

Chemistry 220b, Section 1
Exam 1 (100 pts)
Thursday, February 3, 2011
Chapters 12, 15, 13.1-13.9

Name _____

Write and sign the VU Honor Pledge:

_____ signature

This exam is closed book and closed notes

NOTE: It is difficult for me to give you partial credit if you do not show your work!

Neatness count

Stereochemistry counts are indicated

Good Luck !!

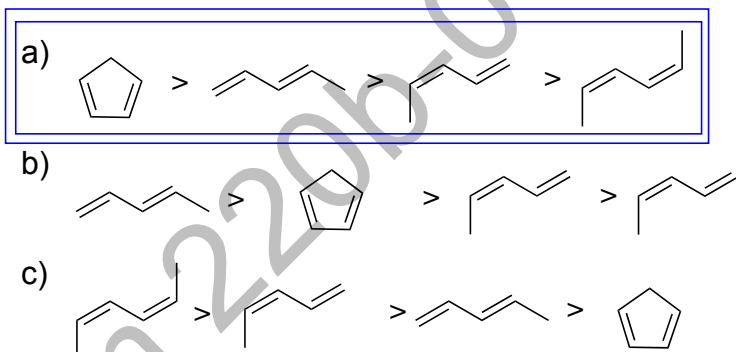
1-15. Multiple choice. Chose the best answer for the following questions (4 pts each, 60 pts)

1. The geometry of the central carbon (C3) of 2,3-pentadiene is . . .
a) trigonal b) sp **c) linear** d) tetrahedral
2. How many nodes are in the lowest energy π molecular orbital of 1,3,5-hexatriene?
a) 0 b) 1 c) 6 d) can not be determine with the information given
3. Which of the following molecules is expected to have the longest wavelength λ_{max} ?
a) ethylene
b) 1,3-butadiene
c) 1,3,5-hexatriene
d) 1,3,7,9-decatetraene

4. Which of the following orbitals is the LUMO of the allyl cation?

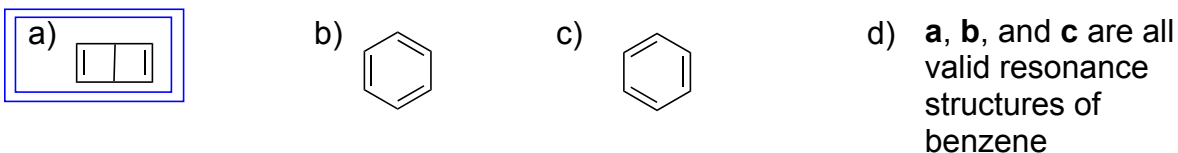


5. What is the expected order of reactivity in the Diels-Alder reaction for the conjugated dienes shown, from most reactive to least reactive?

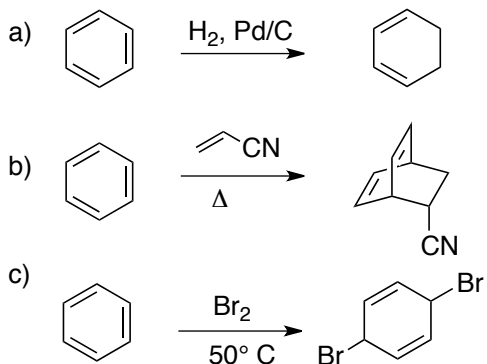


d) all four conjugated dienes are expected to be equally reactive in the Diels-Alder reaction.

6. Which of the following is not a valid resonance structure of benzene?

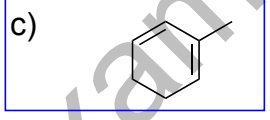
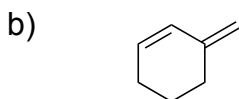
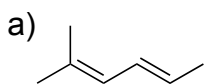


