Second Exam
CHEM 256 – Organic Chemistry II
Prof. Bastin
Spring 2016

Name Key **Section** 1

1. DO NOT START this exam until you are instructed to begin.
2. There are ELEVEN pages including this cover sheet and the IR frequency table - make sure they are all here!
3. Provide *CLEAR, CONCISE* answers using unambiquous, carefully drawn structures and mechanisms for the appropriate questions. *Be sure to read each question VERY CAREFULLY.*
4. Do not provide mechanisms for synthesis and product prediction problems.
5. You may only use a pen or pencil and the materials provided in this packet on this exam.
6. If you have papers and/or books with you, they are to be left on the floor **AT THE FRONT OF THE ROOM**. If you need scrap paper please ask.
7. Cell phones must be **OFF and placed on the table at the FRONT of the ROOM**.

1) _____/12 pts

change #1c

2) _____/12 pts

correct #8b

3) _____/10 pts

4) _____/12 pts

Total: _____/100 pts

5) _____/8 pts

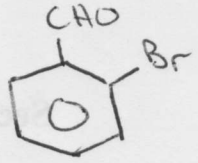
6) _____/10 pts

7) _____/12 pts

8) _____/24 pts

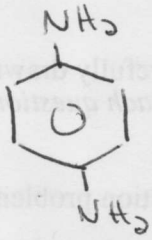
1) (12 pts) Provide structures for the following compounds.

a) *o*-bromobenzaldehyde



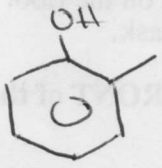
ortho - ½ pt
benzene - ½ pt
aldehyde - 1 pt
-½ for abbrev.

b) *p*-diaminobenzene



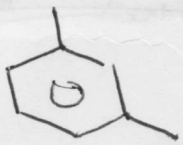
para - ½ pt
benzene - ½ pt
amino
hydrogens
N present

c) *o*-~~hydroxytoluene~~ methylphenol



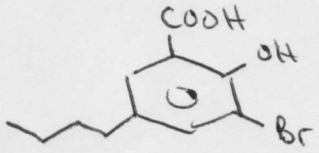
ortho - ½ pt
benzene - ½ pt
OH - 1 pt

d) *m*-xylene



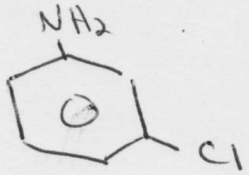
meta - ½ pt
benzene - ½ pt
methyls - 1 pt

e) 2-hydroxy-3-bromo-5-butylbenzoic acid



benzoic acid
hydroxy
butyl
position
} -½ pt each

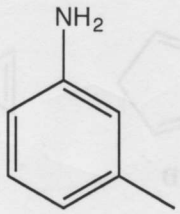
f) 3-chloroaniline



NH2 - 1 pt
benzene - ½ pt
Cl - ½ pt

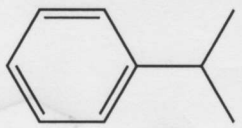
2) (12 pts) Provide either common or IUPAC names for the following compounds.

a)



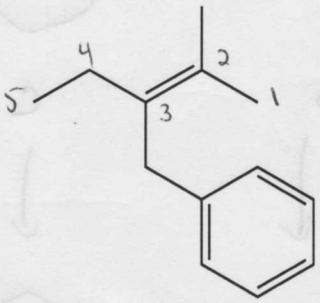
3-methylaniline or m-methylaniline
+1 ec 1pt 1pt

b)



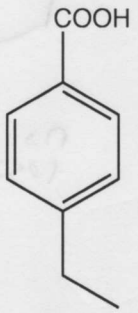
isopropylbenzene
1pt 1pt

c)



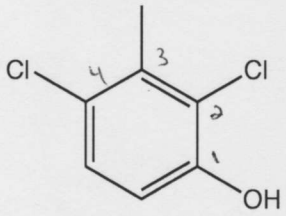
3-benzyl-2-methyl-2-pentene
no E/Z
numbers
order

d)



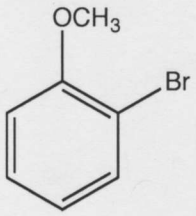
4-ethylbenzoic acid
or
p-ethylbenzoic acid
+1

e)



