CHEM 266 – Exam-1 **Name_____Keys_____**

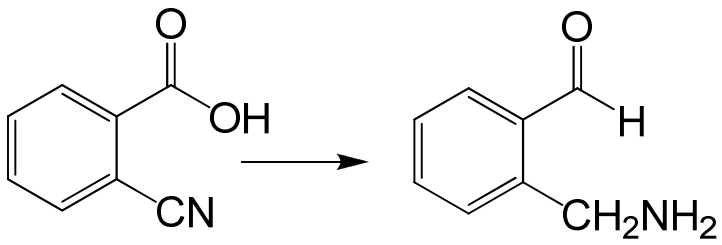
(September 21st, 2017)

1. A 400 MHz spectrometer records protons that absorb at 3675, 3070, 2325 and 1880 Hz downfield from TMS. (8 pts)

(a) Determine the chemical shifts of each of these signals in ppm. (4 pts)

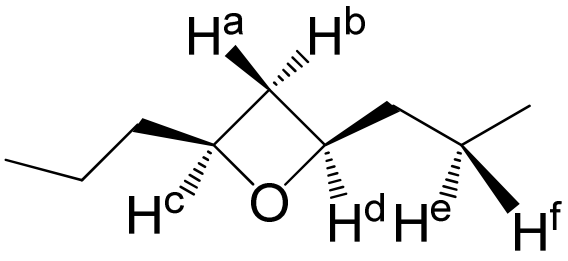
(b) If the spectrum was recorded on a 60 MHz spectrometer, how far downfield (in hertz) from TMS would this proton absorb? (4 pts)

2. You have just performed the following transformation in the lab; predict the type of bonds corresponding to the major signals found in the IR spectra of both the product and the reactant. Explain how IR spectroscopy could be used to check if the reaction worked. (8 pts)



Explain (3 pts)

3. State the relationship between the protons indicated in the structure below (as: homotopic, enantiotopic, diastereotopic, or unrelated). (2 x 4 = 8 pts)



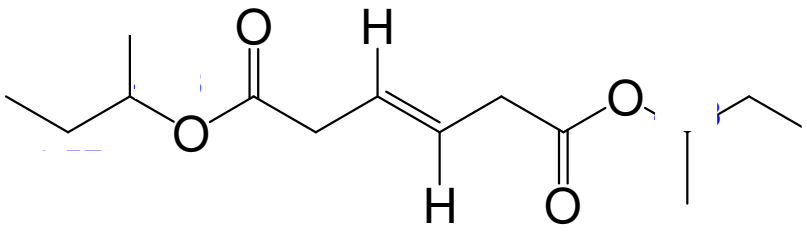
H^a and H^b are

H^c and H^d are

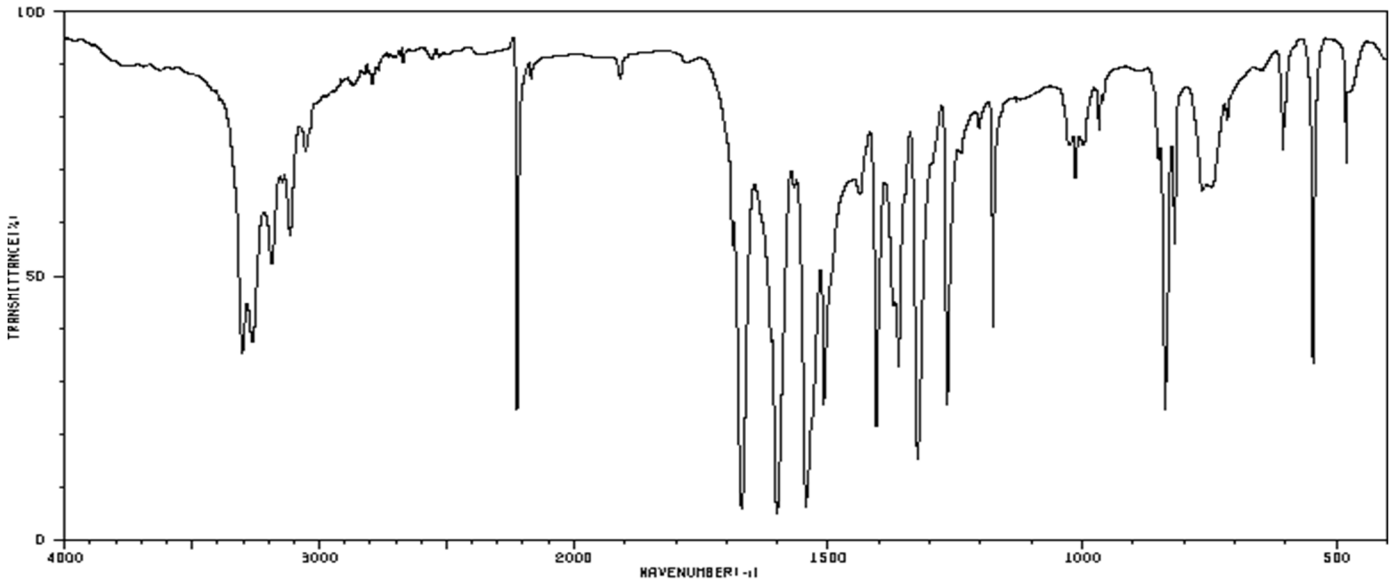
H^e and H^f are

H^a and H^c are

4. Predict the number of signals expected, their splitting, their relative area and their relative intensity in the ^{1}H-NMR spectrum of the following compound. (6 pts)



