Chemistry 220b, Section 1 Name _____

Exam 1 (100 pts)

Tuesday, February 3, 2015

Chapters 13, 15, 16

Write and sign the VU Honor Pledge:

I pledge my honor that I have neither given nor received aid on this examination

I. M. Honest

signature

This exam is closed book and closed notes

NOTE: It is difficult for me to give you partial credit if you do not show your work!

Neatness counts

Stereochemistry counts are indicated

Good Luck !!

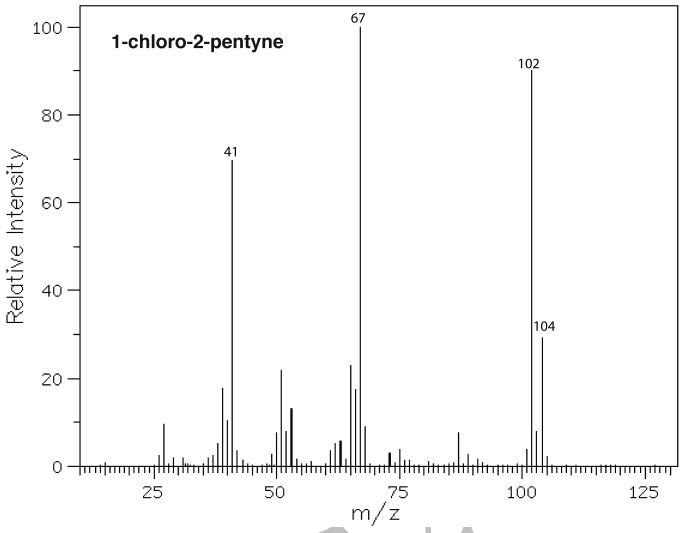
1 H Hydrogen 1.00794																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012182											5 B Boron 10.811	6 C Carbon 12.0107	7 N Nitrogen 14.00674	8 O Oxygen 15.9994	9 F Fluorine 18.9984032	10 Ne Neon 20.1797
11 Na Sodium 22.989770	12 Mg Magnesium 24.3050											13 Al Aluminum 26.981538	14 Si Silicon 28.0855	15 P Phosphorus 30.973761	16 S Sulfur 32.066	17 Cl Chlorine 35.4527	18 Ar Argon 39.948

1 – 15. Multiple Choice. Choose the *best* answer for each of the following questions (60 pts).

1. Calculate the degrees of unsaturation for the molecular formula $C_9H_{13}BrN_2O_2$.

   a) 2 b) 3 c) 4 d) 5

2. Which of the following statements is true about the mass spectrum of 1-chloro-2-pentyne (MW = 102)?



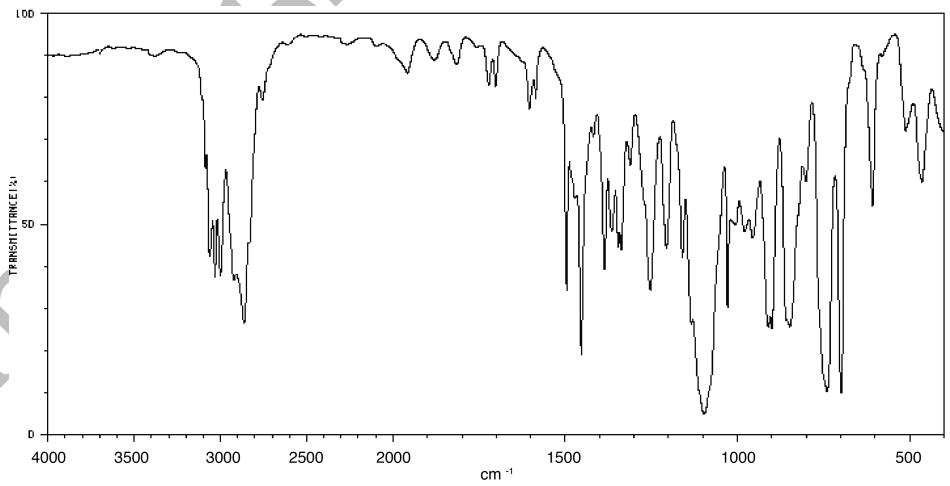
   a) The ion at *m/z* = 102 is the parent ion.

