Second Exam
CHEM 256 – Organic Chemistry II
Prof. Bastin
Spring 2015

Name _____ Section _____

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

2) _____/12 pts

3) _____/10 pts

4) _____/12 pts **Total: _____/100 pts**

5) _____/8 pts

6) _____/12 pts

7) _____/10 pts

8) _____/24 pts

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

a) *m*-iodobenzoic acid

b) *m*-dinitrobenzene

c) *o*-methylanisole

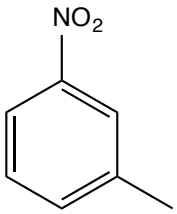
d) *p*-xylene

e) benzyl bromide

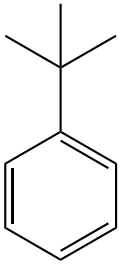
f) 3-chlorophenol

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

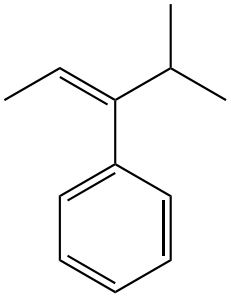
a)



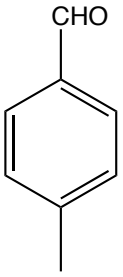
b)



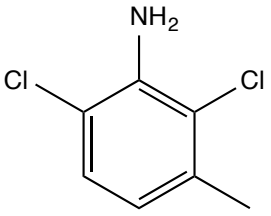
c)



d)



e)



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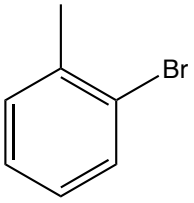
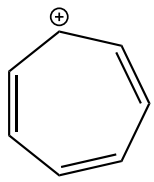
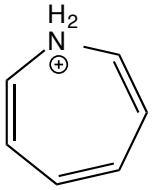


3) (10 pts) The tropylium ion is aromatic. Ion X, however, is not. Explain



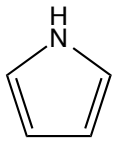
Tropylium ion

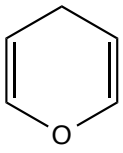


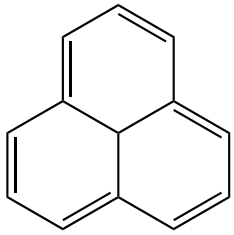
Ion X

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

(a) (b) (c)



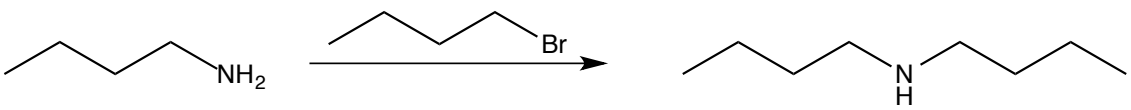




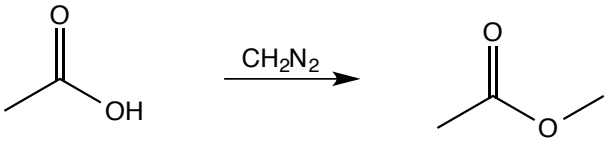
5) (8 pts) Using a Frost circle, draw the π MO energy diagram for the molecule below. Fill the orbitals with the appropriate number of π elections. Based on this diagram, should the molecule be aromatic or anti-aromatic? Explain.

6) (12 pts) What differences in the IR spectra of the reactant and product would enable you to tell that each of the following reactions took place? Be specific and give numbers. Show how IR spectroscopy can be used to distinguish between the compounds in each set. Include all distinguishing peaks.

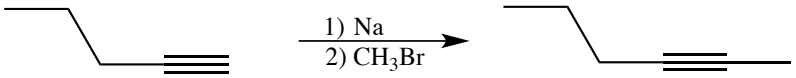
(a)



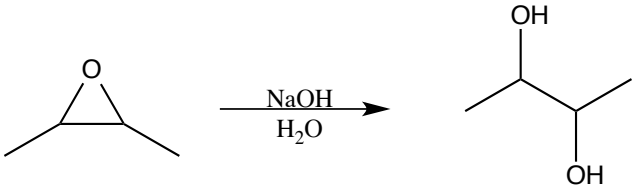
(b)



(c)

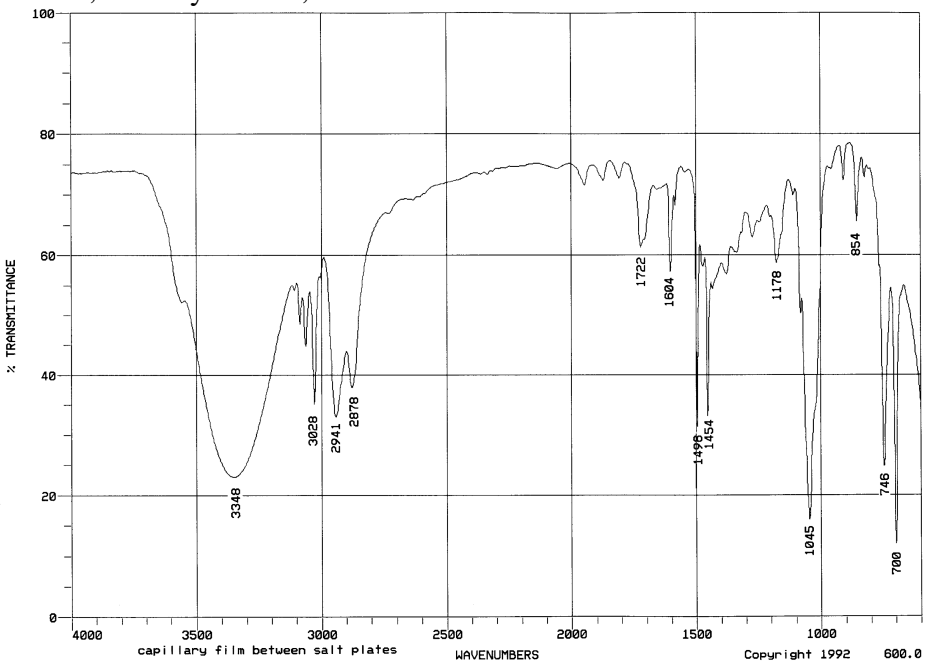


(d)

