I agree to abide by all provisions of the UI College of Liberal Arts and Sciences policies governing academic dishonesty as stated in the College's Student Academic Handbook (http://www.clas.uiowa.edu/students/academic_handbook/ix.shtml), and I understand that copying from others exams or allowing others to copy from my exam will result in a grade of "F".

Signature _____ Sample Exam

Name (print) _____ SAMPLE EXAM -- NO KEY WILL BE POSTED

Please write the name of your TA in the space below.

_____

****

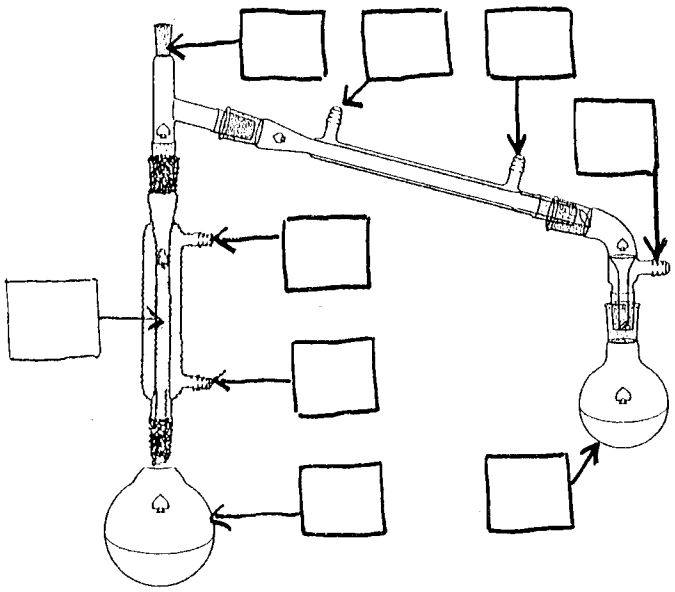
1. SciFinder is a tool for finding
   (4 pts, circle the correct answer)

   (a) chemistry journal articles by a certain author
   (b) physical constants for a specific compound
   (c) various compounds containing a common substructure
   (d) chemical reactions related to a desired product
   (e) all of the above

2. Identify the purpose of each of the parts of the apparatus shown at right, assuming it is used for distillation. (8 pts, place the appropriate letter in each box.)

   (a) removal of gases from the apparatus
   (b) increasing the enrichment of the lower-boiling component
   (c) water inlet for cooling
   (d) water outlet for cooling
   (e) location of instrument to measure temperature
   (f) boiling flask
   (g) receiving flask
   (h) no purpose for this part

   (selections may be used more than once)

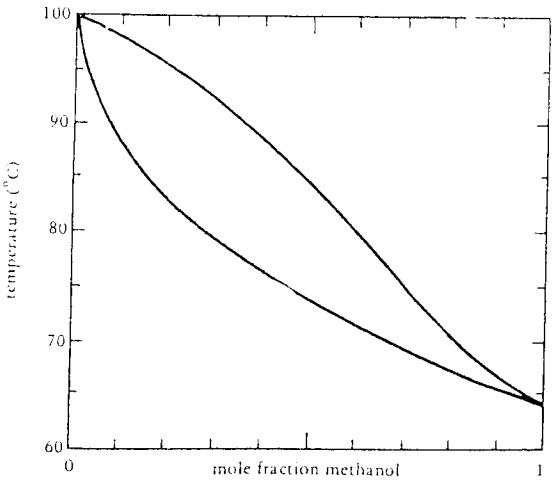


3. The name of the operation conducted with the apparatus in Question 1 is _____ distillation.
   (4 pts, fill in the blank)

4. In one sentence or less, explain why vacuum is used for distillation of carvone.
   (8 pts)

5. Consider the liquid-vapor phase diagram for methanol and water shown below. Starting with a mixture of composition 40% methanol and 60% water, give the expected percentage of methanol in the liquid after *two cycles* of vaporization and condensation.
(4 pts, circle the correct answer)

10% 40% 70% 80% 100%



(0% methanol) (100% methanol)

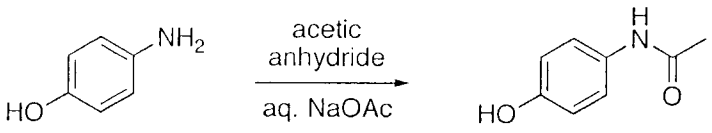
6. In silica gel column chromatography, the separation of two compounds is possible because
(4 pts, circle the correct answer)

(a) the two compounds have different rate constants for reaction with the eluent
(b) the two compounds have different equilibrium constants for association with the stationary phase
(c) the two compounds react with each other as they pass through the column
(d) compounds of the same polarity usually travel at different rates through the column
(e) all of the above

7. The synthesis of acetaminophen includes a procedure involving mixing of p-aminophenol with hydrochloric acid and filtration. The purpose of this part of the procedure is to
(4 pts, circle the correct answer)

(a) obtain the pure acetaminophen in its conjugate acid form
(b) obtain the pure acetaminophen in its conjugate base form
(c) separate p-aminophenol from impurities which ARE NOT soluble in acid
(d) separate p-aminophenol from impurities which ARE soluble in acid
(e) none of the above

