Last Name_____ Seat No. _____

First Name_____ Lecture Section. _____A_____
(Please print your name)

PLEASE REMOVE LAST PAGE OF EXAM BEFORE PRINTING YOUR NAME ON THE BACK OF PAGE 6.
THERE ARE 7 PAGES TO THIS EXAM. CHECK TO MAKE SURE YOU HAVE A COMPLETE EXAM.

CHEMISTRY 331

EXAM V

Tuesday, December 4, 2007

I. (27 points) _____

II. (16 points) _____

III. (15 points) _____

IV. (24 points) _____

V. (12 points) _____

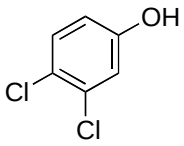
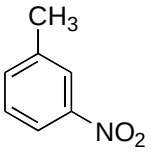
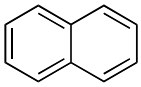
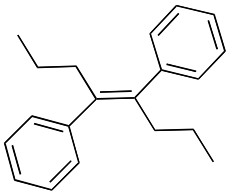
VI. (6 points) _____

_____

TOTAL (100 points) _____

The Final Exam is scheduled for Tuesday, December 11, from 7:00-9:00 P.M.

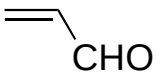
Ia. . Give the proper name for each including stereochemical designation when required. (12pts)

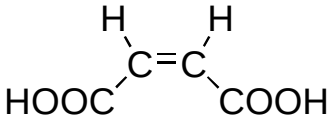
	
	

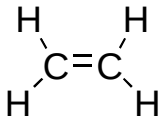
Ib. Write the structure for each of the following. (12pts)

m-dinitrobenzene	*p*-chloroaniline
pyrrole	2-bromophenol

Ic. Rank the following dienophiles (1, 2, 3 where 1 is the fastest), in order of increased reactivity in the Diels-Alder reaction. (3 pts)



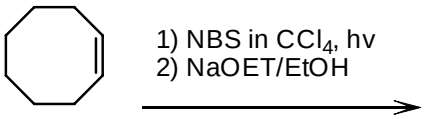




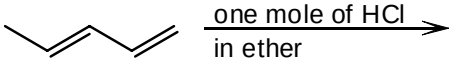
_____ _____ _____

IIa. Draw the product(s) of the following reactions. No stereochemistry required. (12 pts)

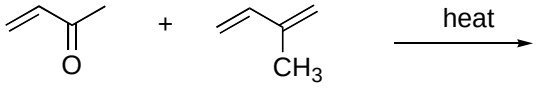
1)



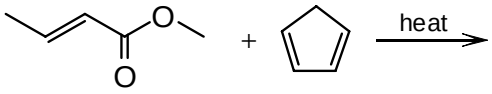
2)



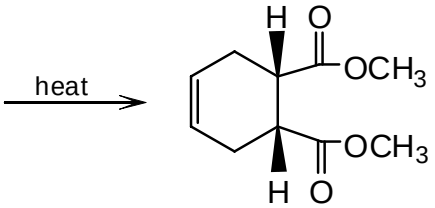
3)



4)

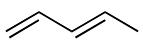


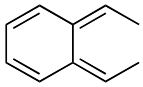
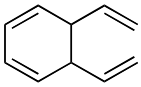
IIb. What dienophile and diene were used to prepare the following molecule? (4pts)



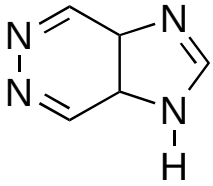
_____ + _____

IIIa. Circle the compound in each pair, which absorbs UV light at a longer wavelength. (4pts)

1)  or 

2)  or 

IIIb. Identify each molecule as aromatic or non-aromatic. (8pts)



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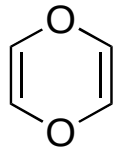

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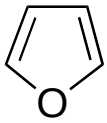

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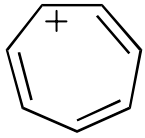

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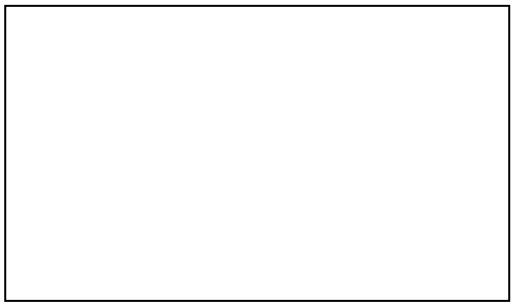
IIIc. The fundamental reaction of vision involves: (3pts)

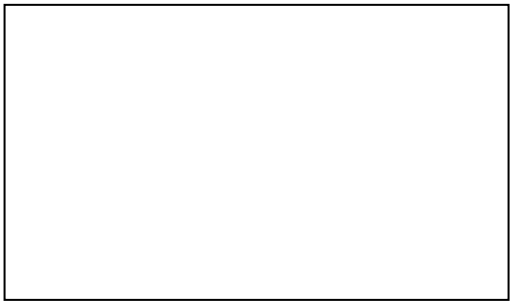
1. a Diels-Alder reaction.
2. The oxidation of vitamin A.
3. The reduction of β-carotene.
4. A cis-trans isomerization.