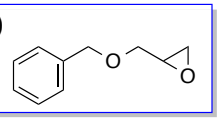
   b) The ion at *m/z* = 104 is due to the ^{37}Cl isotope.

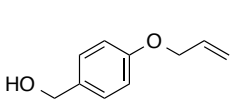
   c) The ion at *m/z* = 67 is the molecular ion.

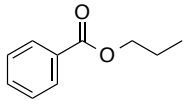
   d) All of the above; i.e., a, b, and c are all true.

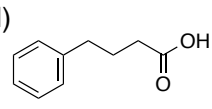
3. Which structure is most consistent with the following IR spectrum?



a) 

b) 

c) 

d) 

4. Which of the following is true about ultraviolet-visible (UV-vis) spectroscopy?

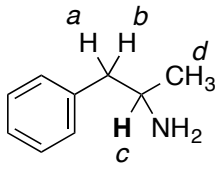
   a) There is a linear relationship between the analyte concentration and the intensity of its UV-vis absorbance(s).

   b) Increasing conjugation will result in absorption of higher energy UV-vis radiation.

   c) A wide range of functional groups have characteristic UV-vis absorbances.

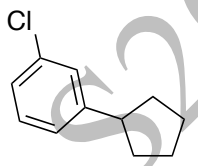
   d) None of the above; i.e., a, b, and c are all not true.

5. What is the multiplicity of proton ***c*** in the ^{1}H NMR spectrum if the coupling constants are J_{ac} = 7.8, J_{bc} = 6.7, and J_{cd} = 6.0 Hz? Proton c does not couple with the NH_2 protons because of exchange.



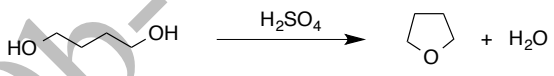
   a) triplet of quartets b) quartet c) doublet of doublet of quartets d) sextet

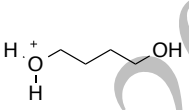
6. How many ^{13}C NMR resonances are expected for the compound below?

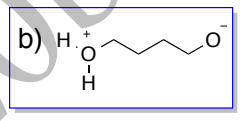


   a) 6 b) 7 c) 9 d) 11

7. Tetrahydrofuran can be formed from 1,4-butandiol and a strong acid catalyst. Which of the following is not an intermediate in the reaction mechanism?



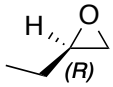
   a) 

   b) 

   c) 

   d) none of the above; i.e., a, b, and c are all intermediates in the reaction

8. Which reagent will react with (*R*)-2-ethyloxirane to give an optically *inactive* product?



   a) H_3C–MgBr, THF, then H_3O^+

   b) H_2SO_4, H_3COH

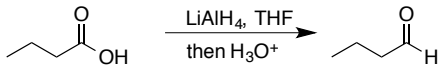
   c) $LiAlH_4$, THF, then H_3O^+

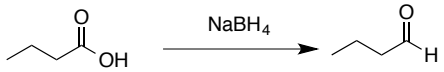
   d) none of the above; i.e., a, b, and c will all give an optically active product

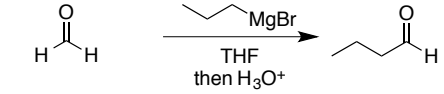
9. Choose the best reagent for the following reaction.

a) O_3, then $(H_3C)_2S$ b)  $Cr_2O_5^{-2}$, CH_2Cl_2 c) $K_2Cr_2O_7$, H_3O^+ d) $LiAlH_4$, THF; then H_3O^+

10. Which of the following is a feasible synthesis of butanal?

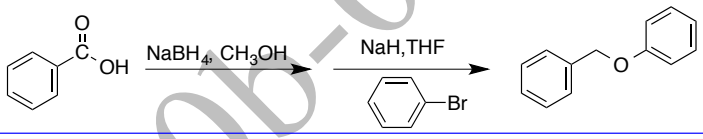
a) 