~~2,3-di~~ ½
2,4-dichloro-3-methylphenol
numbers, ½ ½
½

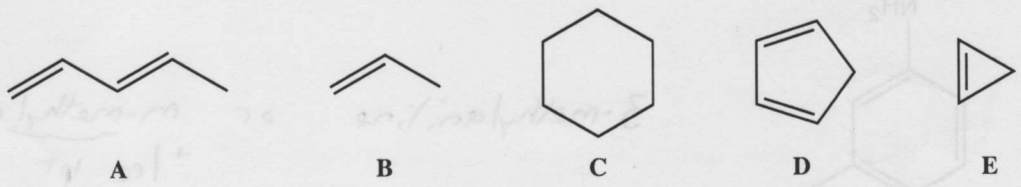
f)



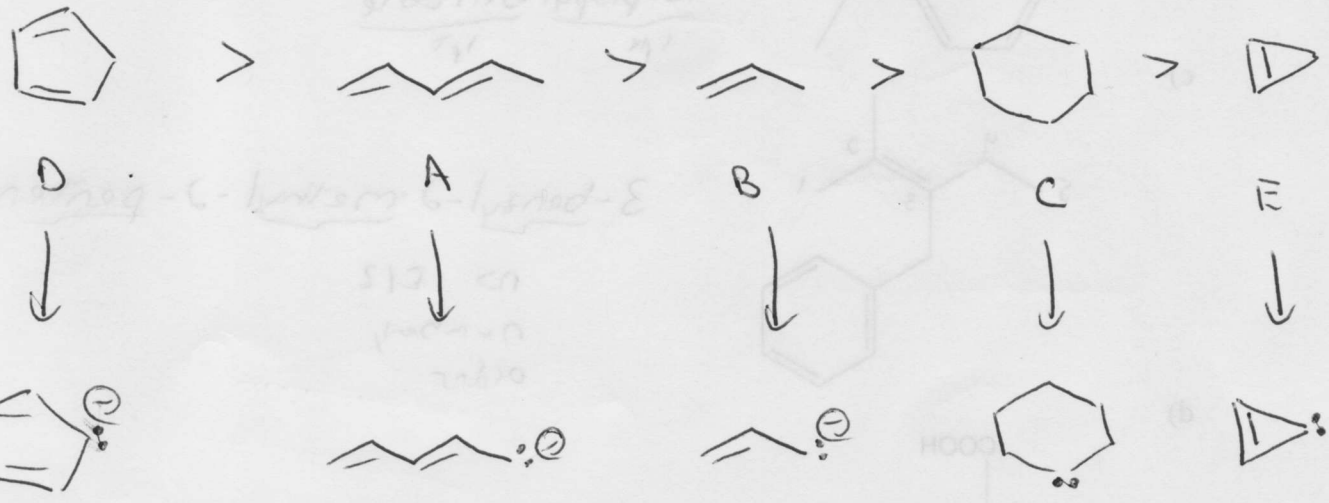
2-bromoanisole
or
o-bromoanisole
+1

3) (10 pts) Rank the following compounds in order of decreasing acid strength, from lowest pK_a to highest pK_a (be sure your order is clearly indicated). Explain.

Party



A **B** **C** **D** **E**



aromatic

3 resonance forms

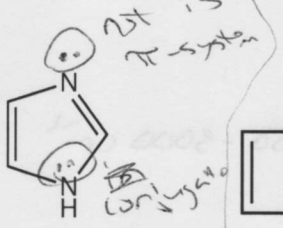
2 resonance form

no resonance

anti-aromatic

4) (12 pts) Predict whether each of the following molecules would be aromatic, non-aromatic, or anti-aromatic. Explain your reasoning.

(a)



- 6 π electrons
- all atoms fully conjugated
- planar
- cyclic

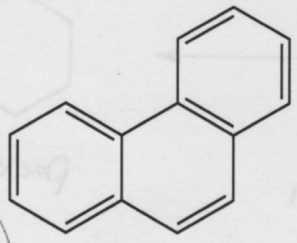
aromatic

(b)

- fully conjugated
- planar
- cyclic
- 4π electrons

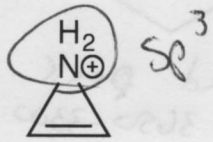
anti-aromatic

(c)



aromatic

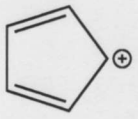
(d)

