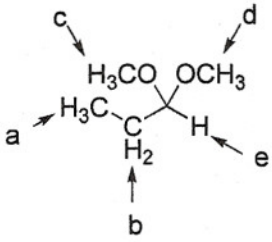
Part I Multiple Choice (16 points)

For the following compound:



1. How many signals do you expect to see in the proton NMR?

a) 3

b) 4

c) 5

d) 9

e) 12

2. Which of the indicated protons should appear the furthest **upfield** in the proton NMR?

a) a

b) b

c) c

d) d

e) e

3. Which of the indicated protons should appear the furthest **downfield** in the proton NMR?

a) a

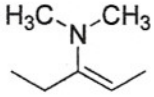
b) b

c) c

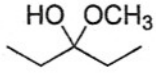
d) d

e) e

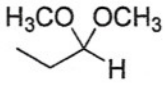
5-8: Consider the following compounds and answer questions 5-8.



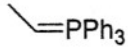
a



b



c



d

5. Which is an **acetal**? a b c d

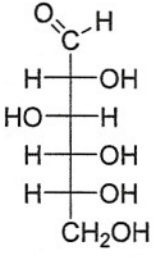
6. Which is an **enamine**? a b c d

7. Which is an **ylide**? a b c d

8. Which would be converted to an **aldehyde** upon acid hydrolysis? a b c d

Short Answer

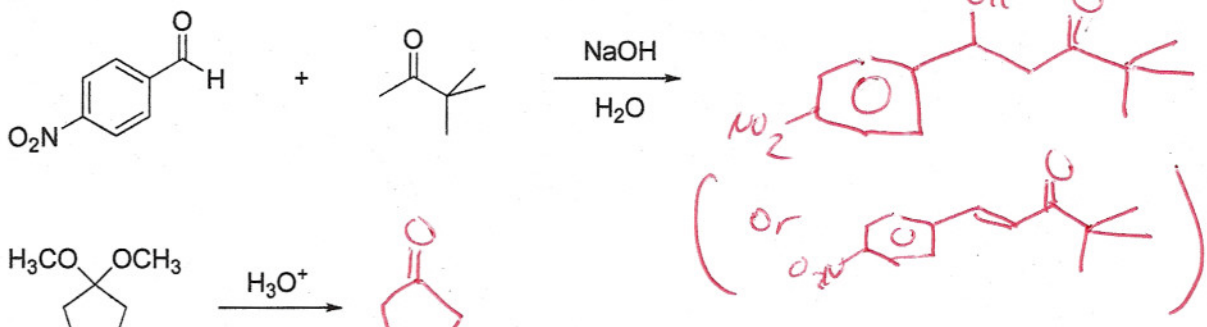
9. (4 points)Explain why the IR spectrum of D-glucose (shown below) doesn't exhibit an absorption corresponding to the carbonyl stretching vibration.



forms (cyclic) hemiacetal

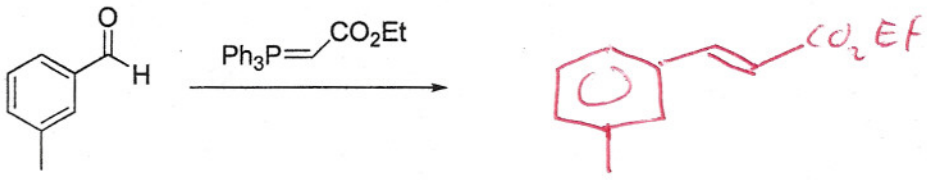
11. (28 points) Give the major product(s) for **7** of the following 10 reactions: **Clearly indicate those you don't wish to be graded.**

a)

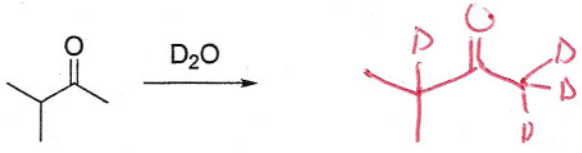


b)

c)