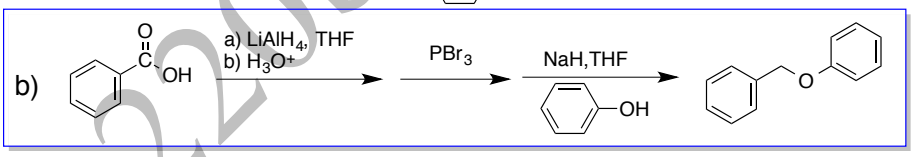
b) 

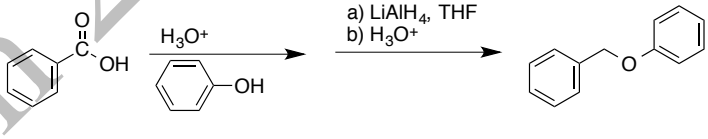
c) 

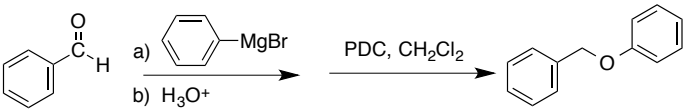
d) 

11. Which of the following is a feasible synthesis of phenyl phenylmethyl ether?

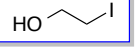
a) 

b) 

c) 

d) 

12. Which is expected to be the major product(s) from the reaction of ethylene oxide and HI?

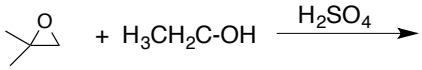
a) 

b) $H_3C–OH + H_3C–I$

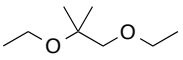
c) $H_3C–O–CH_2–I$

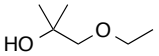
d) No reaction

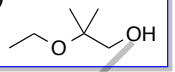
13. Which is expected to be the major product from the following reaction?



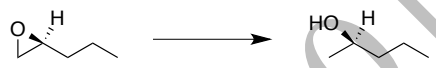
a) 

b) 

c) 

d) 

14. Choose the best reagent for the following reaction.



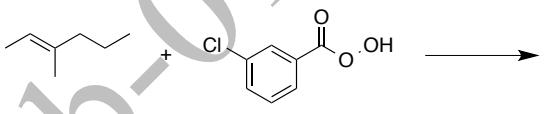
a) H_3C-MgBr, THF, then H_3O^+

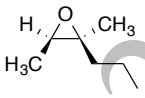
b) H_2SO_4,H_2O

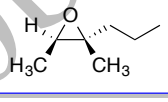
c) OsO_4

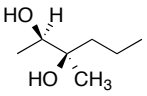
d) $LiAlH_4$, THF, then H_3O^+

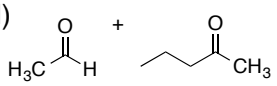
15. Which is the expected product from the reaction of *m*-chloroperoxybenzoic acid with (*E*)-3-methyl-2-hexene? Note that the products are racemic.



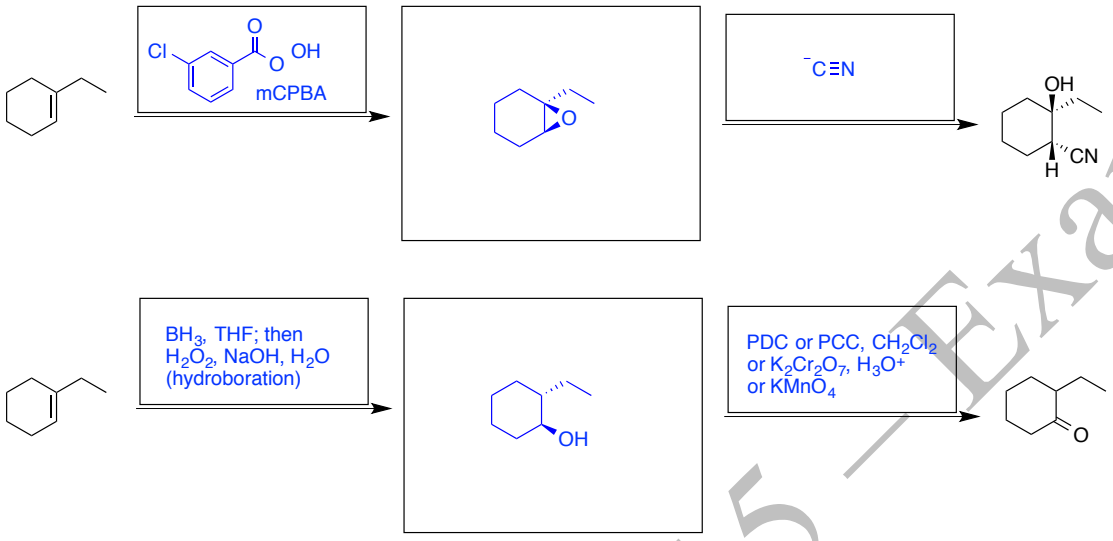
a) 