7. Which of the following is a typical reaction of benzene?

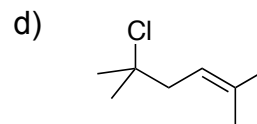
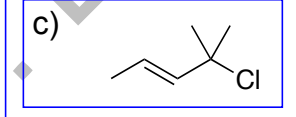
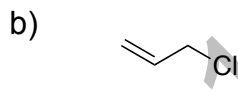
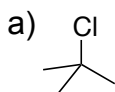


d) none of the above

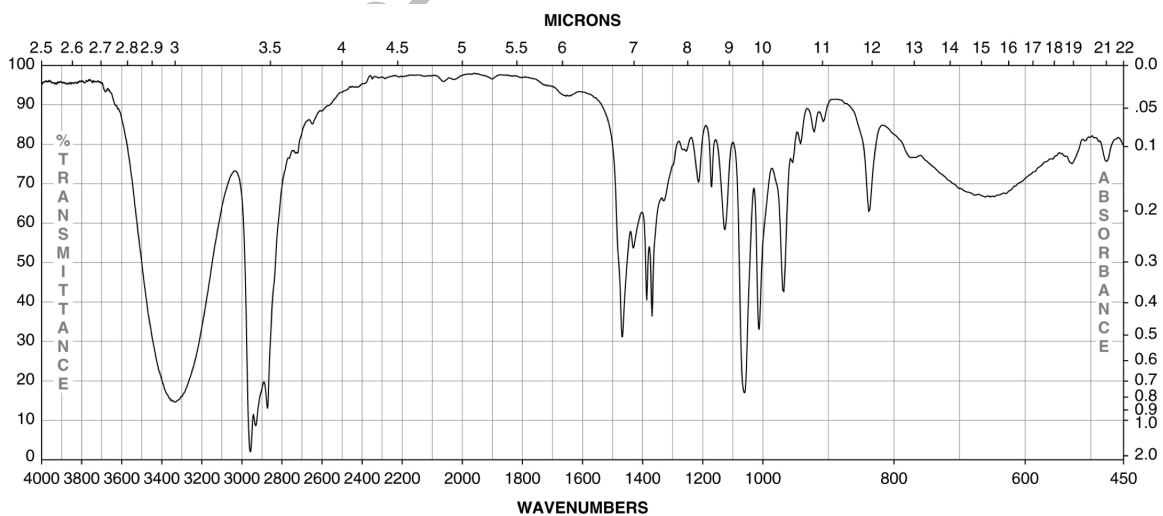
8. Which of the following is in the *s-cis* conformation?



9. Which of the following is predicted to react fastest in an S_N1 reaction?



10. The infrared spectrum below suggests the presence of a(n) . . .



a) alcohol.

b) carboxylic acid.

c) conjugated diene.

d) terminal acetylene.

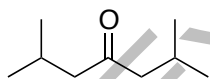
11. Which of the following is true about UV-visible spectroscopy?

- a. There is a linear relationship between concentration and the intensity of the UV-visible absorbance.
- b. The most intense absorbance is the λ_{\max} .
- c. increasing conjugation cause the λ_{\max} to move to higher energy wavelengths.
- d. **a, b, and c are all true**

12. Which of the following is true about mass spectrometry?

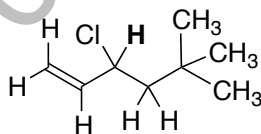
- a) Mass spectrometry measures the abundances of ions according to their mass:charge ratio.
- b) The base peak in a mass spectrum is the most abundant ion.
- c) The molecular ion represents the molecular weight of the analyte
- d) **a, b, and c are all true.**

13. How many ^{13}C NMR resonances are expected for 2,6-dimethyl-4-heptanone (shown below)?



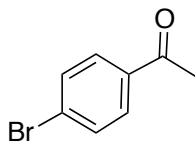
- a) 9
- b) 7
- c) 5
- d) **4**

14. In principle, what is the expected multiplicity of the proton on C3 (in bold) of 3-chloro-5,5-dimethyl-1-hexene (shown above)?



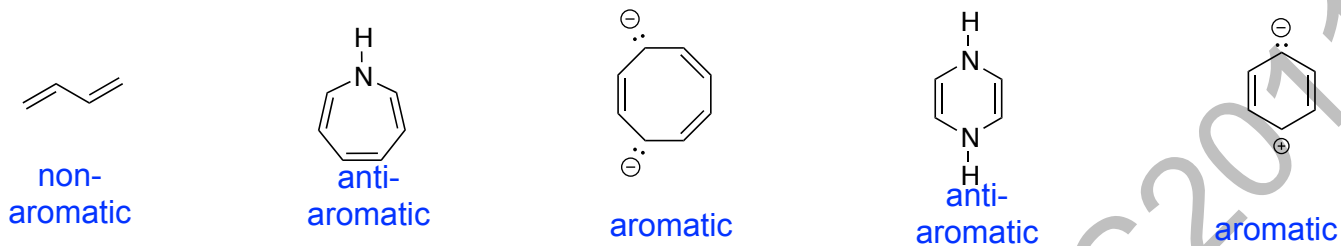
- a) triplet
- b) quartet
- c) doublet of triplets
- d) **doublet of doublet of doublets**

