

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

Name Answers

Section _____

1. DO NOT START this exam until you are instructed to begin.
2. There are FOURTEEN pages including this cover sheet and the IR frequency and NMR chemical shift tables - make sure they are all here!
3. Provide *CLEAR, CONCISE* answers using unambiguous, 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) _____/13 pts

10) _____/10 pts

2) _____/13 pts

3) _____/6 pts

4) _____/8 pts

Total: ~~_____~~/100 pts

5) _____/10 pts

6) _____/12 pts

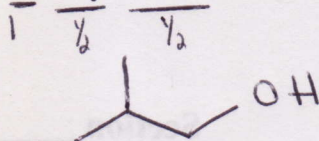
7) _____/12 pts

8) _____/8 pts

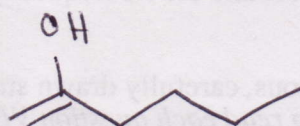
9) _____/8 pts

1) (13 pts) Provide structures for the following compounds.

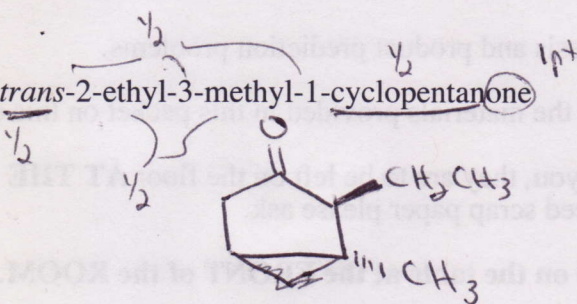
2 pts

a) isobutyl alcohol

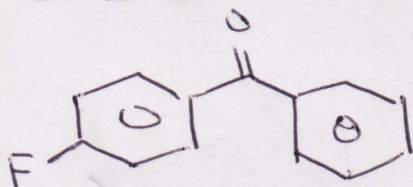
2 pts

b) 1-hexen-2-ol $\frac{1}{2}$ pt each

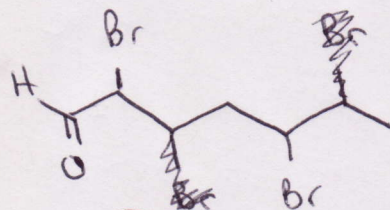
3 pts

c) trans-2-ethyl-3-methyl-1-cyclopentanone

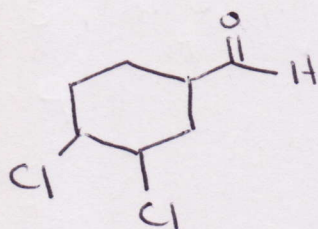
2 pts

d) p-fluorobenzophenone

2 pts

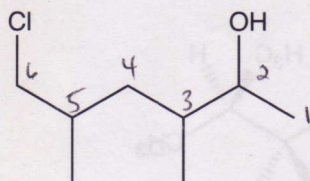
e) 2,5-dibromoheptanal

2 pts

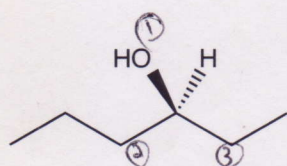
f) 3,4-dichlorohexane carbaldehyde

2) (13 pts) Provide either common or IUPAC names for the following compounds.

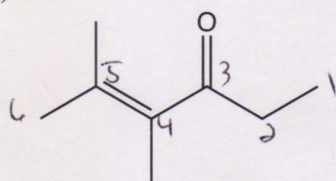
a)

6-chloro-3,5-dimethyl-2-hexanol

b)

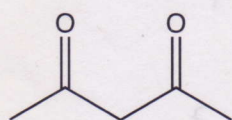
(S)-3-hexanol

c)

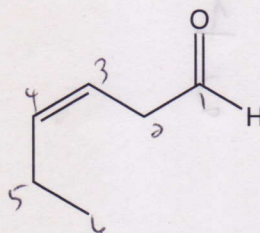
4,5-dimethyl-4-hexen-3-one

Not cis/trans => E/Z

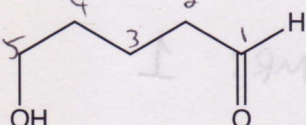
d)