b) 

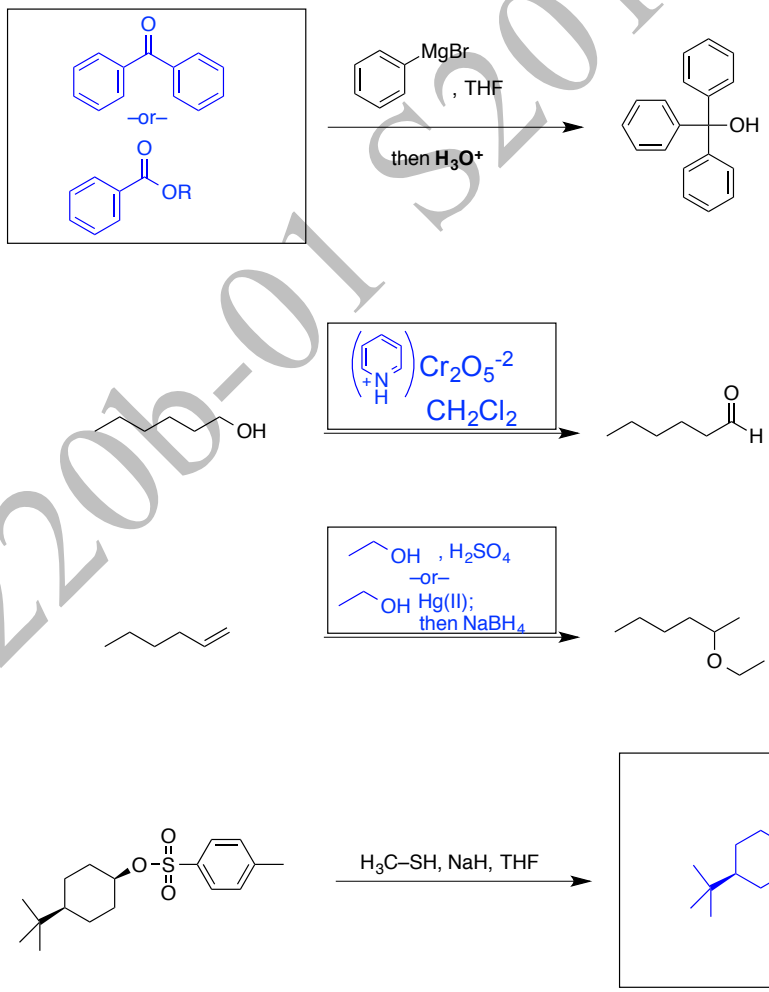
c) 

d) 

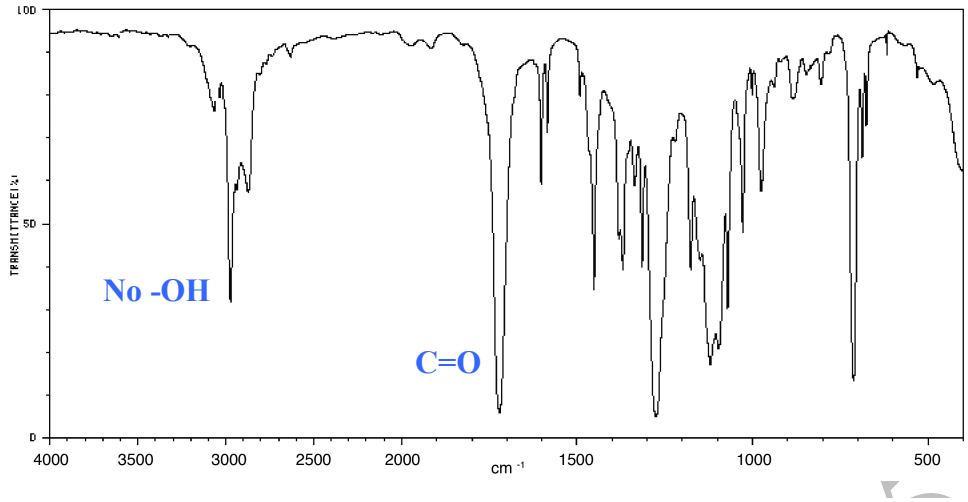
16. The following transformations cannot be done in a single step. Complete the following by providing the correct reagents and the structure of the intermediate. (18 pts):



