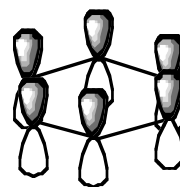


CHEMISTRY 341
Final Exam
Tuesday, December 16, 1997



Name _____

NAID _____

Problem 1 15 pts _____

Problem 2 5 pts _____

Problem 3 26 pts _____

Problem 4 10 pts _____

Problem 5 29 pts _____

Problem 6 25 pts _____

Problem 7 8 pts _____

Problem 8 8 pts _____

Problem 9 8 pts _____

Problem 10 21 pts _____

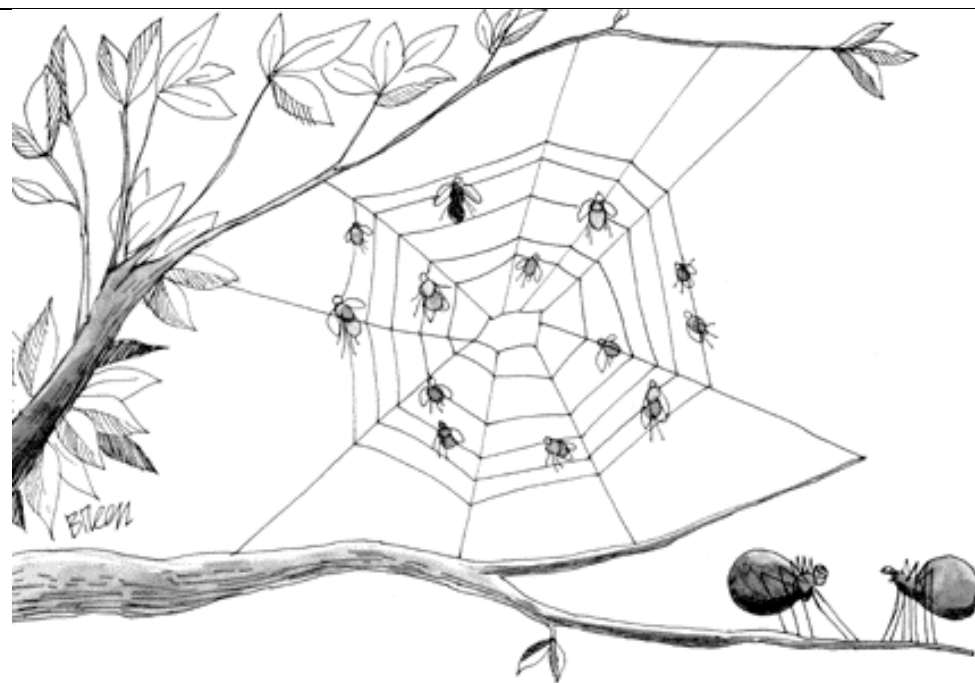
Problem 11 15 pts _____

Problem 12 6 pts _____

Problem 13 20 pts _____

given 4 pts 4

TOTAL 100 pts _____



"Terrific Web site, Carl!"

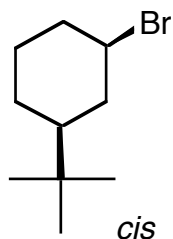
- 1) For the following pairs of compounds, check whether they are identical, constitutional isomers, enantiomers, or diastereomers. (15 points)

	Identical	Constitutional Isomer	Enantiomers	Diastereomers
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

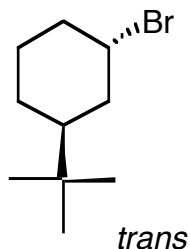
- 2) Draw the structure of meso-1,3-dichloro-1,3-dimethylcyclopentane. (5 points)



- 3) a) For each of the following 1-bromo-3-*tert*-butylcyclohexane diastereomers, draw the most stable chair conformation. (16 points)



most stable conformation



most stable conformation

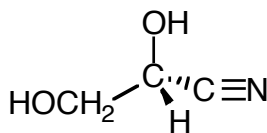
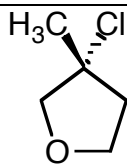
- b) Indicate which of the above isomers will undergo E2 elimination the fastest, and briefly explain your answer. (10 points)