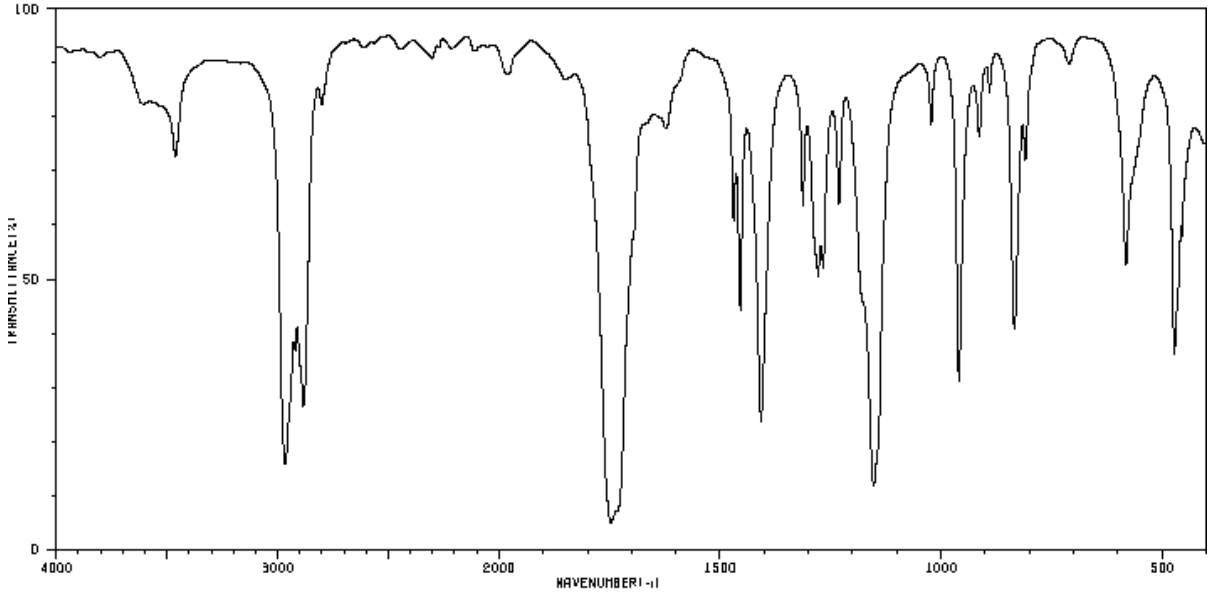


7) (10 pts) For each of the following IR spectra (**a-c**) there is a choice of three possible types of compounds. For each spectrum, choose the most appropriate class of compound. Explain your reasoning by noting the presence or absence of characteristic bands in the spectrum.

a) alcohol, carboxylic acid, or water

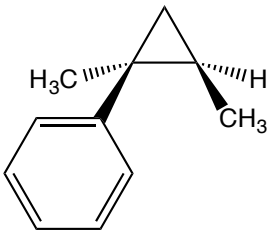


b) aldehyde, ketone, or ether compound



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.

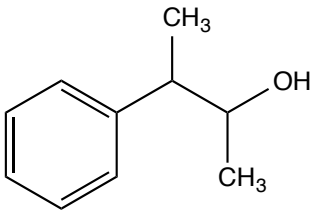
a) Pay attention to the stereochemistry in the target to determine the required stereochemistry of the starting material.



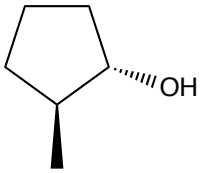
+

enantiomer

from



b)



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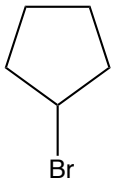

+

enantiomer

Functional Group	**Frequency (cm^{-1})**	**Intensity and Comments**
Alkanes		
C–H	2980-2850	medium to strong
C–C	1480-1420	medium
Alkenes		
=C–H stretch	3150-3000	medium; very weak for trans
=C–H bend	980-960 (trans)	strong
	730-665 (cis)	strong
C=C	1680-1600	weak to medium
Alkynes		
≡C–H	3350-3300	strong
C≡C	2260-2100	weak to medium
Alkyl halides		
C–Cl	800-600	strong
C–Br	600-500	strong
C–I	500	strong
Alcohols		
O–H	3650-3300	strong and broad
C–O	1350-1050	strong
Amines		
N–H	3500-3100	medium and strong; 1° amines-2 bands; 2° amines-1 band
C–N	~1200	medium
Aromatics		
C–H stretch	3080-3020	weak to medium
C–H bend	900-730	strong
C=C	1650-1580	weak to medium
Carbonyls (C=O)		
Ketones/aldehydes	1730-1700	strong
Esters	1750-1735	strong; also has C–O stretch
Amides	1680-1630	strong; 1° and 2° amides also have N-H stretch
Acids	1730-1700	strong; also has O–H stretch
Acid Anhydride	1850-1740	strong; doublet
Acid Chlorides	1820-1770	strong
Nitrile (C≡N)	2200-2250	medium