2,4-pentanedioneor
2,4-pentadione

e)

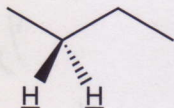
(Z)-3-hexenalor
cis

f)

5-hydroxypentanal

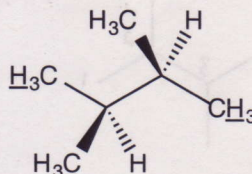
- 3) (6 pts) Identify the symmetrical relationship (homotopic, enantiotopic, diastereotopic) of the underlined or starred atoms in the following molecules.

a)



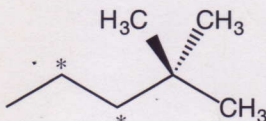
enantiotopic @ low T
homotopic @ RT

b)



homotopic

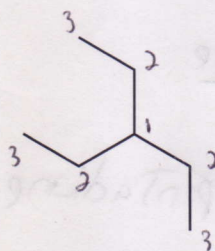
c)



diastereotopic

- 4) (8 pts) Indicate the number of peaks that a (a) ^{13}C -NMR spectrum and (b) ^1H -NMR spectrum of each of the following molecules would contain?

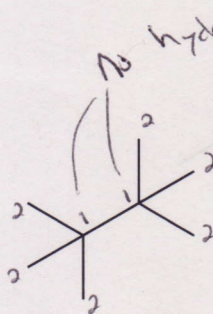
a)



^1H -NMR: 3

^{13}C -NMR: 3

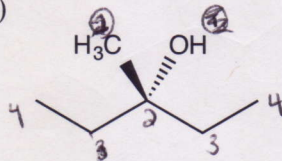
b)



^1H -NMR: 1

^{13}C -NMR: 2

c)



^1H -NMR: 5 (also 4 except)

^{13}C -NMR: 4

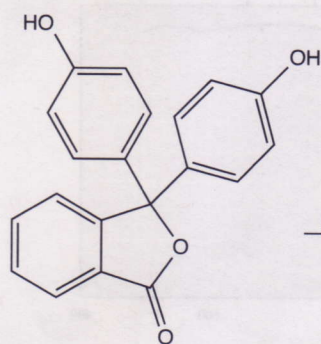
d)



^1H -NMR: 1

^{13}C -NMR: 1

- 5) (10 pts) Phenolphthalein is often used as an indicator in acid-base titration experiments because its color depends upon the pH of the solution. When the solution is acidic or near neutral ($\text{pH} < 8$), it is colorless. Under mildly basic conditions ($\text{pH} 9-13$), the solution is red. Under strongly basic conditions ($\text{pH} > 14$), the solution is colorless again. Given the following structures of phenolphthalein under the various pH conditions indicated, explain the color dependence on pH.

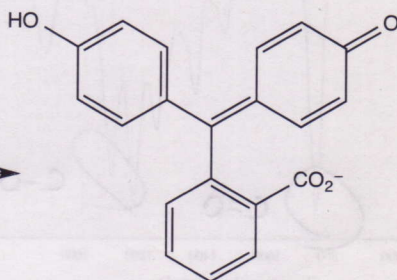


Phenolphthalein
 $\text{pH} < 8$

The 3 phenyl rings are individually conjugated

2pts

NaOH

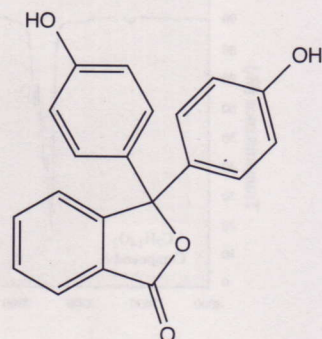


Phenolphthalein
 $\text{pH} 9-13$

The entire molecule is now completely conjugated. ~~the amount of~~
The amount of conjugation has tripled