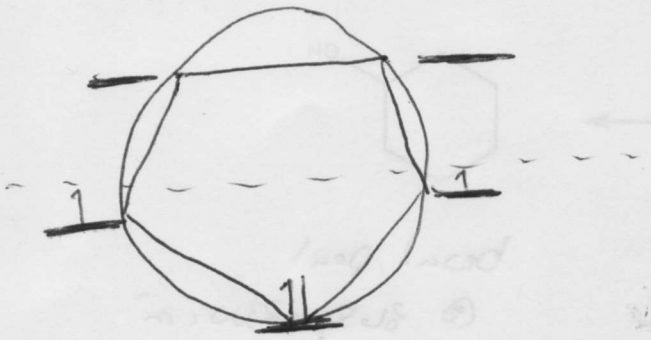


- planar
- cyclic
- not fully conjugated

non-aromatic

5) (8 pts) Using a Frost circle, draw the π MO energy diagram for the molecule below. Fill the orbitals with the appropriate number of π elections. Based on this diagram, should the molecule be aromatic, non-aromatic, or anti-aromatic? Explain.





non-aromatic
- all ~~bonding~~ bonding orbitals are not filled
- but ~~so~~ there are no electrons in anti-bonding orbitals

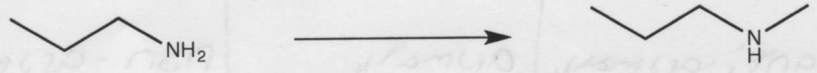
6) (10 pts) What differences in the IR spectra of the reactant and product in each of the following transformations would enable you to tell that each reaction took place? Be specific and give numbers. Include all distinguishing peaks.

(a)

broad peak @ 3650-3300 cm^{-1}

peak at 3150-3000 cm^{-1}

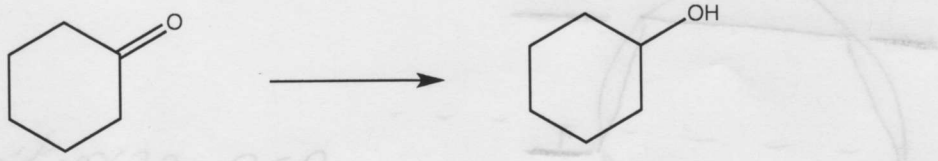
(b)



doublet @ 3500-3100 cm^{-1}

singlet @ 3500-3100 cm^{-1}

(c)

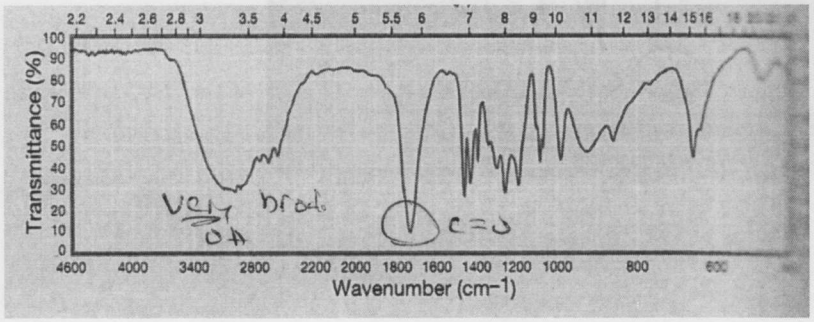


peak @ 1730-1700 cm^{-1}

broad peak @ 3650-3300 cm^{-1}

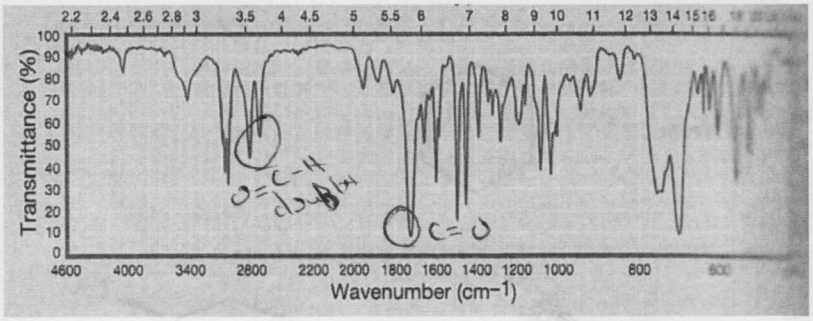
7) (12 pts) For each of the following IR spectra (**a-d**) there is a choice of three possible types of compounds. For each spectrum, choose the most appropriate class of compound. Explain your reasoning by noting the presence or absence of characteristic bands in the spectrum.

