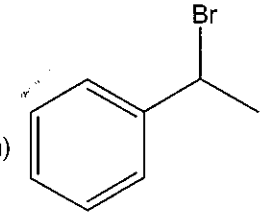


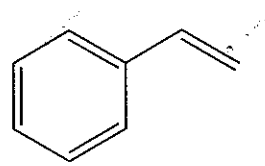
Short answer questions.

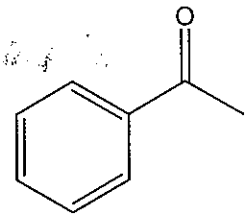
1. Shown below is the synthesis of the herbicide propranil. Identify correct reagents for each step of the following synthesis (10 points).

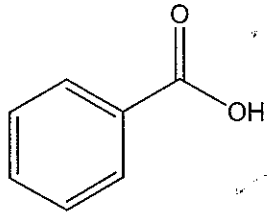


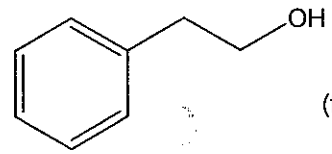
2. Using ethyl benzene as the starting material show how to synthesize the following compounds. In addition to ethylbenzene, use any other organic or inorganic reagents. Any compound already synthesized in one part of the problem may be used to make other compounds in the problem (12 points).

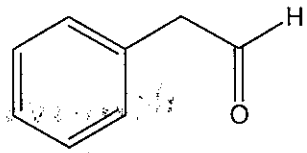
(a) 

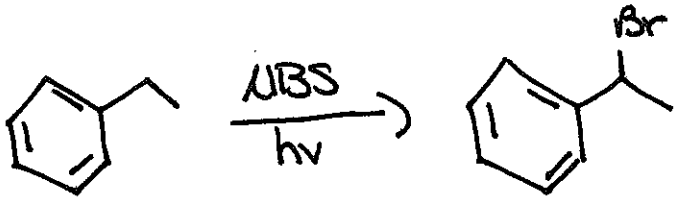
(b) 

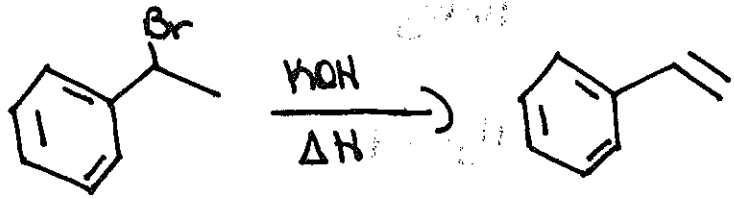
(c) 

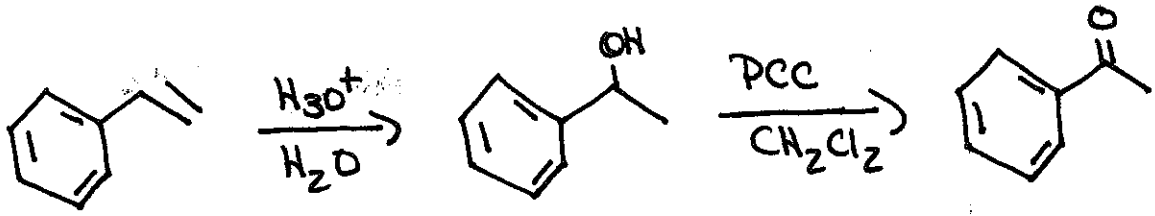
(d) 

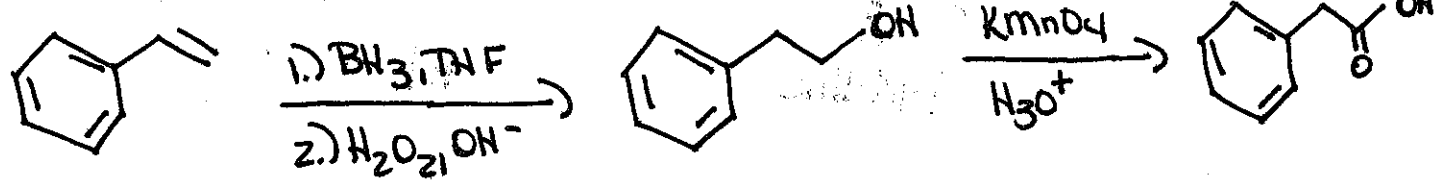
(e) 

