

WINTER 1999
FINAL EXAM, 130AL
MOUSER, 3/15/99

Name: _____

Signature: _____

(signature is mandatory)

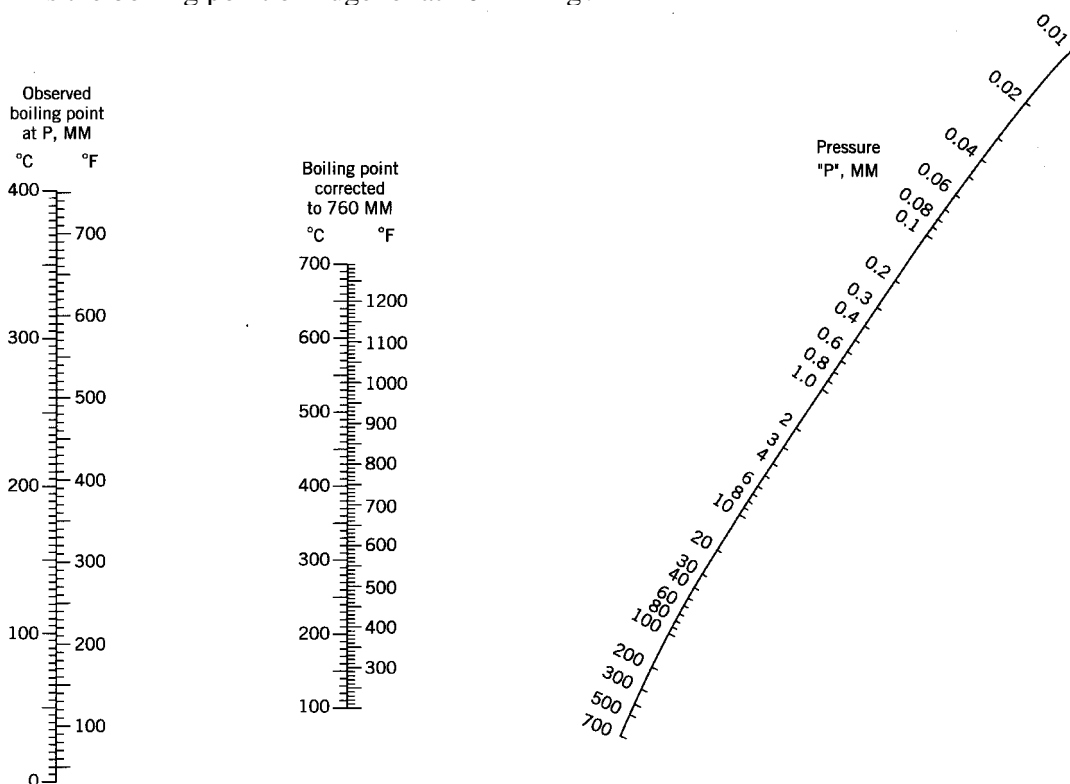
YOUNG HALL CS 76

Place in this box the first two initials of your last name (e.g., if your last name is SMITH then you would place "SM" in the box).

DO NOT START UNTIL INSTRUCTED TO DO SO!

Problem	Possible Points	Points Scored	Grader
1	10 points		
2	12 points		
3	15 points		
4	10 points		
5	20 points		
6	20 points		
7	15 points		
8	10 points		
9	20 points		
10	20 points		
11	18 points		
12	15 points		
TOTAL	185 points		

1. (10 points) At standard atmospheric pressure, the boiling point of Eugenol is 255°C. What is the boiling point of Eugenol at 20 mm Hg?

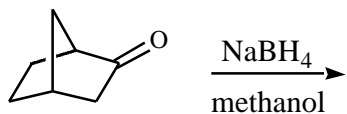


2. (12 points) Rank the following compounds in increasing order of polarity: benzil, dibenzyl ketone, ligroin, tetraphenylcyclopentadienone.
3. (15 points) Solute W has a distribution coefficient of 1.0 between water and diethyl ether. 320 mg of W is dissolved in 10 mL of water. If this solution is extracted five times with 10 mL of diethyl ether, how much of solute W will be left in the aqueous phase? how much of solute W will be in the combined organic phases? **SHOW YOUR WORK FOR CREDIT**

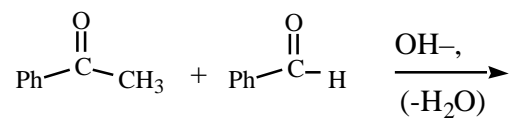
6. (20 points) In the esterification experiment, what role(s) did the sodium bicarbonate wash play in isolating the final product? Show any pertinent chemical reactions for full credit.