IV. In the box provided propose a structure consistent with each data set. (24pts)

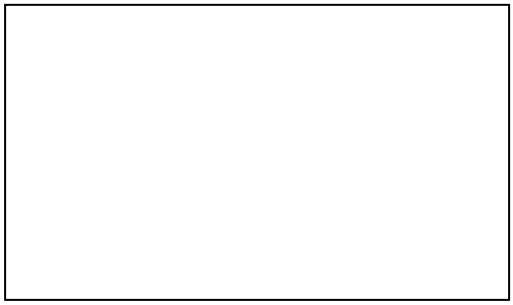
a) Molecular formula $C_8H_{10}O$.
IR absorption at 3150- 2850 cm^{-1}.
^1H NMR data: 7.3-6.8 (multiplet, 5H), 3.95 (quartet, 2H) ppm and1.4 (triplet, 3H) ppm.



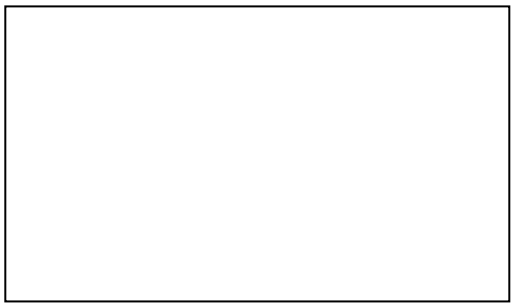
b) Molecular formula $C_5H_{10}O$
IR absorption at 1710-1740 cm^{-1}.
^1H NMR 2.55 (1H, septet), 2.10 (3H singlet), 1.05 (6H, doublet) ppm.
^{13}C NMR 212.6. 41.5, 27.2, 17.8 ppm.



c) Molecular formula $C_{10}H_{12}O$
IR absorption at 1710 cm^{-1}.
^1H NMR 7.2 ppm (5H, singlet), 3.6 (2H, singlet), 2.4 (2H, quartet), 1.0 (3H, triplet) ppm.



d) Molecular formula $C_6H_{14}O_2$
IR absorption at 3400 cm^{-1}.
^1H NMR 2.0 (2H, singlet), 1.2 (12H, singlet) ppm.



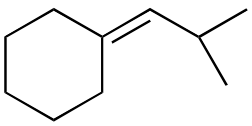
Va. In the box provided propose a structure consistent with each data set. (12pts)

a) Molecular formula $C_{10}H_{14}$
^{1}H NMR 7.0 (4H, singlet), 2.70 (4H, quartet), 1.20 (6H triplet) ppm.
^{13}C NMR 141.4, 127.8, 28.5, 15.7 ppm.

b) Molecular formula $C_{10}H_{14}$
^{1}H NMR 7.18 (4H, broad singlet), 2.85 (1H, septet), 2.28 (3H, singlet), 1.20 (6H doublet) ppm.
^{13}C NMR 145.8, 135.1, 128.9, 126.2, 33.7, 24.1, 20.9 ppm.

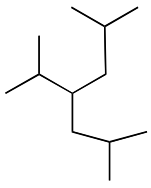
VI. How many signals are present in the broadband-decoupled ^{13}C NMR spectrum of: (6pts)

a)



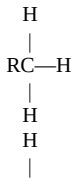
1) 7 2) 8 3) 9 4) 10

b)



1) 2 2) 3 3) 4 4) 6

CHARACTERISTIC PROTON CHEMICAL SHIFTS

Type of proton		Chemical shift δ,ppm
Cyclopropane		0.2
Primary		0.9
Secondary	$R_2C—H$	1.3
Tertiary	$R_3C—H$	1.5
Vinylic	C=C—H	4.6-5.9
Acetylenic	C≡C—H	2-3
Aromatic	Ar—H	6-8.5
Benzylic	Ar—C—H	2.2-3
Allylic	C=C—C—H	1.7
Fluorides	H—C—F	4-4.5
Chlorides	H—C—Cl	3-4
Bromides	H—C—Br	2.5-4
Iodides	H—C—I	2-4
Alcohols	H—C—OH	3.4-4
Ethers	H—C—OR	3.3-4
Esters	RCOO—C—H	3.7-4.1
Esters	H—C—COOR	2-2.2
Acids	H—C—COOH	2-2.6
Carbonyl compounds	H—C—C=O	2-2.7
Aldehyclic		9-10
Hydroxylic	RO—H	1-5.5
Phenolic	ArO—H	4-12
Enolic	C=C—O—H	15-17
Carboxylic	RCOO—H	10.5-12
Amino		1-5