(f) 

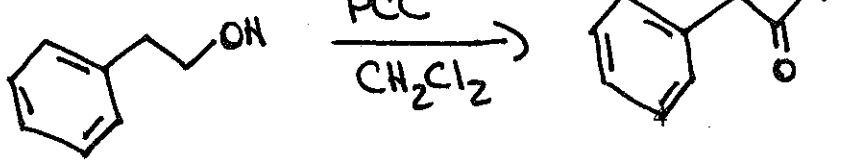
a.) 

b.) 

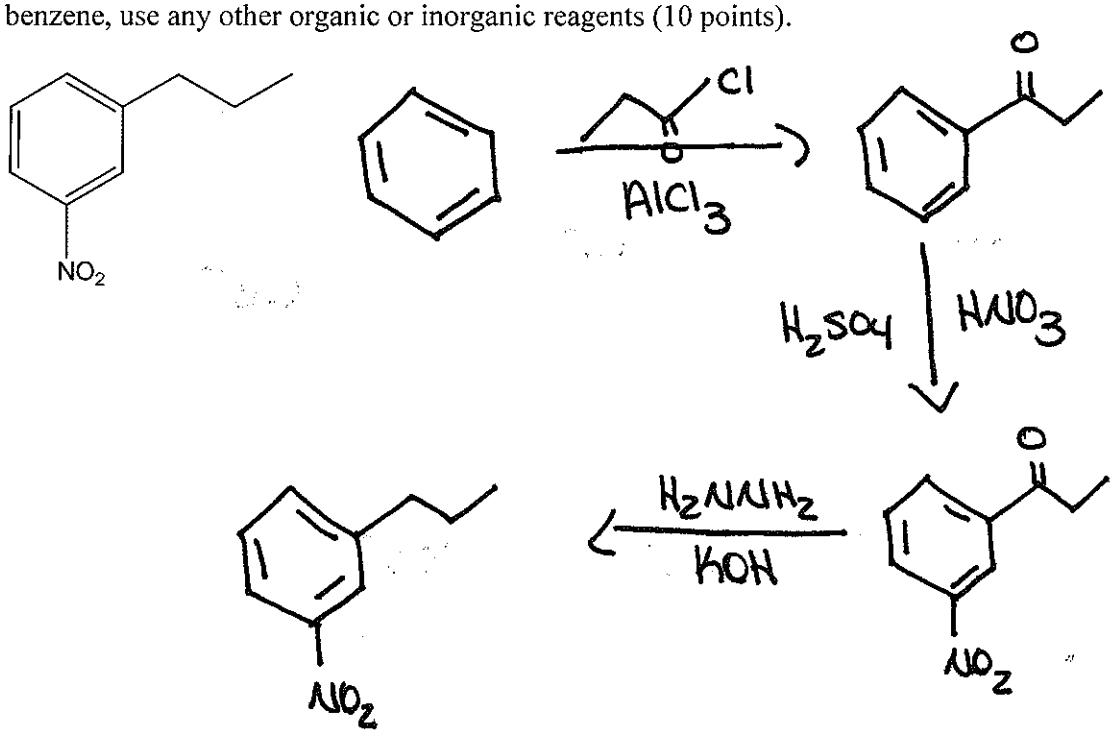
c.) 

d.) 