7. (15 points) What is the expected major product for the following reactions:

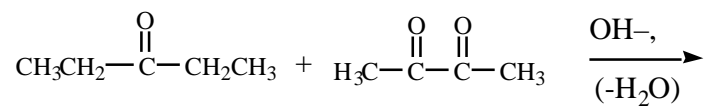
a.



b.



c.



8. (10 points) In the reduction experiment, what advantage did NaBH_4 have over LiAlH_4 ? (or in other words, what was the most likely reason why NaBH_4 was used instead of LiAlH_4 ?)

9. (20 points) Referring to gas chromatography answer the following questions:

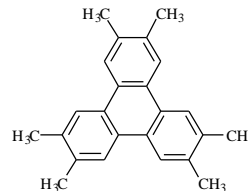
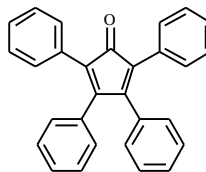
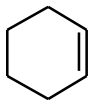
a) define "retention time"

b) how would the retention time of borneol be affected if a nonpolar column was used instead of a polar column?

c) how would the retention time of borneol be affected if the flow rate of the carrier gas was increased?

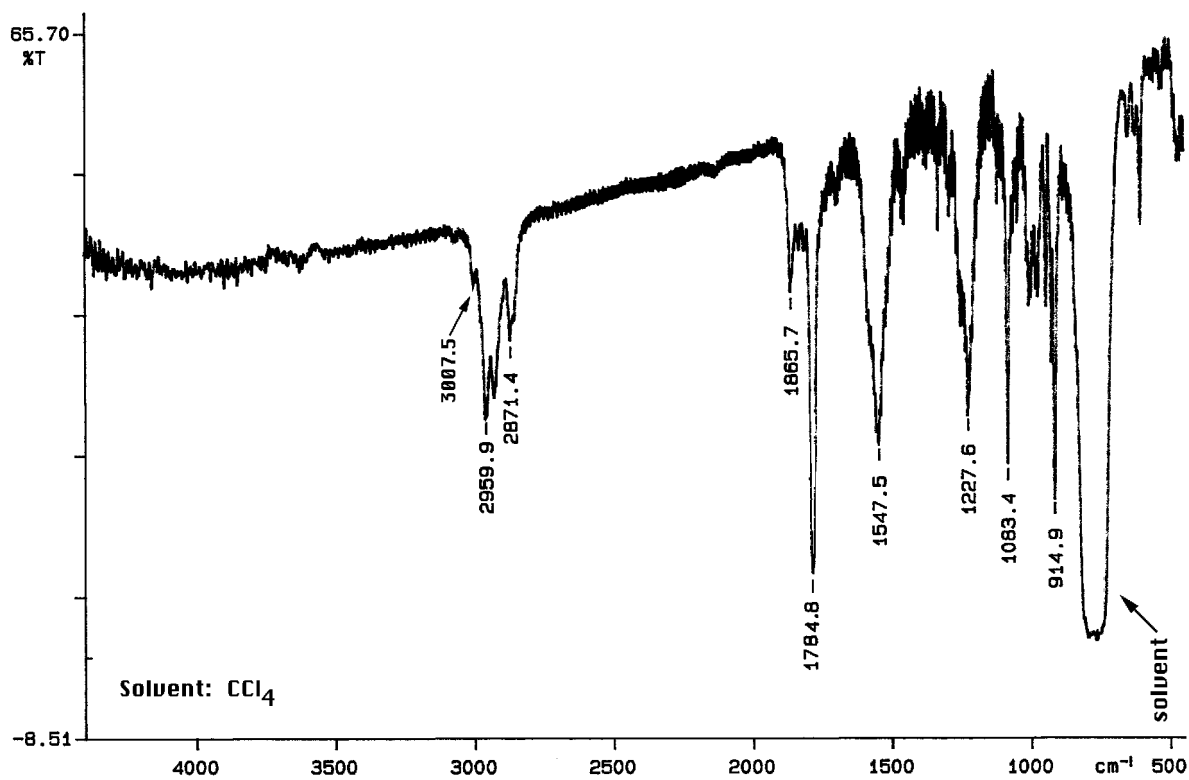
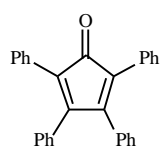
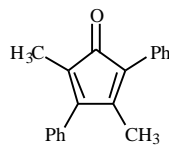
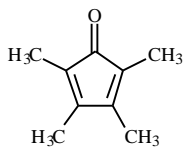
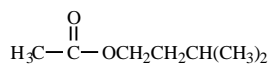
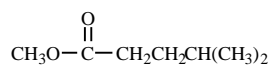
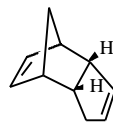
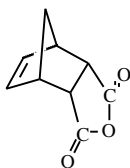
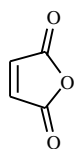
d) how would the retention time of borneol be affected if the column temperature was increased?