2pts

NaOH



Phenolphthalein
 $\text{pH} > 14$

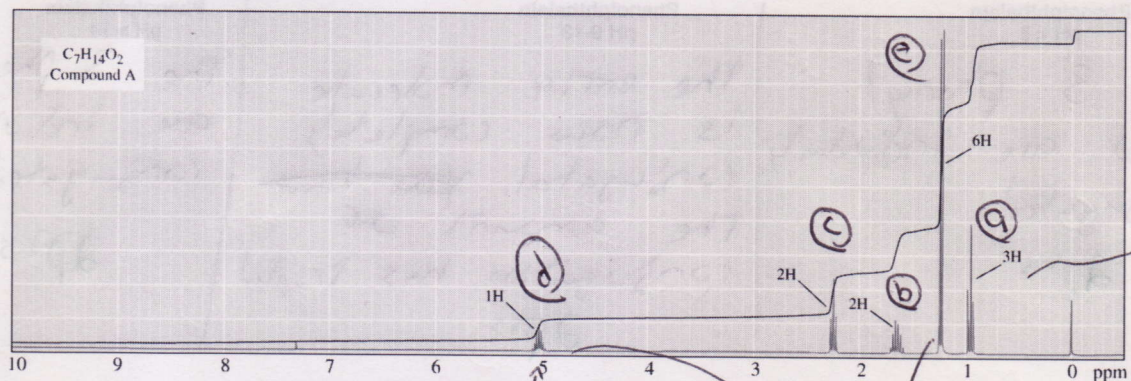
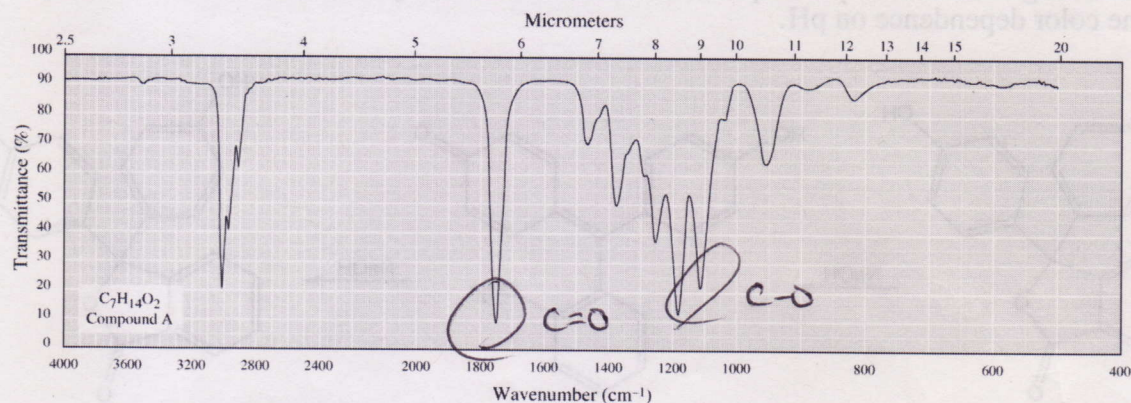
The 3 phenyl rings are individually conjugated

2pts

The increased conjugation at $\text{pH} 9-13$, significantly lowers the HOMO-LUMO gap. The HOMO-LUMO gap is now sufficiently small enough to allow absorption of light in the visible range of light.

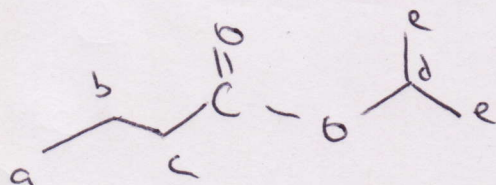
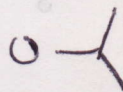
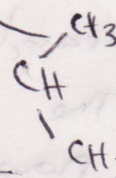
2pts

- 6) (12 pts) Propose a structural formula for compound A, $C_7H_{14}O_2$, consistent with the following 1H -NMR and IR spectra. To receive credit you must justify your structure by assigning ALL the appropriate peaks in the IR and NMR spectra and provide a short narrative describing what structural information each piece of data provided.