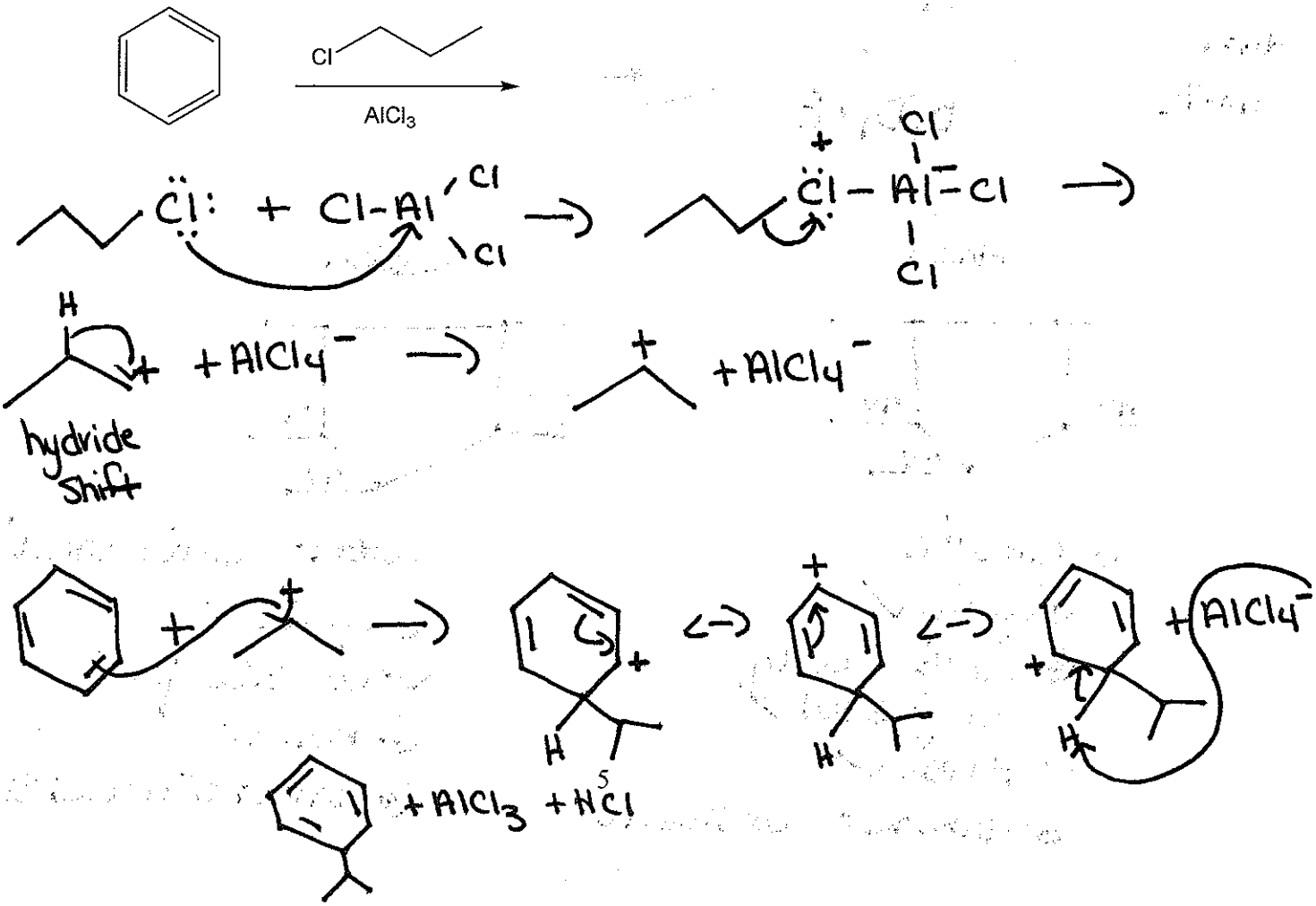
e.) 1st Step to D

f.) 