17. Provide either the reagent, starting substrate, or product for the following reactions. (12 pts)

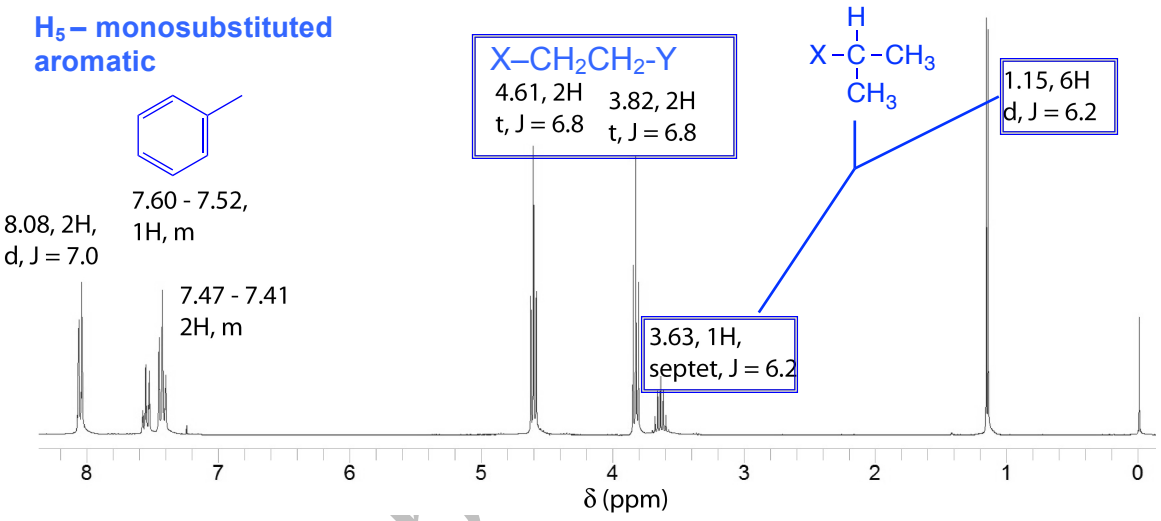


18. The IR, ^{1}H and ^{13}C NMR spectroscopic data for a molecule with a formula $\mathbf{C_{12}H_{16}O_3}$ is given below. Provide a structure that is consistent with the data. *Please circle your final answer*. (10 pts)



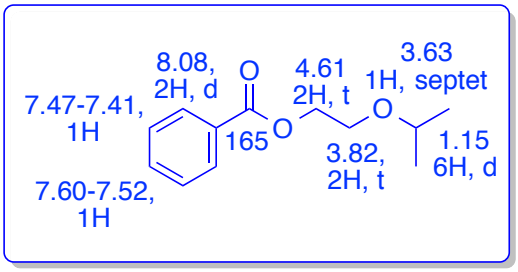
$C_{12}H_{16}O_3$ = 5° of unsaturation

H_5 – monosubstituted aromatic



^{13}C NMR: δ 165.6 C=O, ester, acid, amide (ester since there is no OH in IR and no N in the formula

132.9
130.5
129.7
128.3
72.0
66.0
64.6
22.1



Problem 1-15:_____ (60 pts)

16:_____ (18 pts)

17:_____ (12 pts)

18:_____ (10 pts)

Total out of 100: _____