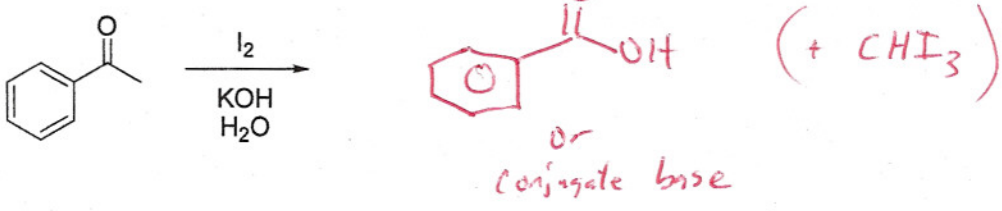


d)



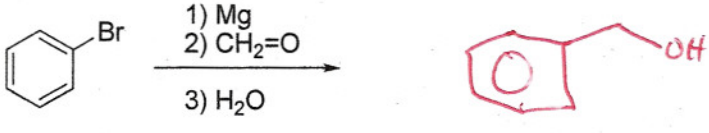
(1 point per D)

e)

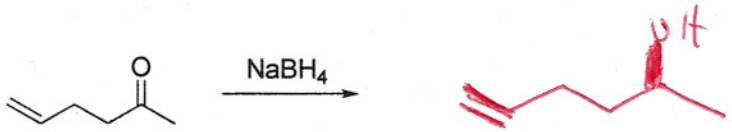


f)

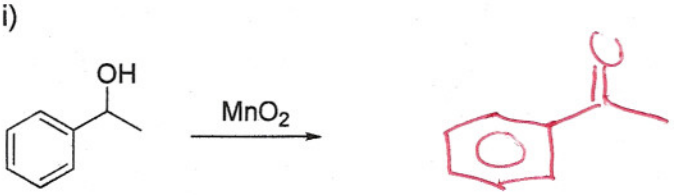
g)



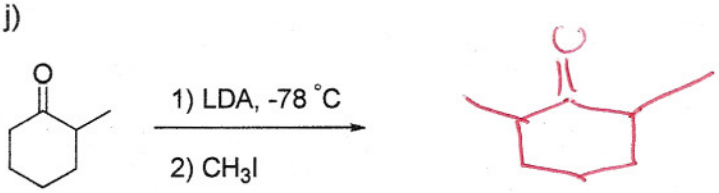
h)



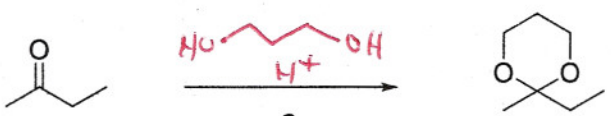
i)

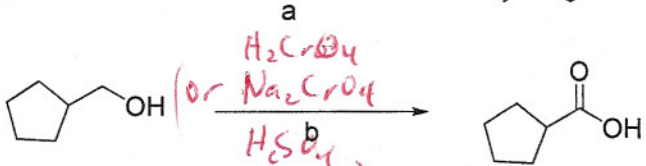


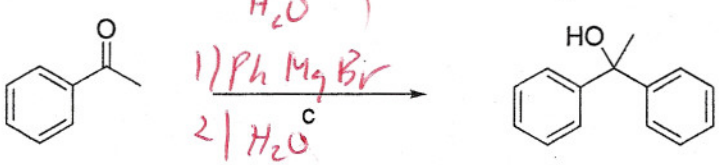
j)

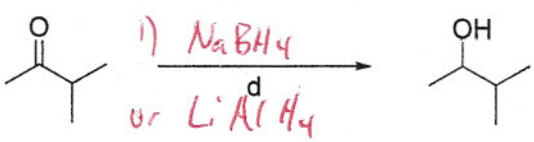


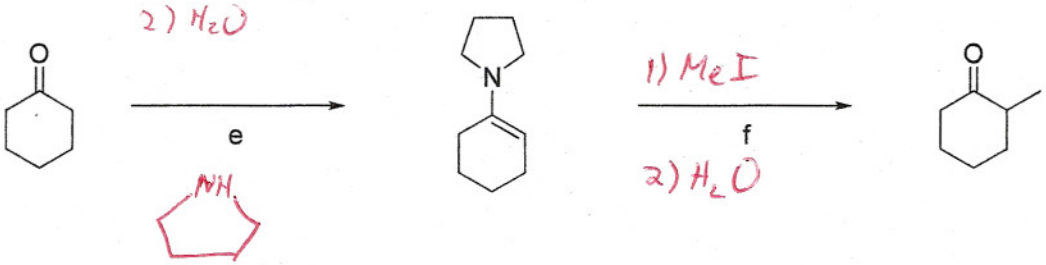
12. (15 points) Provide reagents for **5** of the following 6 transformations (a-f). **Clearly indicate those you don't wish to be graded.**