a) alcohol, carboxylic acid, or phenol



carboxylic acid

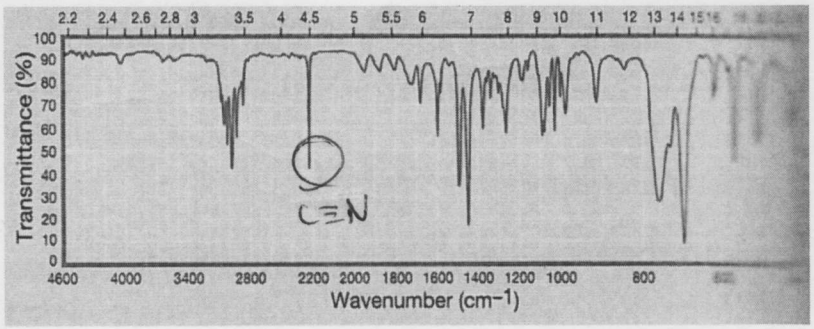
b) aldehyde, ester, or ketone



aldehyde

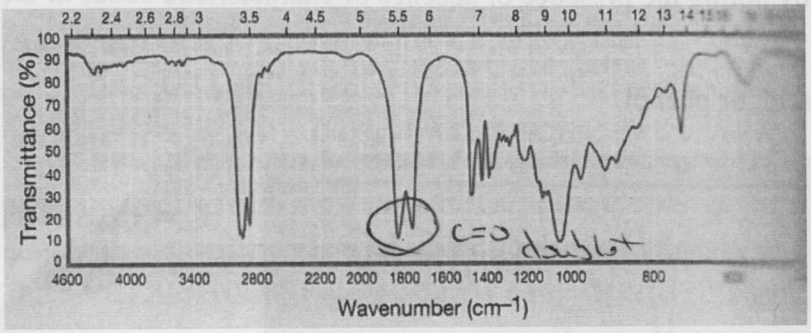
c) 1-alkyne, symmetrical internal alkyne, or nitrile

no ≡C-H



nitrile

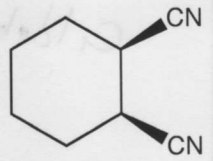
d) anhydride, carboxylic acid, or ester



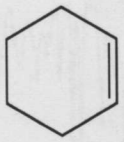
anhydride

8) (24 pts) Devise (below and on the following blank page) a synthesis for the following transformations using any reagents that we have discussed, the indicated starting material, and any other stable organic starting materials needed. If you need more space, please use the back of this sheet and direct me there. For **FULL** credit be sure to show the retrosynthetic analysis AND the complete synthesis.

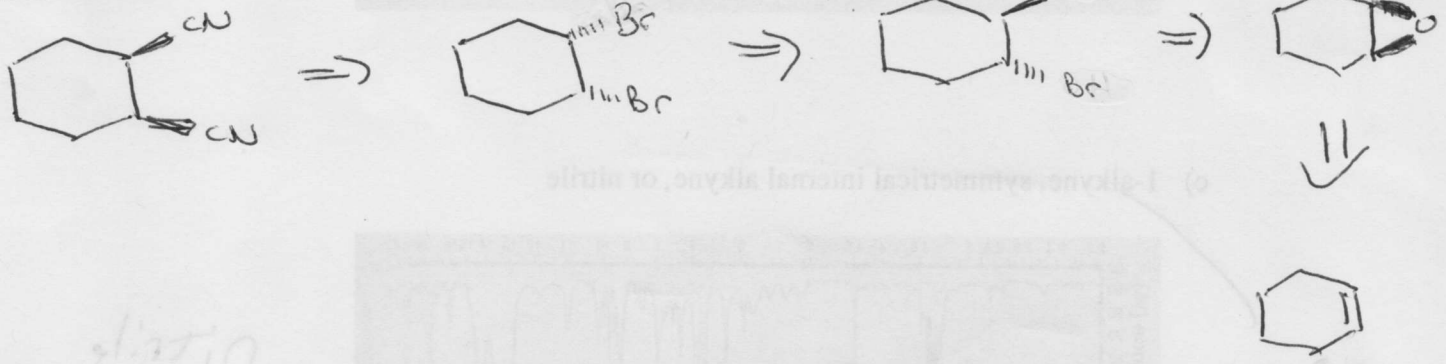
a)