10. (20 points) How many signals would be expected for the following compounds in the $^{13}\text{C}\{^1\text{H}\}$ NMR spectrum?

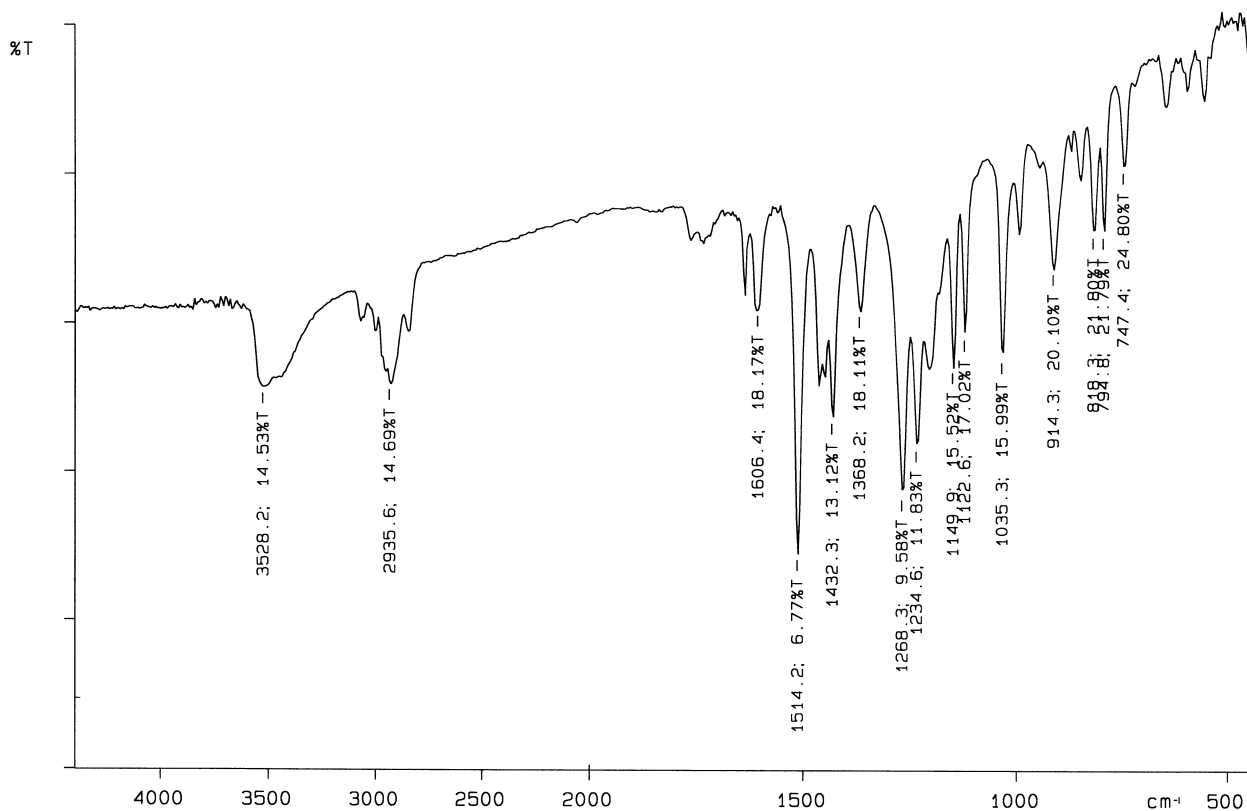
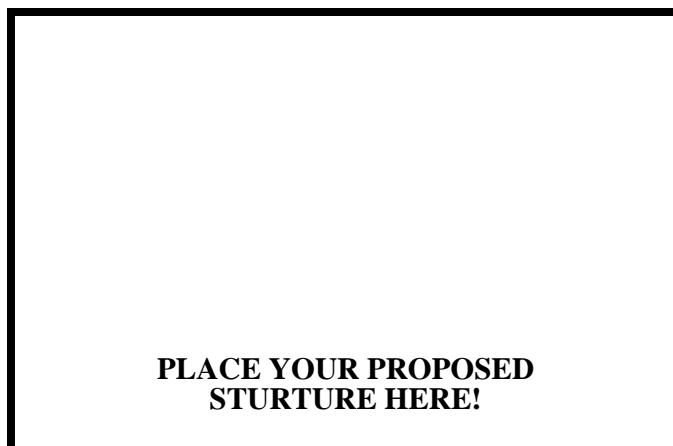