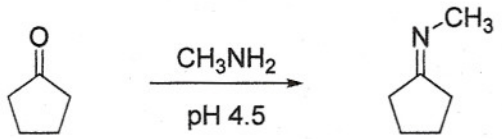




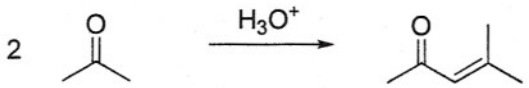


13 (10 points) Give the mechanism for **ONE** of the two following transformations. **Clearly indicate which one of the two mechanisms you wish to be graded.**

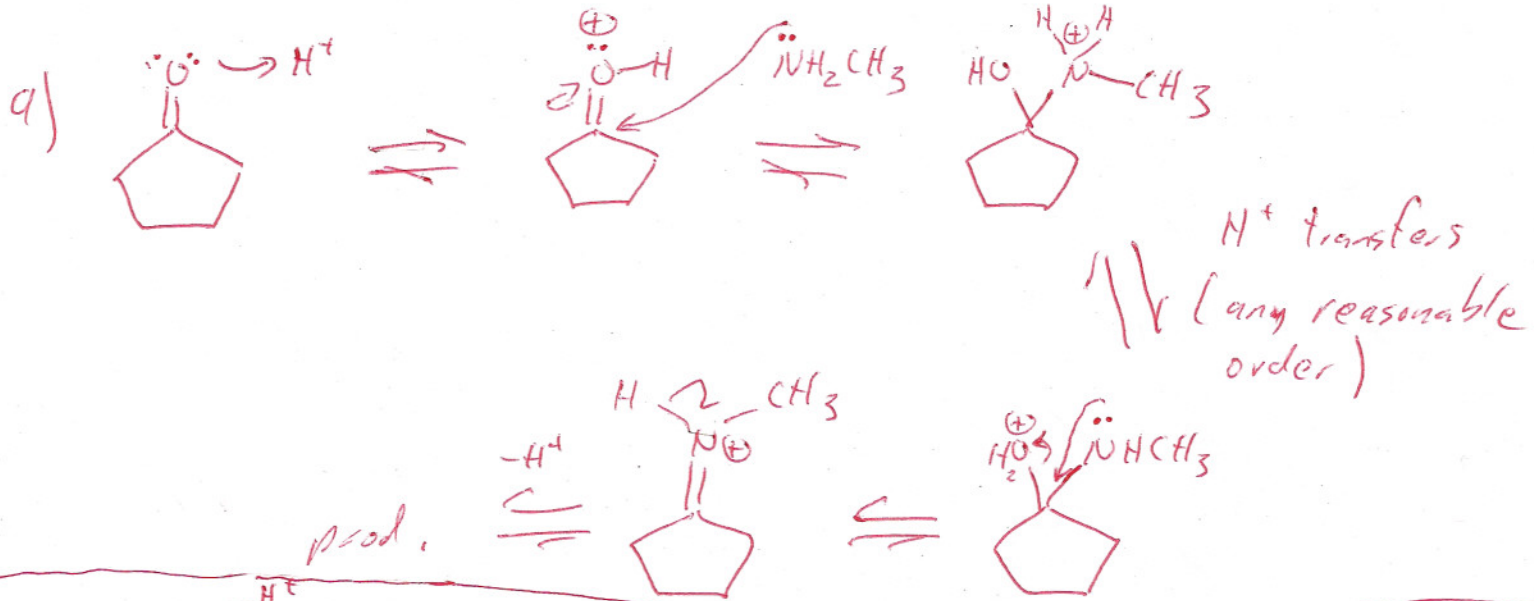
a)



