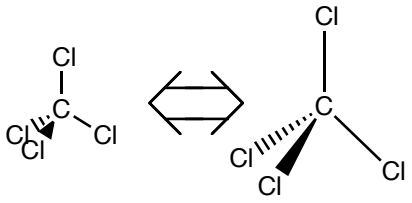
Name
PHYS 0203 (Organic II)

Test 4 (5/9)
Spring 2007

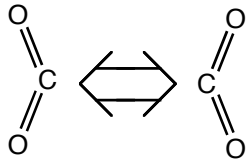
1. (6 pts.) In order for a molecular vibration to absorb infrared light, what must the vibration cause?

2. (5 pts. each) For each of the vibrational modes shown below determine whether the vibration would result in the absorption of infrared light.

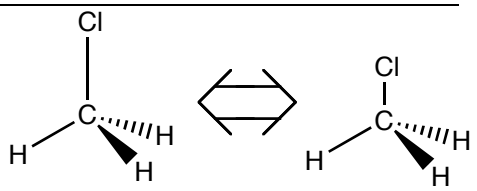
a.



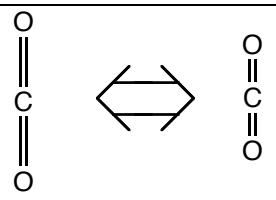
b.



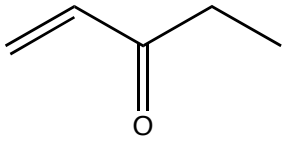
c.



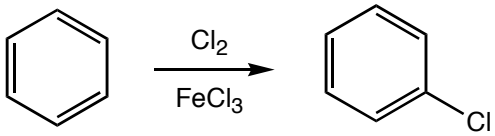
d.



3. (10 pts.) Explain why conjugated ketones like the one drawn below have stretching frequencies at lower waver numbers as compared to unconjugated ketones. (Hint: consider how possible resonance structures contribute to the structure of the molecule.)



4. (10 pts.) Draw the mechanism for the electrophilic aromatic substitution reaction drawn below.



1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

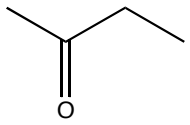
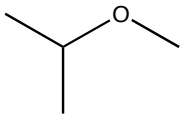
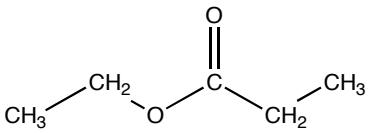
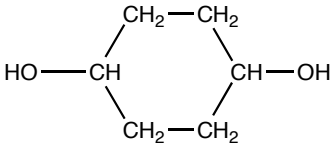
7. _____

8. _____

9. _____

10. _____

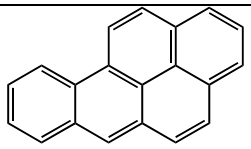
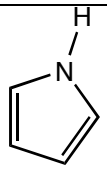
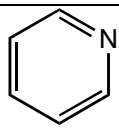
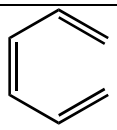
5. a. (4 pts. each) For the following molecules, label the chemically inequivalent protons; label the ^1H that resonates at the lowest frequency ***a***. Label the rest of the protons alphabetically in order of increasing chemical shift (frequency).
   b. (4 pts. each) For molecules i and iii, indicate the expected multiplicity (singlet, doublet, triplet etc.) of the peaks.

i.		ii.	
iii.		iv.	

6. (6 pts.) What property of the proton makes NMR spectroscopy possible?

7. (10 pts.) Explain why you would expect that the peak for a CH_3 adjacent to a C=O would be farther down field than the peak for a CH_2.