11. a. (6 points) Which of the following compounds best fits the below IR spectrum (**CIRCLE**)

b. (12 points) In the below IR label all signals between 4000-1600 cm^{-1}

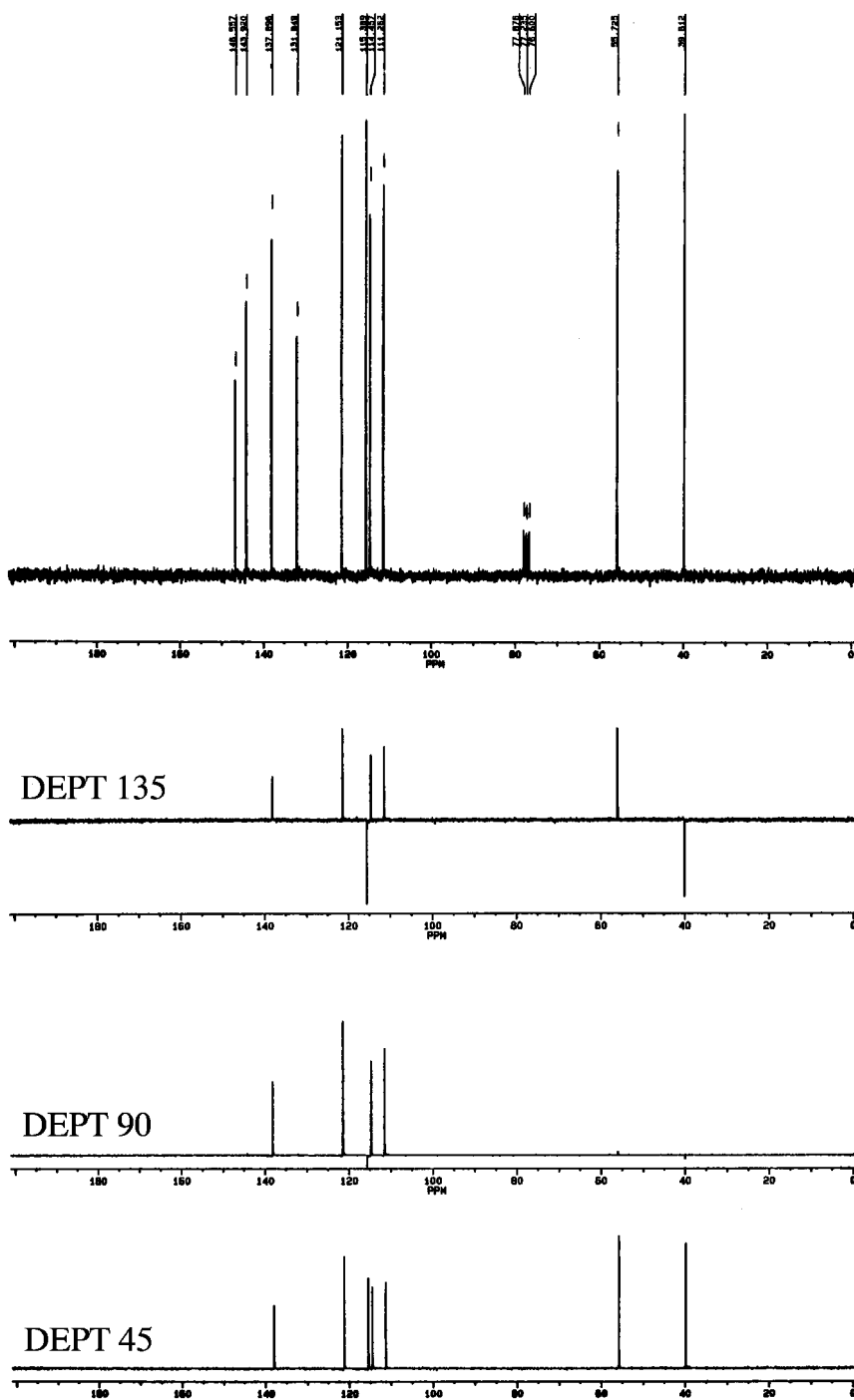


12. (15 points) Compound **Z** has a molecular formula $C_{10}H_{12}O_2$. Compound **Z** is soluble in 5% NaOH and insoluble in 5% $NaHCO_3$. Given the IR, $^{13}C\{^1H\}$ and DEPT NMR spectrum, **propose a structure for