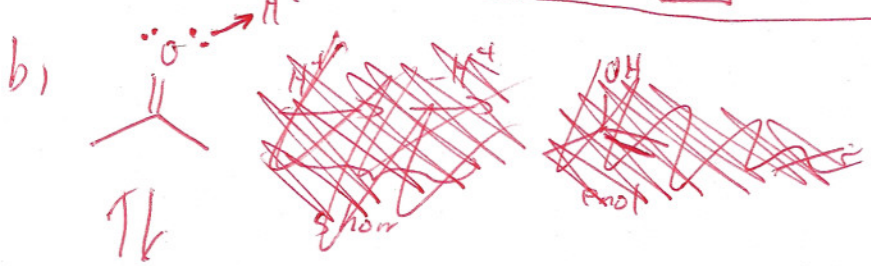
b)



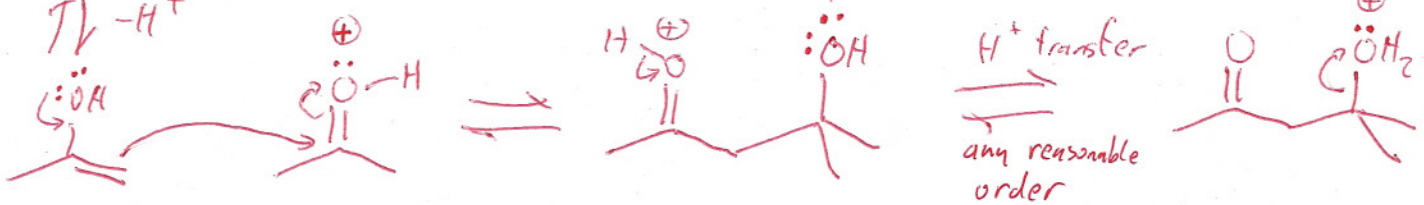
a)



b)

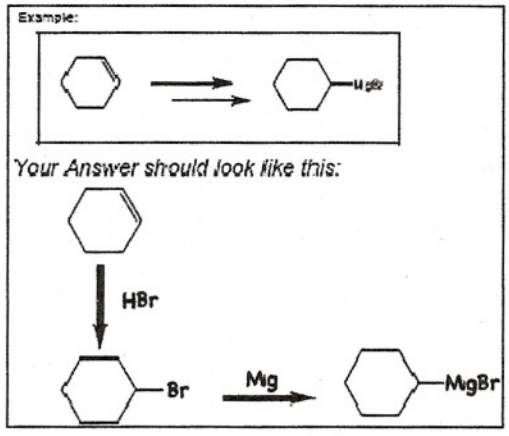


E1 or E2 OK

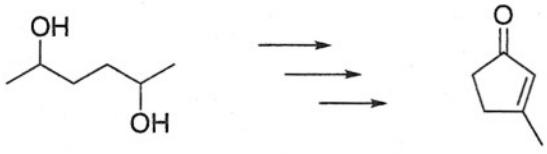


Multistep Synthesis (9 points)

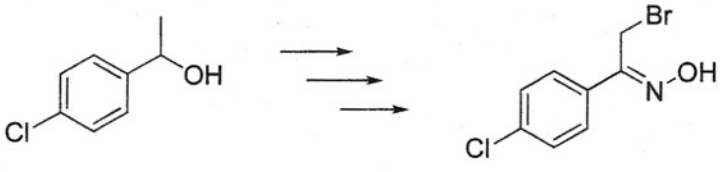
14. Choose one of the two following synthesis problems. Show how you can synthesize the product on the right from the indicated starting material on the left. You can show a retrosynthesis for partial credit, but full credit requires writing out a sequence of forward reactions (see box at right for an example).