The *cis* isomer

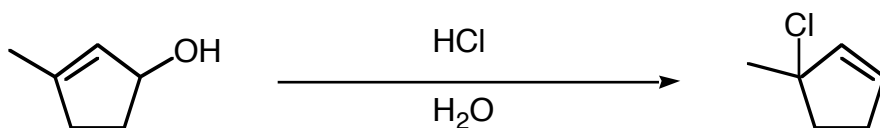
the *trans* isomer

explain:

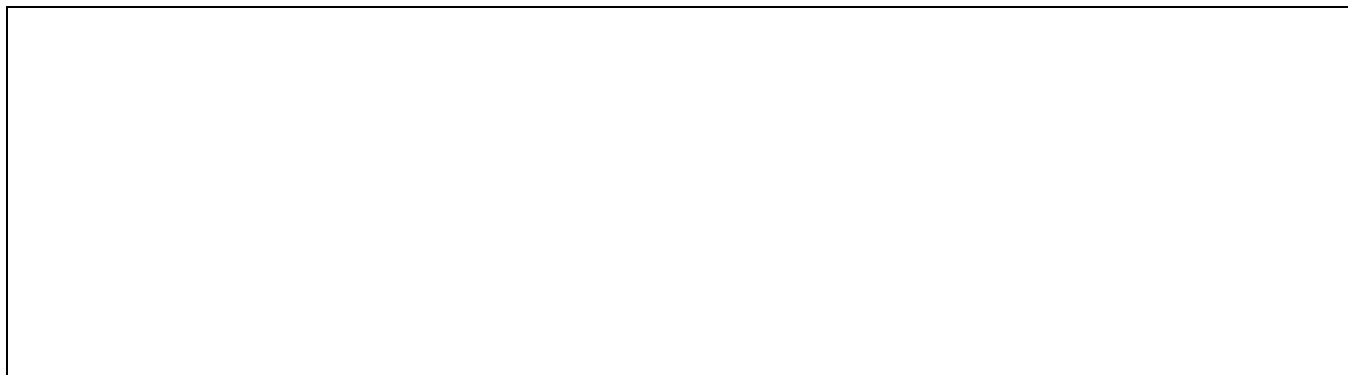
- 4) Determine whether the following molecules have the R or S configuration. (10 points)



- 5) 3-Methyl-2-cyclopenten-1-ol will undergo a substitution reaction when treated with HCl to give the more substituted 3° chloride as the major product.



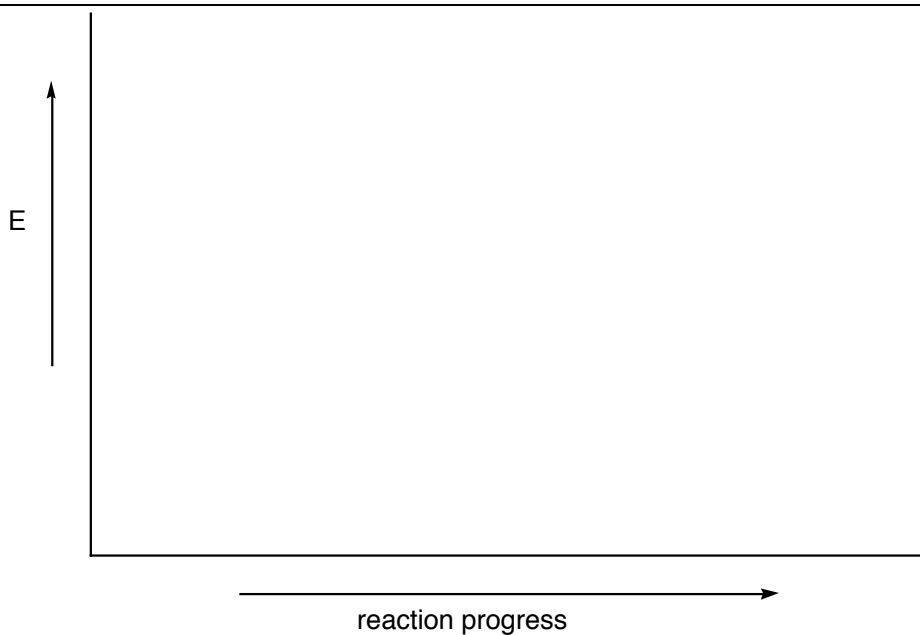
- a) Explain the origin of the product by drawing the structure of the intermediate involved in this reaction. (15 points)