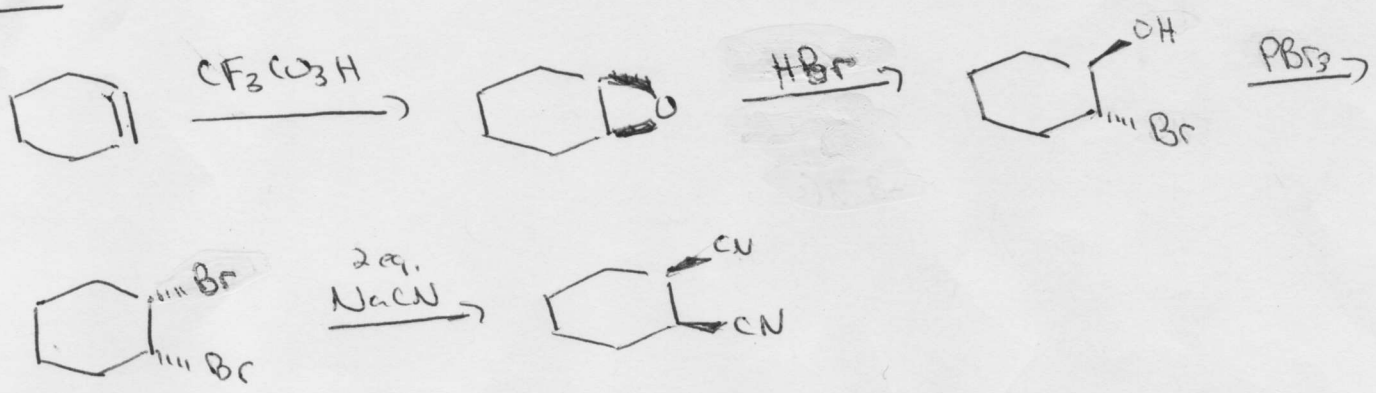
from



Retrosynthesis

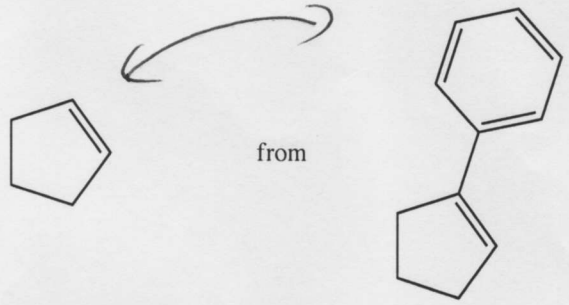


Synthesis

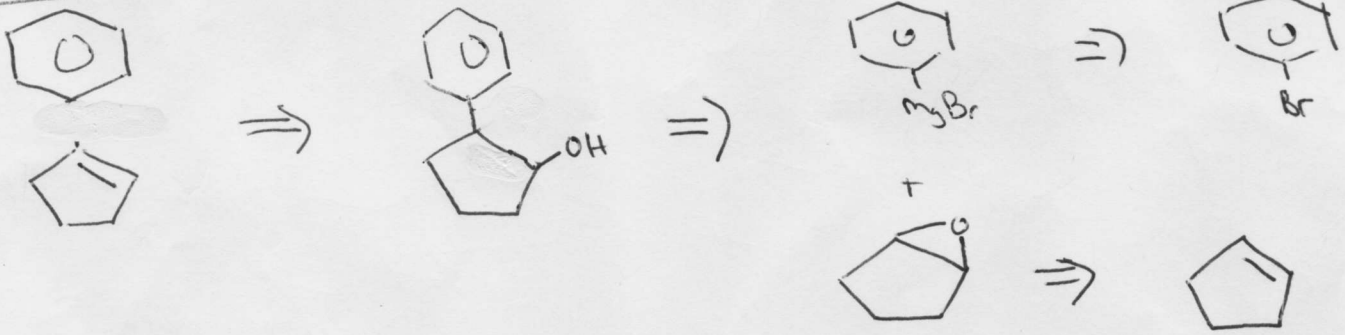


b)

Key!



Retrosynthesis



Synthesis