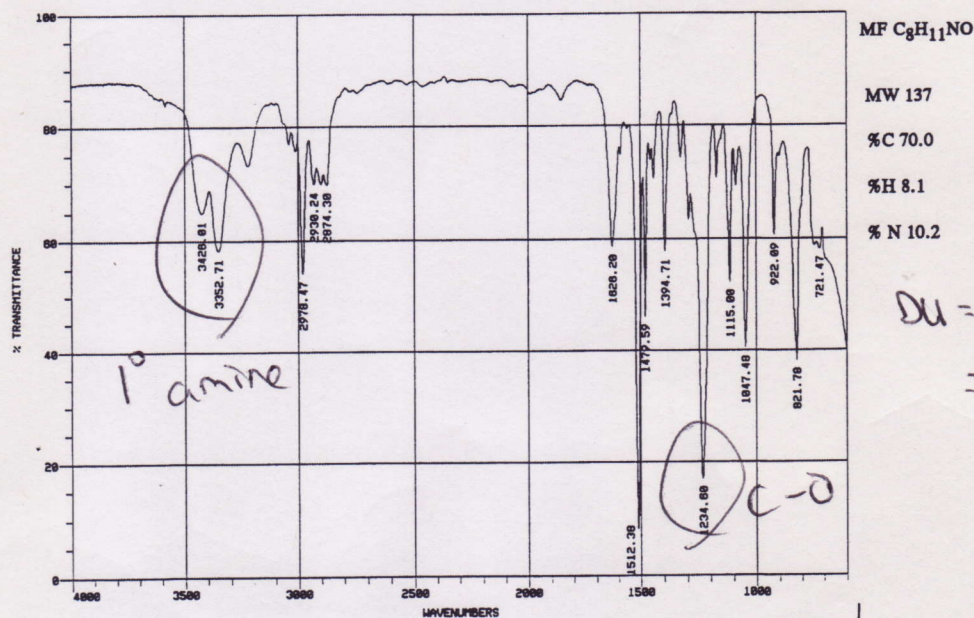
$$DU = 7 - \frac{14}{2} + 1 = 1$$

O-CH



Narrative

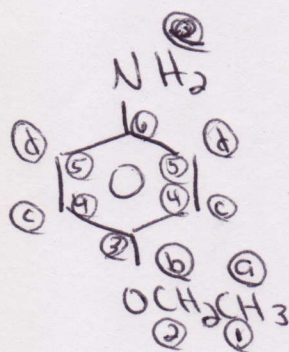
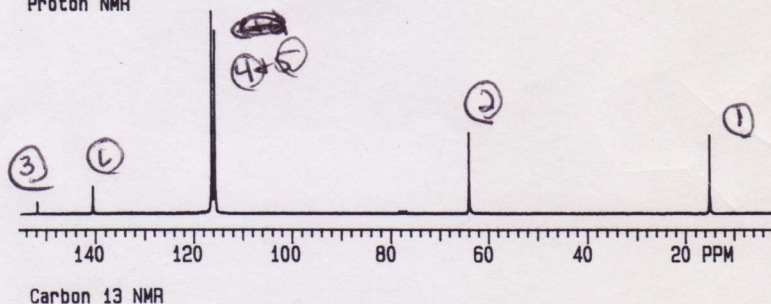
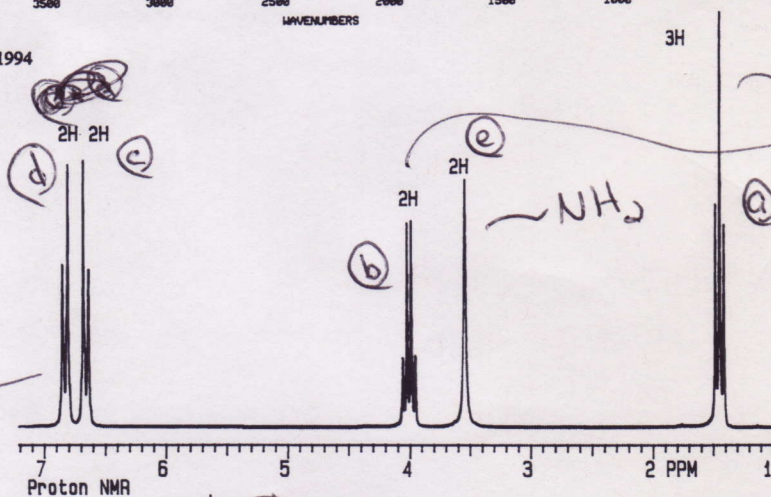
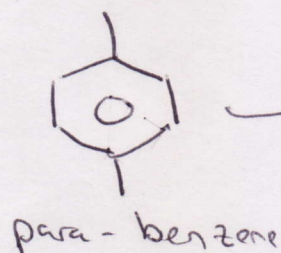
- 7) (12 pts) Provide the structure of a compound with the molecular formula $C_8H_{11}NO$ using the IR, 1H -NMR, and ^{13}C -NMR provided below. Justify your structure by assigning ALL the appropriate peaks in the IR and NMR spectra and with a short narrative describing what structural information each piece of data provided.