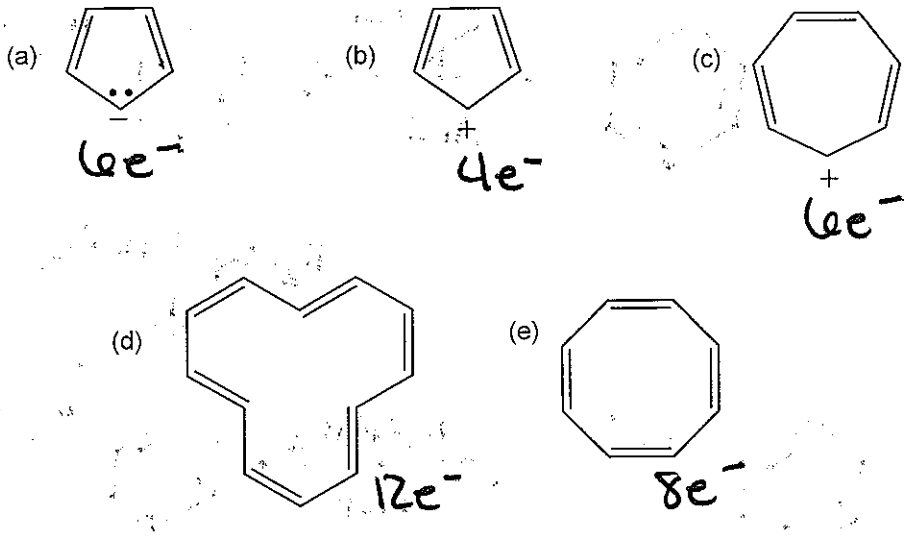
3. Propose the synthesis of the following compound starting from benzene. In addition to benzene, use any other organic or inorganic reagents (10 points).



4. What is the major product obtained in the following reaction? Draw detailed reaction mechanism for its formation (10 points). (*HINT*: Carbocation rearrangement is possible).



5. Answer the following questions based on the structures given below. Assume all structures are planar (14 points).



6e⁻ 4e⁻ 6e⁻ 12e⁻ 8e⁻

$4n+2=6$, $4n=4$, $n=1$

$4n+2=4$, $4n=2$, $n=1/2$

$4n+2=12$, $4n=10$, $n=5/2$

$4n+2=8$, $4n=6$, $n=3/2$

i) State the number of 2p orbital electrons (π electrons) in each of the molecules/ions?

ii) Which are aromatic?

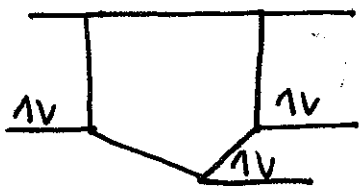
A + C

iii) Which are antiaromatic?

B, D, + E

iv) Construct the Frost Circles for cyclopentadienyl anion (a) and cyclopentadienyl cation (b) and explain why one of them is aromatic and the other is antiaromatic.