15. Which of the following statements is not true regarding the spectral properties of *p*-bromoacetophenone ($\text{C}_8\text{H}_7\text{BrO}$, MW = 199)

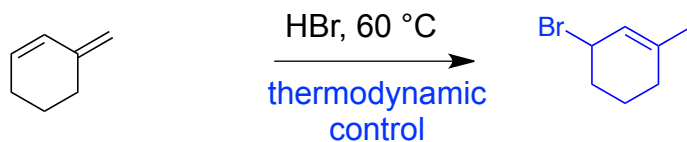
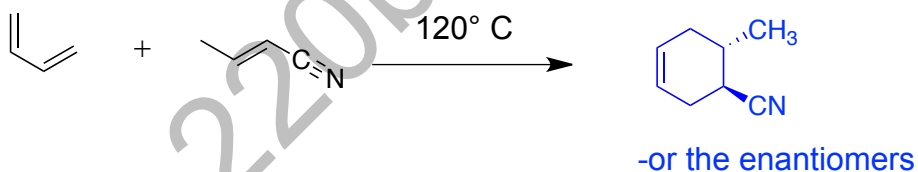
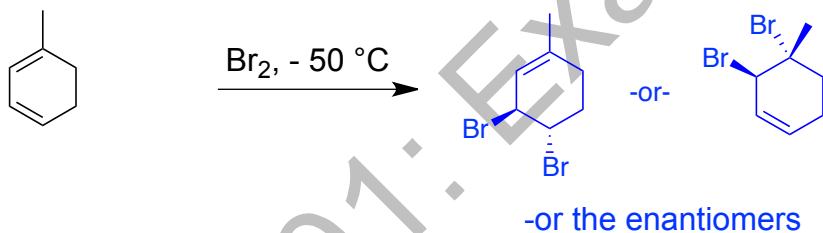


- a) The ^1H NMR resonance for the methyl group will be a singlet at $\delta \sim 2.1$ ppm.
- b) A resonance at ~ 200 ppm will be observed in the ^{13}C NMR spectrum.
- c) **A strong, sharp absorption at 2250 cm^{-1} will be observed in the IR spectrum.**
- d) A $\sim 1:1$ ratio of peaks at m/z 198 and 200 will be observed in the mass spectrum.

16. Designate the following species as aromatic, anti-aromatic, or non-aromatic. Assume all of the atoms are coplanar. (10 pts)



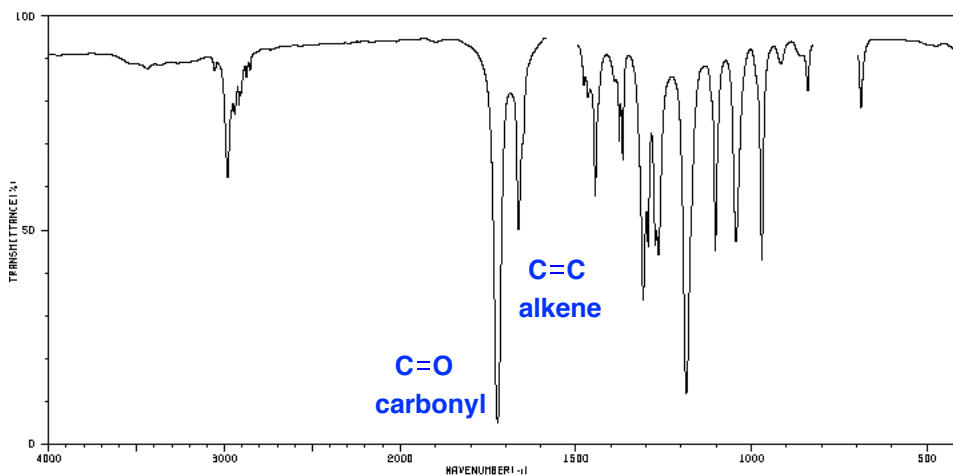
17. Give the major product for each of following reactions. Clearly indicate stereochemistry as necessary. (12 pts)