DEPT 90 CH

DEPT 135 CH, CH_3 positive signal
CH_2 negative signal

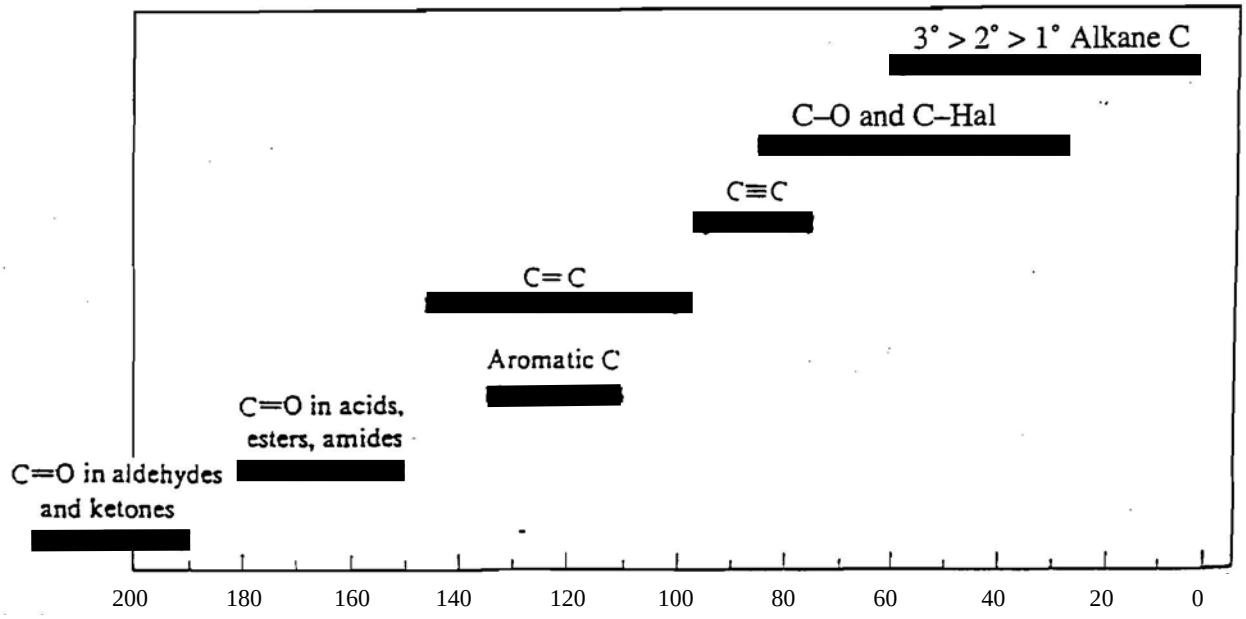
CHARACTERISTIC INFRARED ABSORPTION FREQUENCIES

Bond	Compound type	Frequency range, cm^{-1}
C—H	Alkanes	2850-2960 1350-1470
C—H	Alkenes	3020-3080 (*m*) 675-1000
C—H	Aromatic rings	3000-3100 (*m*) 675-870
C—H	Alkynes	3300
C=C	Alkenes	1640-1680 (*v*)
C≡C	Alkynes	2100-2260 (*v*)
C—C	Aromatic rings	1500, 1600 (*v*)
C—O	Alcohols, ethers, carboxylic acids, esters	1080-1300
C=O	Aldehydes, ketones, carboxylic acids, esters	1690-1760
O—H	Monomeric alcohols, phenols	3610-3640 (*v*)
	Hydrogen-bonded alcohols, phenols	3200-3600 (*broad*)
	Carboxylic acids	2500-3000 (*broad*)
N—H	Amines	3300-3500 (*m*)
C—N	Amines	1180-1360
C≡N	Nitriles	2210-2260 (*v*)
$—NO_2$	Nitro compounds	1515-1560 1345-1385

*All bands strong unless marked: *m*, moderate; *v*, variable.

Abbreviated Periodic Table

1A 1												3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
1 H 1.01	2A 2						8B			1B 11	2B 12						2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3	3B 3	4B 4	5B 5	6B 6	7B 7	8	9	10			13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8



Chemical shifts for ^{13}C in various kinds of compounds.