8. For the reaction shown below, draw all intermediates in the mechanism of the reaction. Use curved arrows to illustrate the movement of electrons. (8 pts)



9. List five ways to analyze the purity of a product in the organic lab. (10 pts)

_____

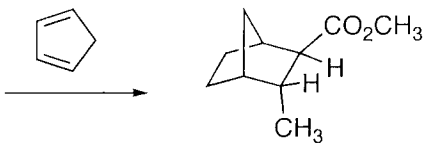
_____

_____

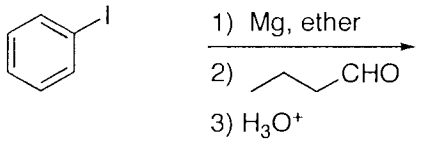
_____

_____

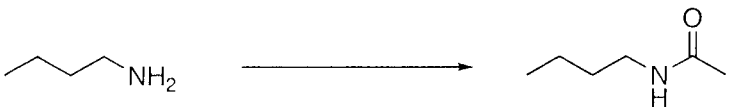
10. Provide the missing reactants, reagents, or products in the reactions shown below. (15 pts)

(a) 

(provide reactant)

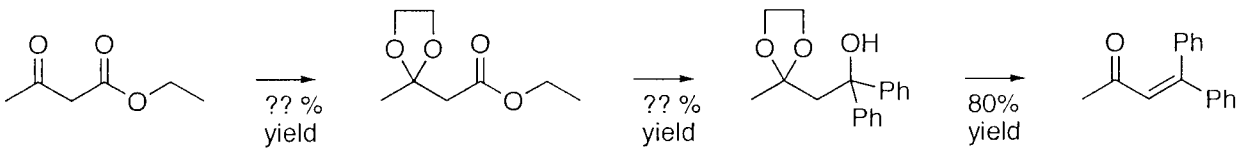
(b) 

(provide product)

(c) 

(provide reagents)

11. Suppose you begin with 5.0 g of ethyl acetoacetate (**A**), and carry out the reaction sequence shown below, obtaining the indicated amounts of each product. All of each product is used in the next step. The reagents are not shown, but you may assume they are used in excess, so that **A**, **B**, and **C** are limiting reagents in each reaction. (Ph = phenyl, C_6H_5)



A (5.0 g) **B** (4.0 g) **C** (4.0 g) **D** (?? g)

(a) What is the *percent yield* of the first step in the sequence to form **B**? (5 pts, show calculation for full credit)

Yield of **B** _____

(b) What is the *mass* of the final product **D**? (5 pts, show calculation for full credit)

Mass of **D** _____

(part c on next page)

(c) What is the *overall percent yield* for the three step process? Overall yield _____
(5 pts, show calculation for full credit)

12. Dick and Jane obtain an unexpected compound from an experiment. Using the data provided below, propose the structure of their unknown compound. Put the final structure in the box. (16 pts)

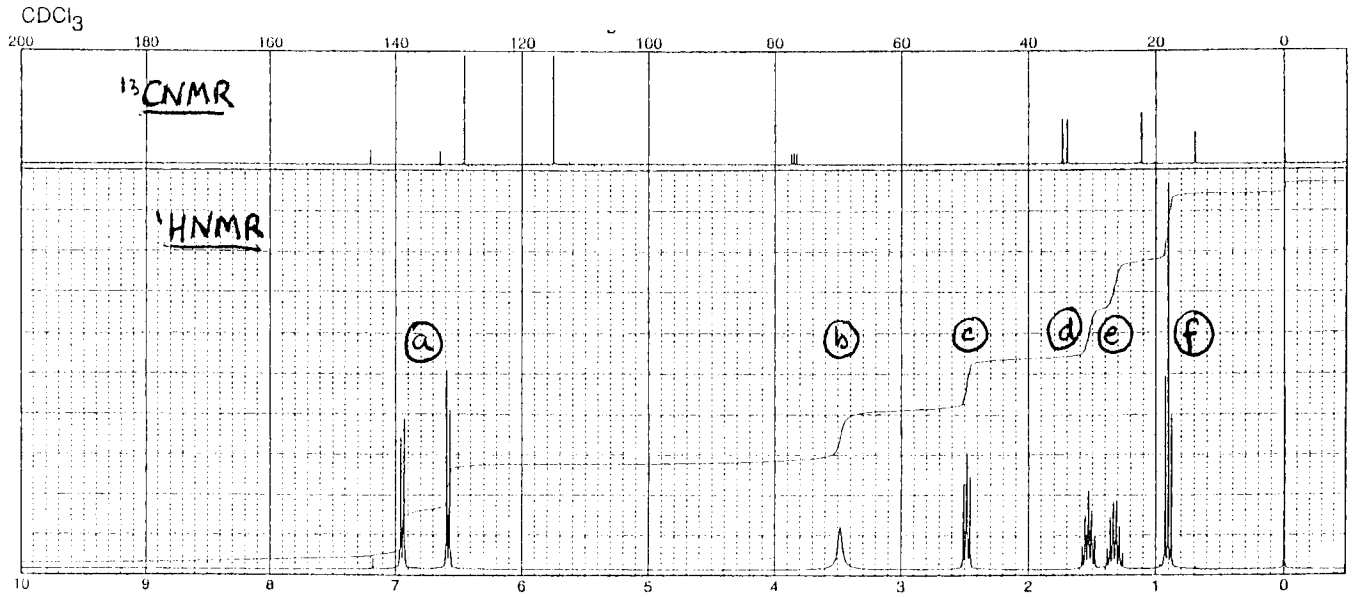
On your final structure, label each set of hydrogens with a letter corresponding to the letter assigned to each peak in the ^{1}H NMR spectrum.