18. A molecule of formula $C_6H_{10}O_2$ has the following IR, 1H and ^{13}C NMR data. Provide a structure that is consistent with the data. *Please circle your final answer.* (10 pts)

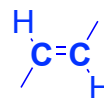
$C_6H_{10}O_2 = 2$ degrees of unsaturation

IR:



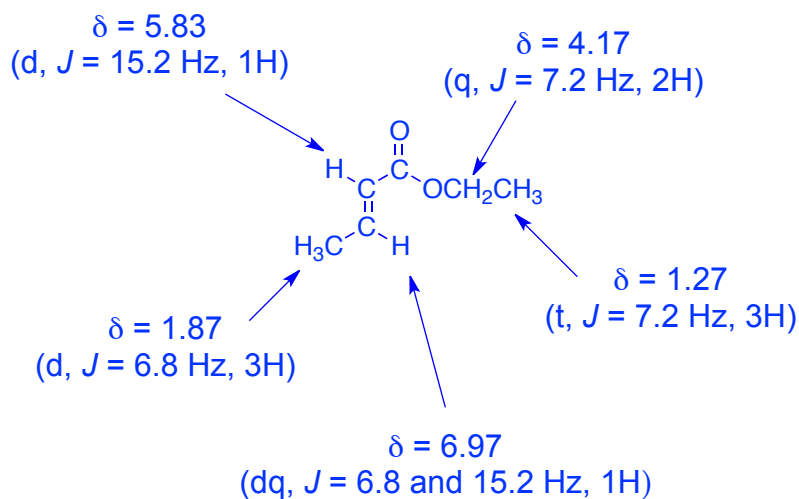
1H NMR :

- δ (ppm) = 6.97 (dq, $J = 6.8$ and 15.2 Hz, 1H), $=\underline{CH}-CH_3$ } 2 CH's in the vinyl region
 5.83 (d, $J = 15.2$ Hz, 1H), $-\underline{CH}=\underline{CH}$ } large J , *trans* alkene
 4.17 (q, $J = 7.2$ Hz, 2H), $-\underline{CH}_2-\underline{CH}_3$ }
 1.87 (d, $J = 6.8$ Hz, 3H), $-\underline{CH}-\underline{CH}_3$ } $-CH_2CH_3$
 1.27 (t, $J = 7.2$ Hz, 3H), $-\underline{CH}_2-\underline{CH}_3$ } (ethyl group)

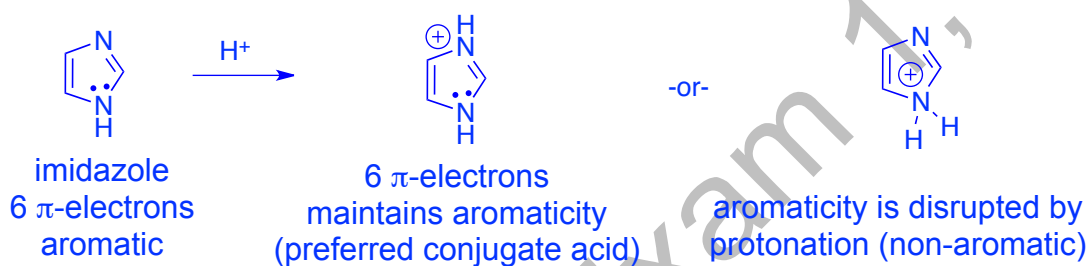
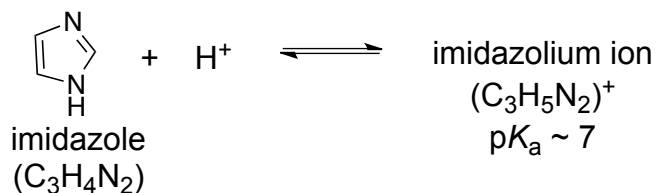


^{13}C NMR

- δ (ppm) = 170.0 ester carbonyl
 144.6
 123.0
 60.3
 18.1
 14.5



19. Imidazole has two potentially basic nitrogen atoms. Draw the preferred structure of the conjugated acid of imidazole (imidazolium ion). Briefly justify your answer. (8 pts)



Problem 1-15: _____ (60 pts)

16: _____ (10 pts)

17: _____ (12 pts)

18: _____ (10 pts)

19: _____ (8 pts)

Total out of 100: _____