compound Z in the below provided box**. [No credit will be given for structures placed outside the box.]



96/05/16 02:20
Y: 1 scan, 4.0cm-1

$^{13}\text{C}\{^1\text{H}\}$ NMR
of Compound Z



DEPT TABLE:

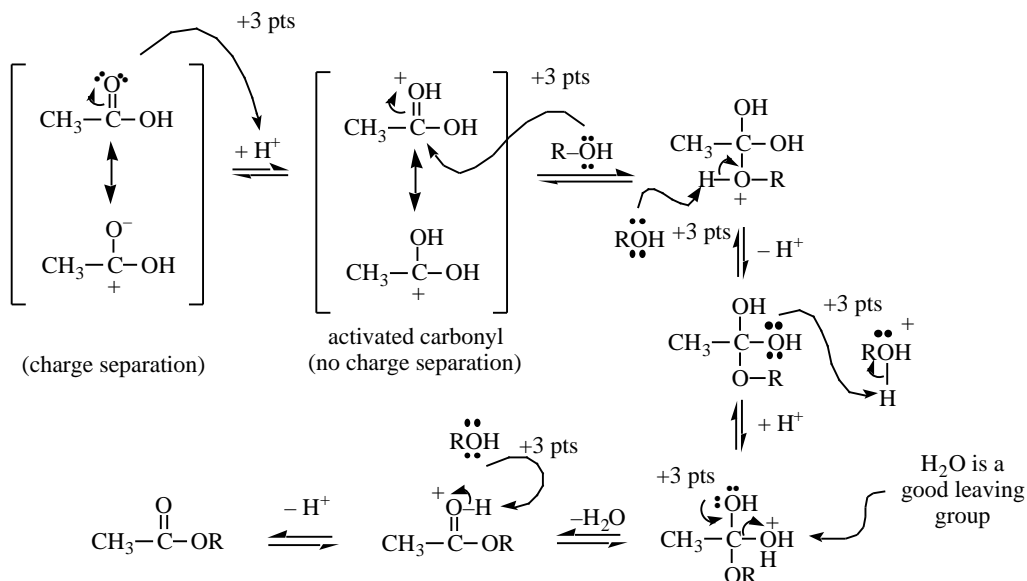
# of attached hydrogens	0	1	2	3
DEPT 135	0	up	down	up
DEPT 90	0	up	0	0
DEPT 45	0	up	up	up

CONDENSED ANSWER KEY

- 110 °C (±10)
- ligroin, tetraphenylcyclopentadienone, benzil, dibenzyl ketone
-