$$DU = 8 - \frac{11}{2} + \frac{1}{2} + 1 = 4$$

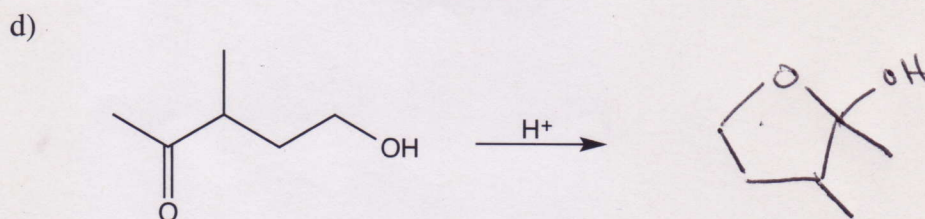
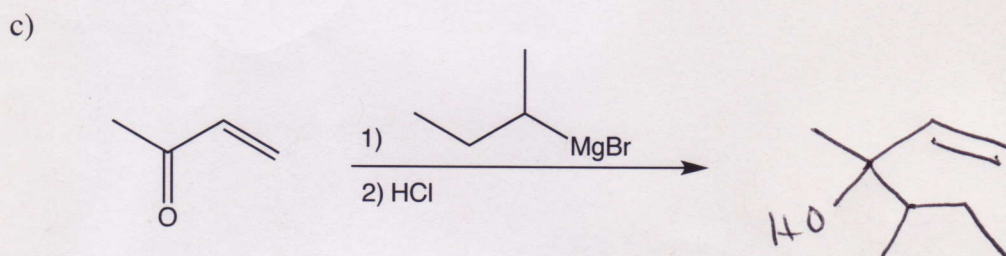
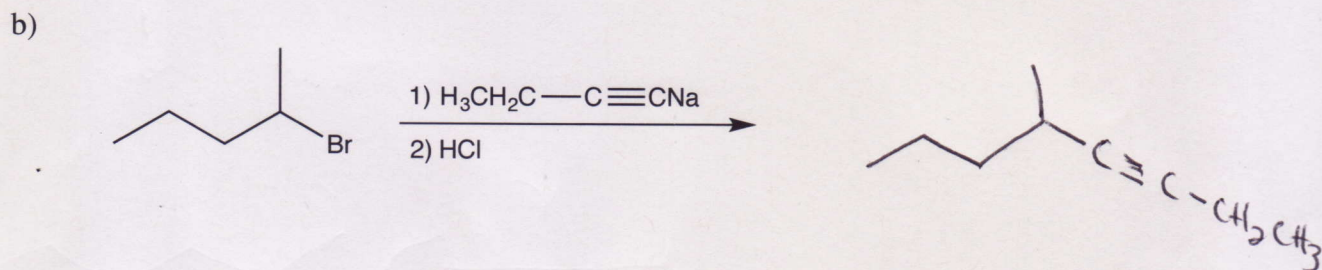
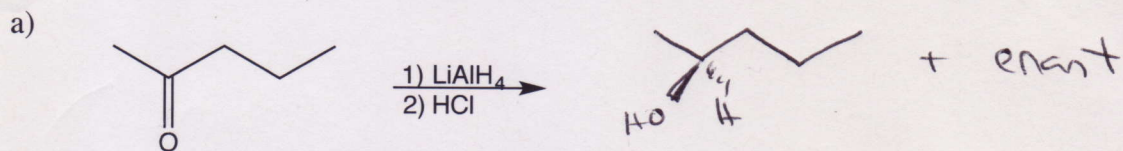
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3H