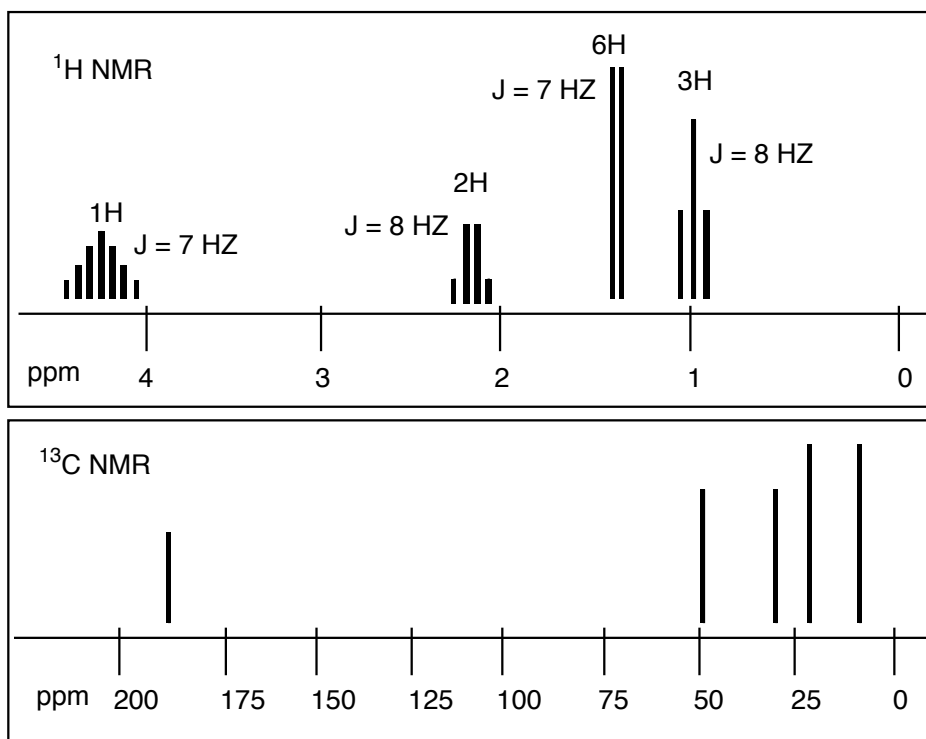
- b) Is this an example of an S_N1 or an S_N2 reaction? (4 points)



- c) Sketch the reaction diagram for this reaction, and indicate on the diagram where the intermediate lies and which step is rate determining. (10 points)



- 6) A molecule with the formula $C_6H_{12}O_2$ shows a characteristic Infrared absorption at 1735 cm^{-1} and the following NMR spectra. The proton spectra shows the peaks, the number of hydrogens that each resonance integrates for, and the coupling constant (J in Hz). The carbon spectrum shows 5 different carbons.