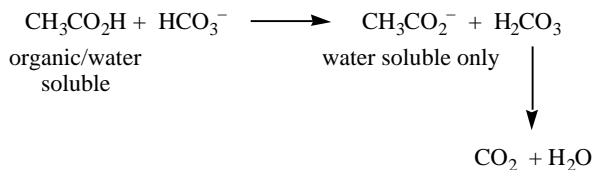
$$\begin{aligned}
 \text{Amount of solute extracted} &= 320 \text{ mg} - 320 \text{ mg} \left(\frac{10 \text{ mL}}{1 \left(\frac{50 \text{ mL}}{5} \right) + 10 \text{ mL}} \right)^5 \\
 &= 320 \text{ mg} - 320 \text{ mg} \left(\frac{10 \text{ mL}}{10 \text{ mL} + 10 \text{ mL}} \right)^5 \\
 &= 320 \text{ mg} - 320 \text{ mg} (1/2)^5 \\
 &= 320 \text{ mg} - 10 \text{ mg} = 310 \text{ mg extracted (organic phase)} \\
 &\quad \text{with 10 mg of W remaining in the aqueous phase.}
 \end{aligned}$$

- Anhydrous Na₂SO₄ has a higher capacity because it will complex more water than anhydrous MgSO₄.
-

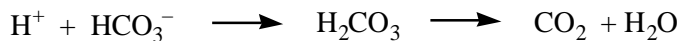


+3 points for arrow pushing for each step; + 2 points for equilibrium arrows; -1 point for each wrong charge assignment; - 6 points for wrong alcohol or carboxylic acid (or for not defining "R" group).

- a) efficient extraction of excess acetic acid

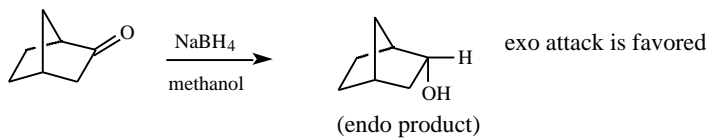


- Extracts isopentyl alcohol
- Neutralizes reaction (kill catalysis)

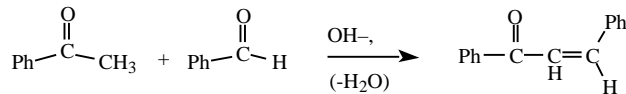


7.

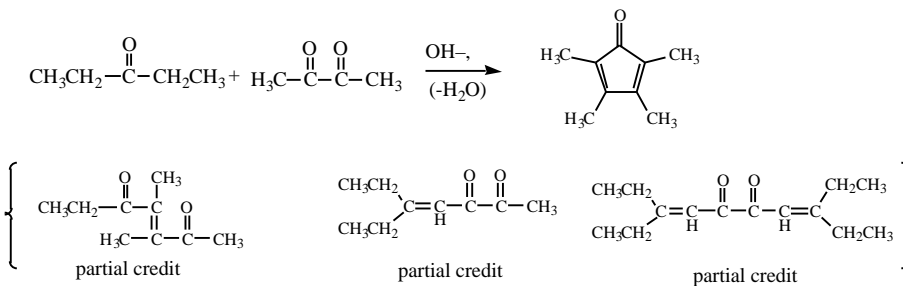
a.



b.



c.

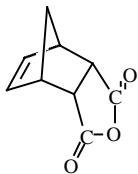


8. NaBH_4 is less reactive and thus more easily handled. LiAlH_4 reacts violently with protic solvents such as water or alcohols. NaBH_4 is stable in water.

9. time required for a compound to come off the column; decrease; decrease; decrease

10. 3, 6, 11, 4

11.



unsaturated stretch or $=\text{C}-\text{H}$ stretch 3007.5 cm^{-1}

+5 points

saturated stretch or $-\text{C}-\text{H}$ stretch $2960, 2871\text{ cm}^{-1}$

+5 points

$\text{O}=\text{C}-\text{O}-\text{C}=\text{O}$ anti-symmetric stretch 1866 cm^{-1}

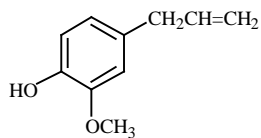
+5 points

$\text{O}=\text{C}-\text{O}-\text{C}=\text{O}$ symmetric stretch 1785 cm^{-1}

+5 points

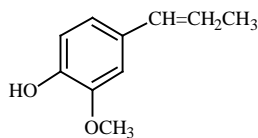
$\text{C}=\text{C}$ stretch (very weak)

12.



+15 points

(or any aryl R group variation)



+3 points