5. (a) Identify the major signals and the corresponding bonds vibration present in the compound having the following IR spectrum; Molecular formula **$C_{13}H_{16}N_2O$** (7 pts)



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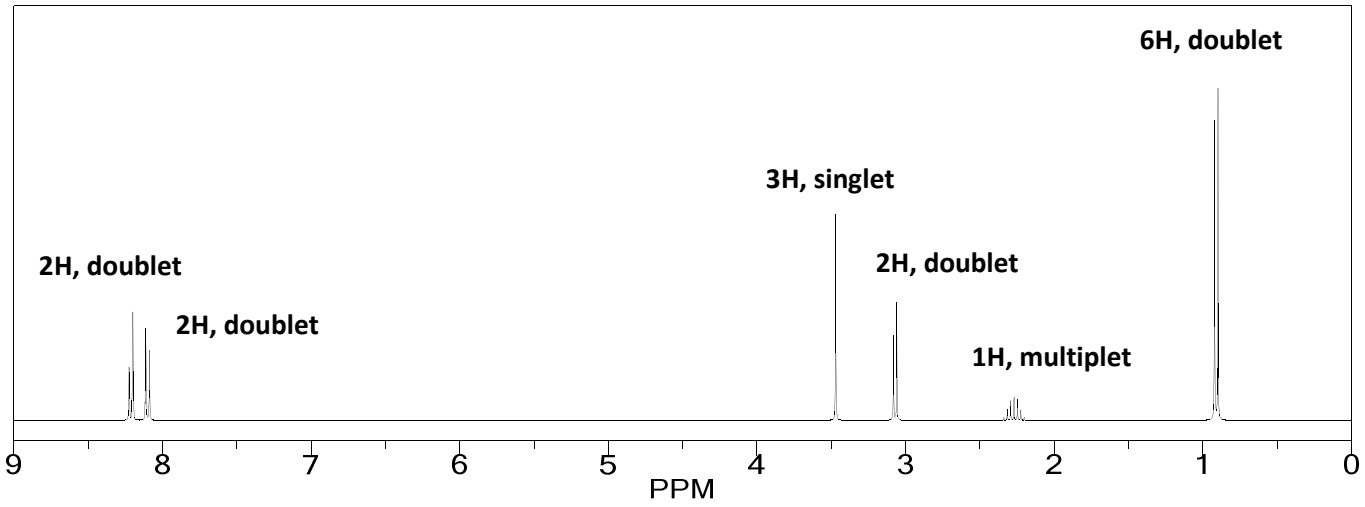
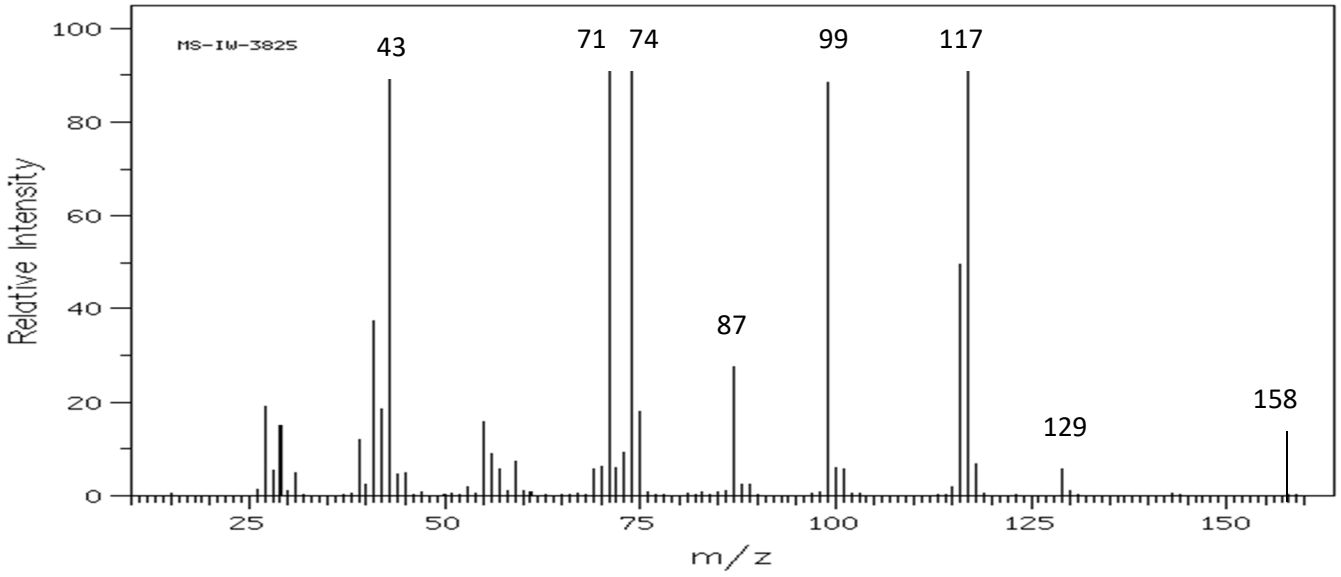
(b) The ^{1}H-NMR shown below is that of the same compound with the IR spectrum shown in (a). Determine its structure and explain your answer.