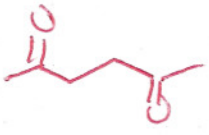
a)

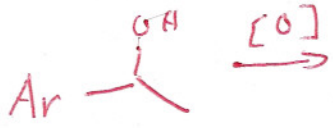
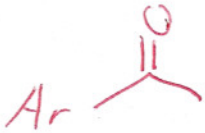
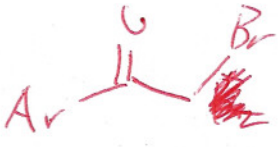


b)



Similar to Hartung and Schwartz, Org. Synth. **2002**, *79*, 228.

a) [O] e.g. Cr^{VI} →  → H^+ (accept ^-OH) → prod.

b)  [O] →  → Br_2, H^+ (eg: AcOH) →  → NH_2OH (H^+) → 

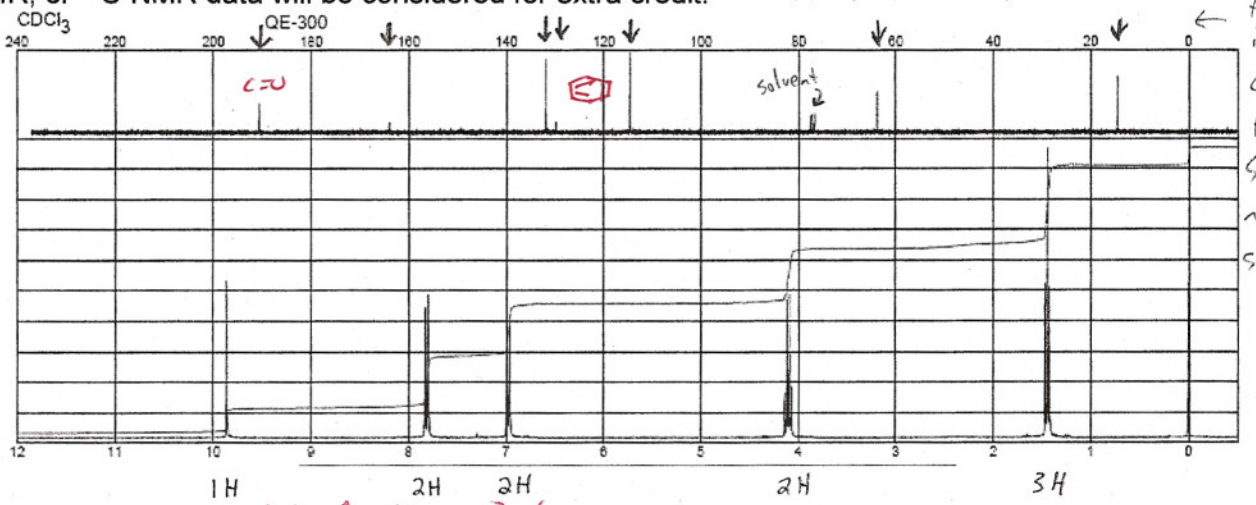
This is problem 9 from
The U. of Colorado at Boulder

Spectroscopic Analysis of an Unknown Compound (10 points)

15. The ^{1}H (bottom) and ^{13}C (top) NMR spectra for a compound with the formula $C_9H_{10}O_2$ is shown below. An expansion of the ^{1}H NMR, and an IR spectrum, are shown on the following page. The numbers on the NMR expansion indicate the integrations for each signal.

Identify the structure of the compound. Use the ^{1}H NMR data to construct a table (chemical shift, integration, multiplicity, assignment) to identify structural fragments, then arrive at the structure. **You are being graded on your analysis**. Any use of the degrees of unsaturation, IR, or ^{13}C NMR data will be considered for extra credit.

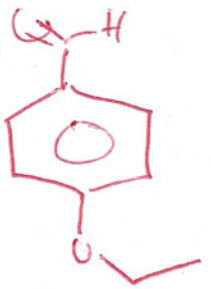
7 different carbons



← Arrows above indicate carbon signals for unknown. Signals at ~δ77 are solvent (ignore)

÷2 for these 3 alone

δ	int	mult	asst	
9.8	1H	s	CHO	2
7.8	2H	d		
7.0	2H	d		2
4.1	2H	q	OCH_2CH_3	2
1.4	3H	t	CH_3CH_2	2



2

DBE 5 + (1)
7 C (+1)

IR: C=O stretch (+1) 1698 cm^{-1}
C–H stretch (+1) 2828, 2739 cm^{-1}

Use of ^{13}C shifts, eg: C=O ^{13}C (+1)