- a) Calculate the degrees of unsaturation in this molecule:
(5 points)

- b) What functional group does the IR absorption at 1735 cm^{-1} correspond to? (5 points)

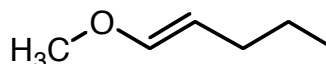
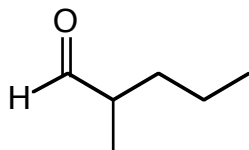
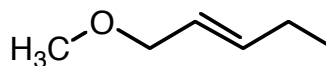
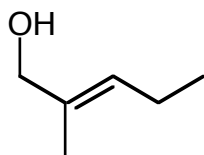


- c) Draw the structure of this molecule (partial credit will be given for correct "pieces" of the molecule if they match the NMR data). (15 points)

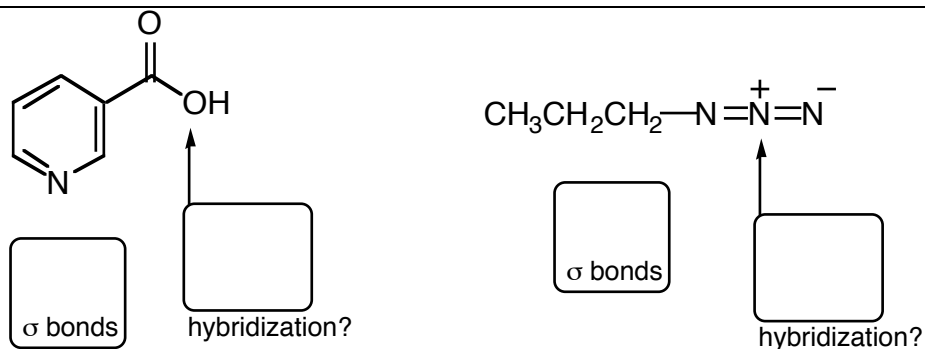


- 7) You are given a sample which contains one of the following constitutional isomers. The infrared spectrum shows C-H stretches at 3035 and 2910 cm^{-1} . There are no other strong absorptions. The mass spectrum shows the mass for the sample of $m/z = 100$. In addition, a large abundance of an ion at $m/z = 71$ also appears. Given this data, which of the following structures is the correct one (circle your answer). (8 points)

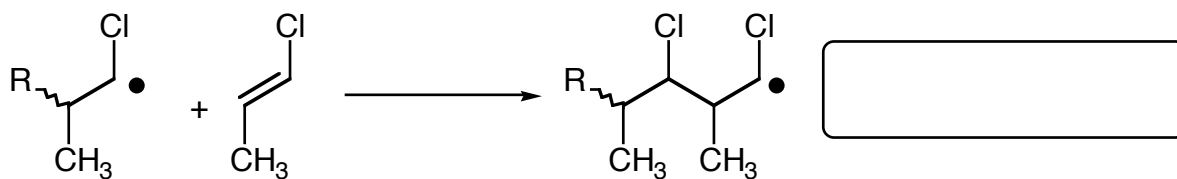
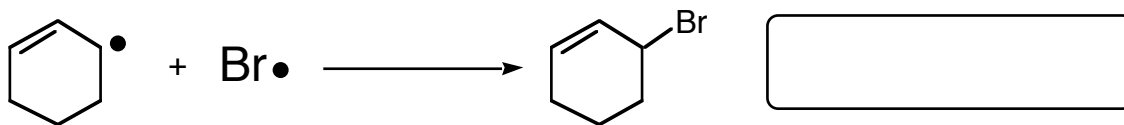
atomic mass: C - 12, H - 1, O - 16