If the structure is incorrect, partial credit (up to 8 points) will be available based on reasonable interpretations of the data. For partial credit you must show your analysis.

place final answer in the box

Formula: $C_{10}H_{15}N$

IR: 3300 (broad), 3200 (broad), 3050, 2960, 2940, 2880, 1620, 1510 cm^{-1}



Extra credit: What three Spring Break activities did Dr. Friestad show in his lecture on March 3? (3 pts) (no partial credit)

IR

TABLE 12.1 Characteristic Infrared Absorption Wavenumbers

Functional Group	Wavenumber (cm^{-1})
O—H	3600–3400
N—H	3400–3200
C—H	3080–2760
C≡N	2260–2215
C≡C	2150–2100
C=O	1815–1650
C=C	1660–1600
C—O	1200–1050

FOR GRADING ONLY

Page 1 _____

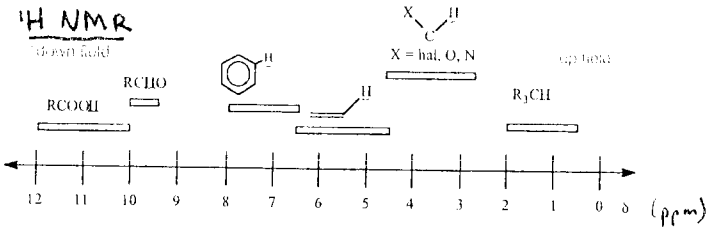
Page 2 _____

Page 3 _____

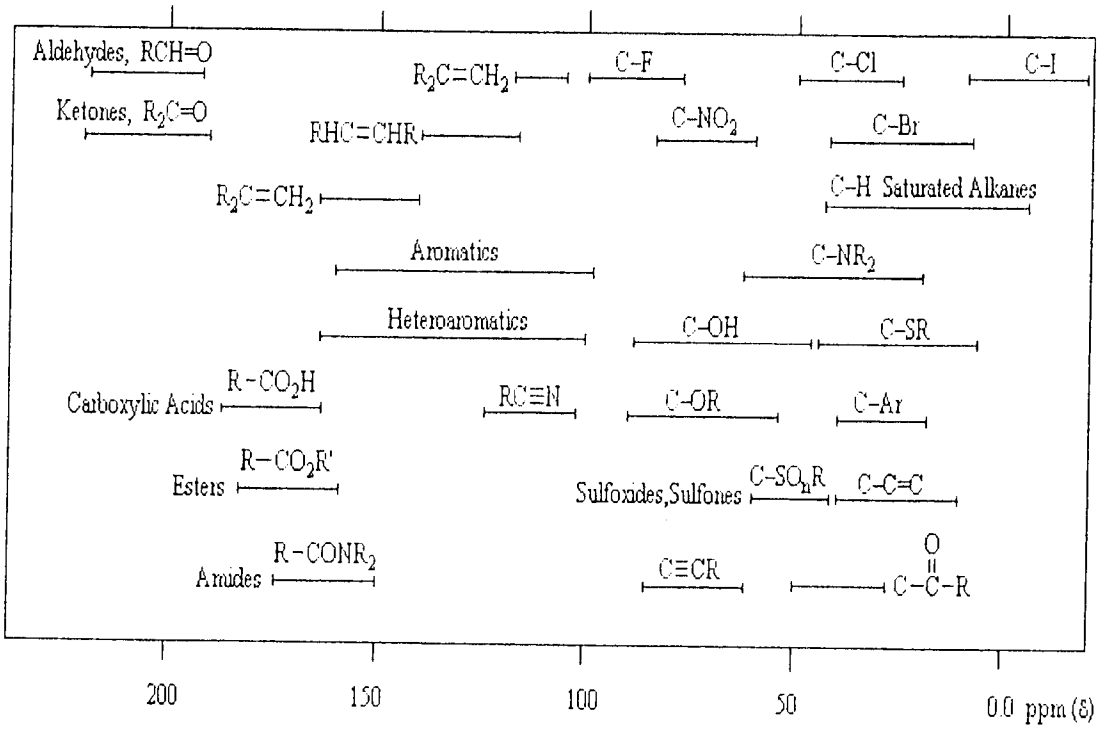
Page 4 _____

TOTAL _____

^{1}H NMR



^{13}C NMR



Selected Periodic Table Entries

1	6	7	8
H	C	N	O
1.00797	12.011	14.0067	15.9994