Structure (4 pts) **REMOVED FROM THE EXAM**

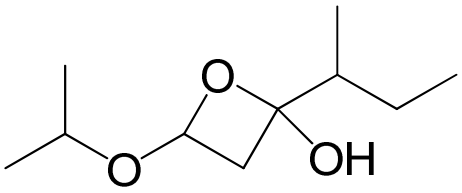
Explain (4 pts)

6. The mass spectrum showed below is that of propyl 2-methylvalerate (see structure). Provide a structure for each of the fragments corresponding to the peaks indicated by the *m/z* 158, 129, 117, 99, 87, 74, 71 and 43 (you must show the fragmentation pattern to receive full credit) (7 pts).

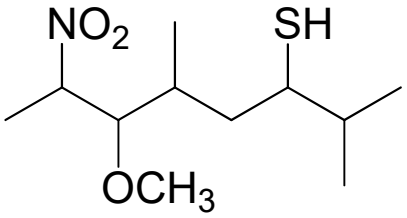


7. Name the following compounds (3 x 5 = 15 pts)

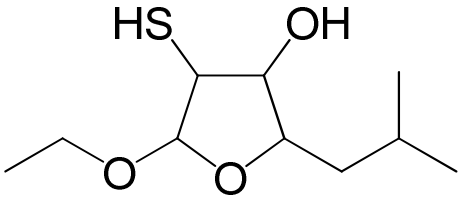
(a)



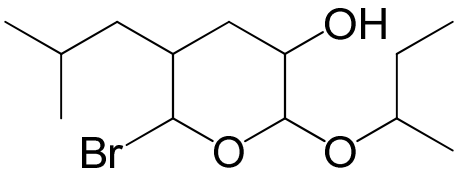
(b)



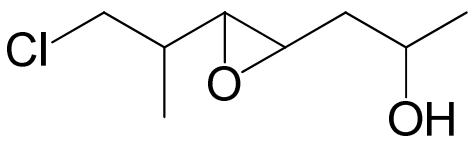
(c)



(d)



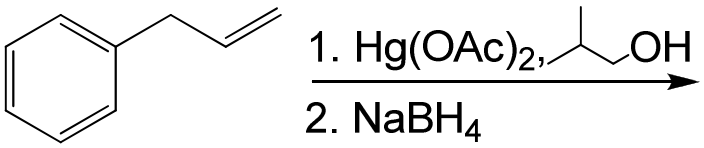
(e)



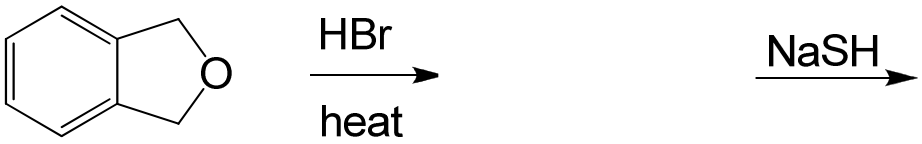
8. Predict the major product(s) expected from the following reaction sequences (3.5 x 6 = 21 pts)

(a)

(b)



(c)



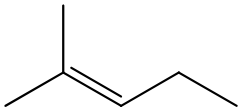
(d)

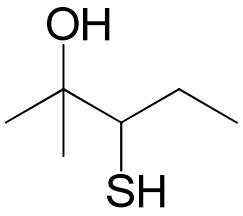
(e)

(f)

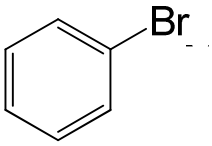
9. Show how you would synthesize each of the following compounds from the given starting material(s). You must draw keys intermediates to receive full credit (3 x 2 = 6 pts).

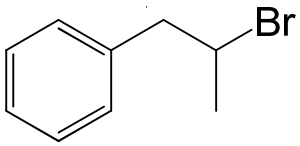
(a)





(b)





10. Draw a plausible mechanism for the reaction below (3 pts)