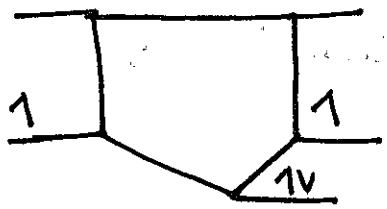
Anion



Aromatic

① Cyclic ✓
② Continuously Conjugated ✓
③ Planar ✓
④ 4n+2 πe = Closed Shell ✓

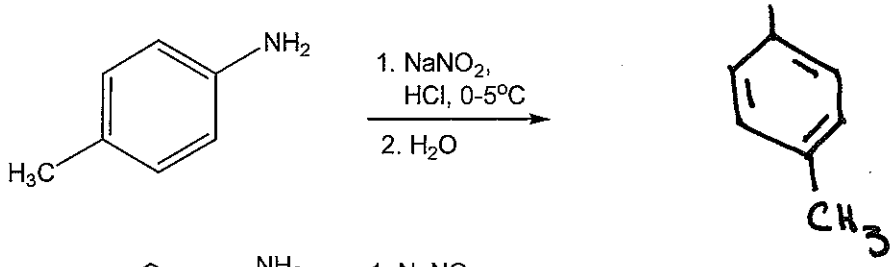
Cation

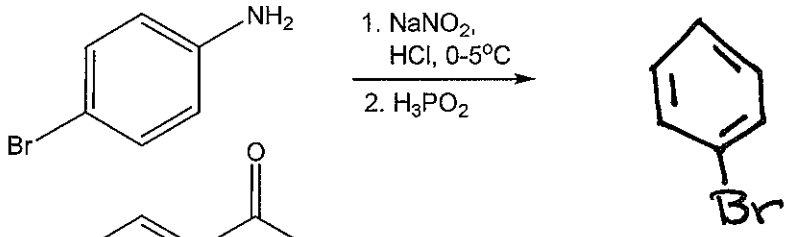


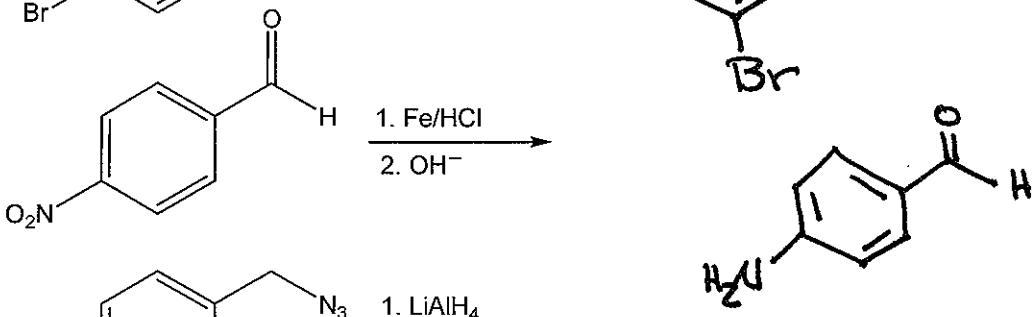
Antiaromatic

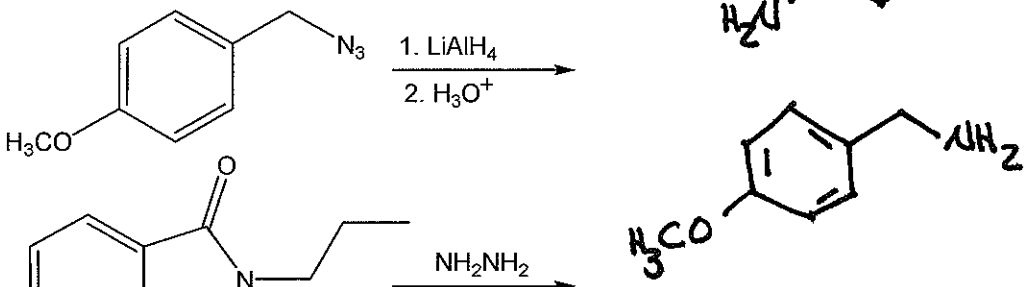
① Cyclic ✓
② Cont. Conj. ✓
③ Planar ✓
④ 4n+2 πe⁻ = Closed Shell X

6. Give the major organic product(s) for the following reactions (14 points).

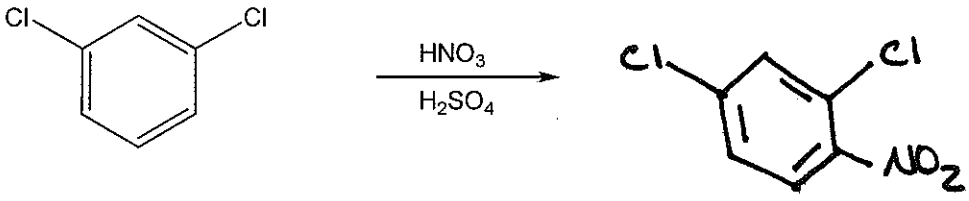
(a) 

(b) 

(c) 

(d) 

(e)

(f) 

(g)