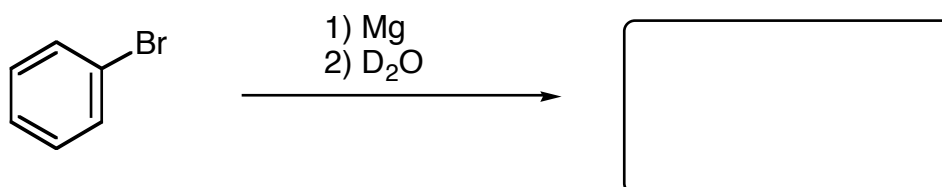
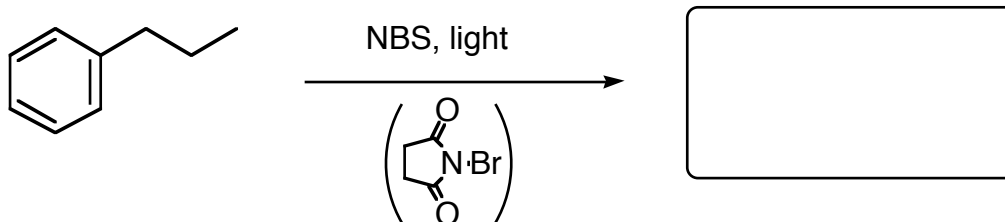
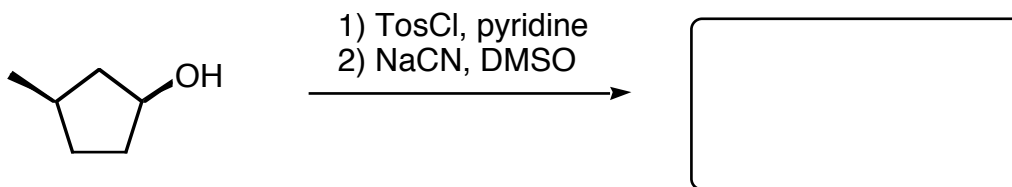
- 8) For the following compounds, determine the number of sigma bonds, and indicate the hybridization of the specified atoms. (8 points)

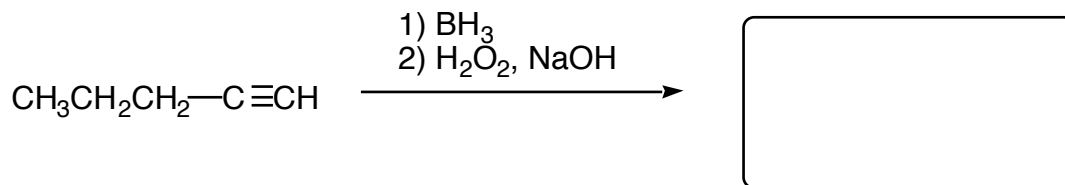
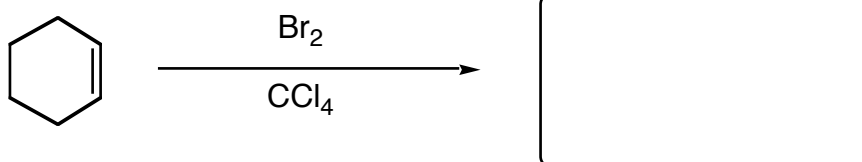
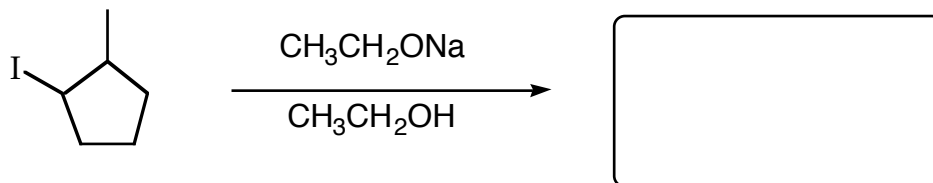


- 9) For the following free radical chain reaction steps, indicate whether it is an initiation, propagation, or termination step. (8 points)