8. (5 pts. each) Which of the following molecules is(are) aromatic

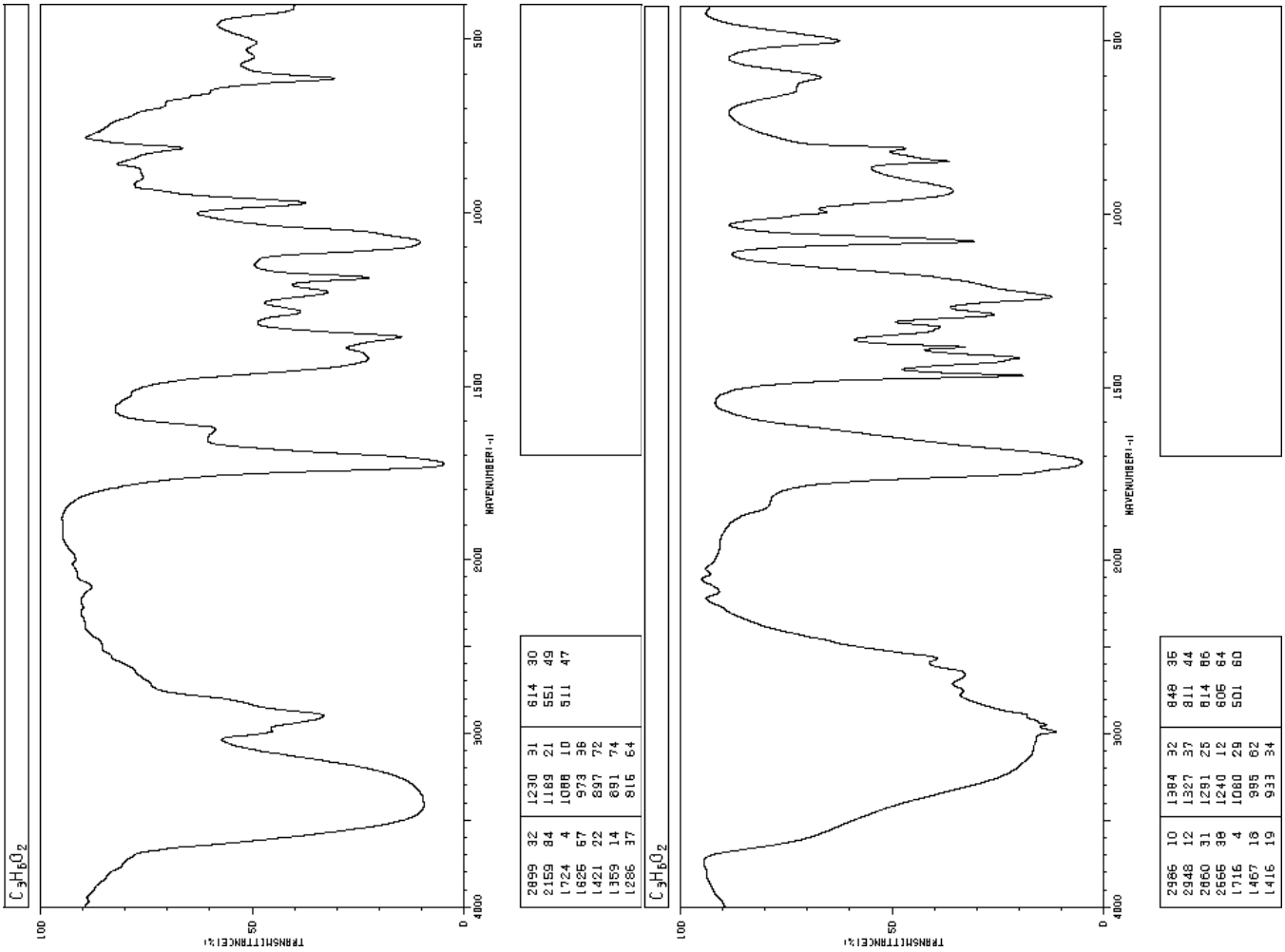
a.		b.		c.		d.	

9. Two IR spectra are provided below. The chemical formulae for the molecules that give rise to the spectra are the same, $C_3H_6O_2$. One molecule is a carboxylic acid, the other molecule is not.

a. (5 pts.) Identify the spectrum that corresponds to the carboxylic acid, and explain how you identified the carboxylic acid.

b. (5 pts.) What must the structure of the carboxylic acid be?

c. (10 pts.) Determine the structure of the molecule that gives rise to the other spectrum. Explain your reasoning. (Listing all the possible structures and eliminating the structures that aren't supported by the IR spectrum might help you determine the structure of the molecule.)



10. Below is the IR spectrum and the ^{1}H NMR spectrum of $C_4H_8O_2$.

a. (6 pts.) Determine the structure of the molecule.

b. (6 pts) Label the peaks in the NMR spectrum and label the corresponding H atoms on the structure.

c. (6 pts.) Explain how the IR spectrum supports the structure that you have drawn.