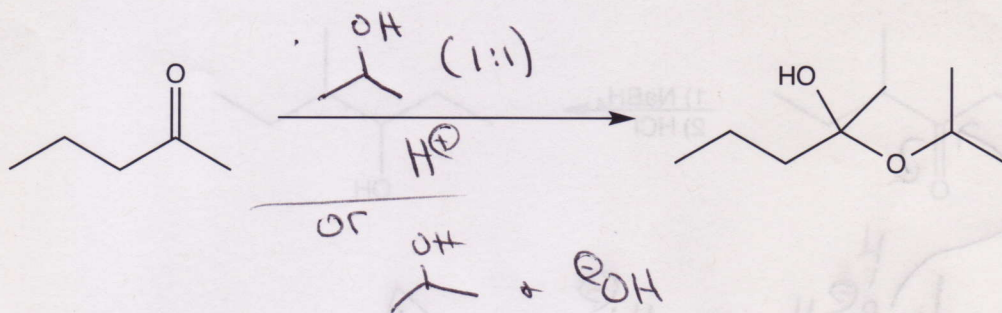
narrative

8) (8 pts) Draw the major product(s), if any, of the following reactions. Indicate stereochemistry where relevant.

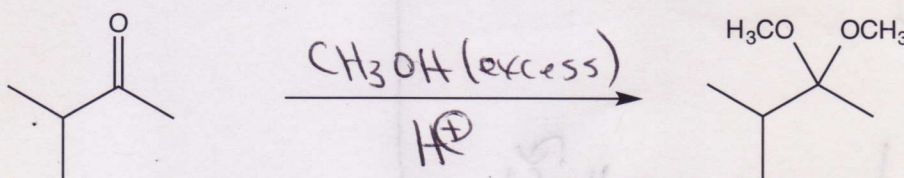


9) (8 pts) Provide the reagent(s) needed to bring about the following transformations.

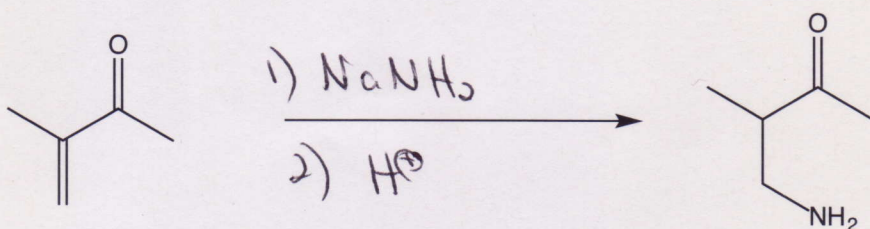
a)



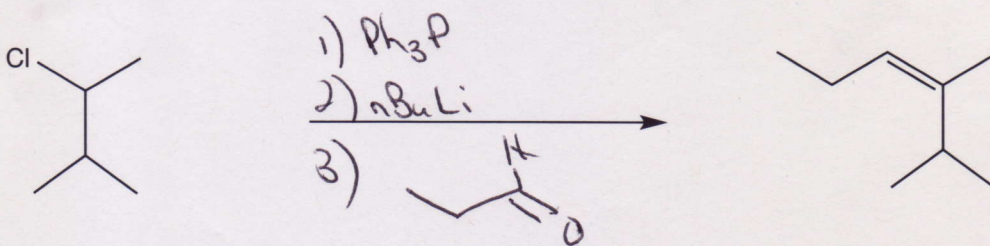
b)



c)



d)



10) (10 pts) Provide a mechanism for the following reaction.