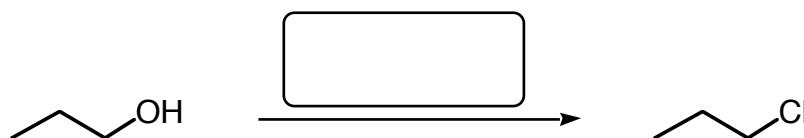
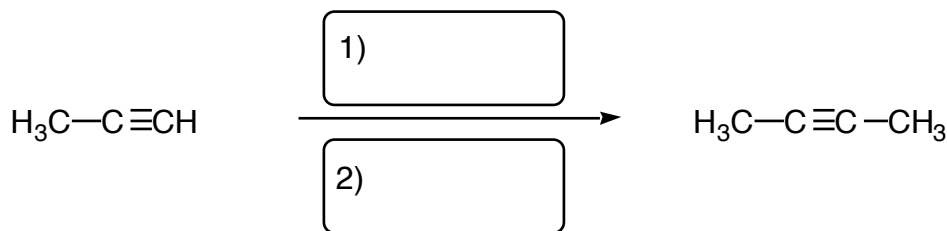
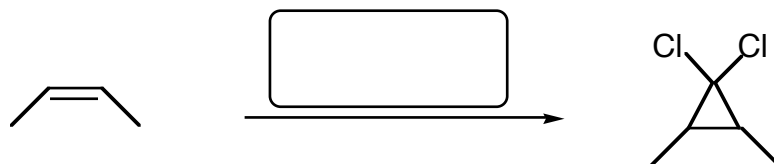


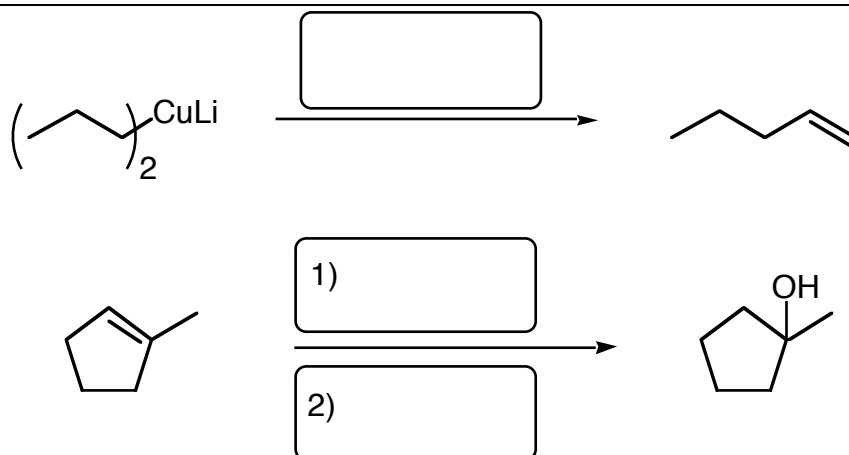
- 10) Draw the major organic product for the following reactions. Be sure to indicate stereochemistry where appropriate. (21 points)



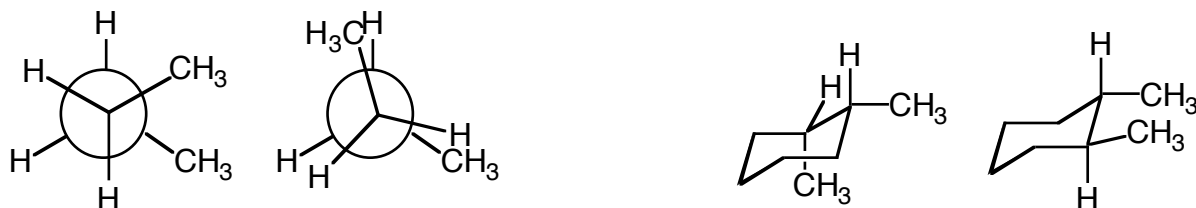


11) Provide the missing reagents for the following reactions. (15 points)

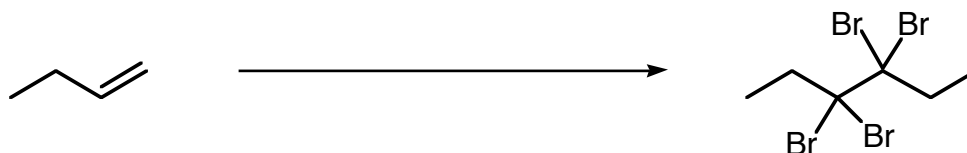




- 12) For the following pairs of molecules, indicate whether or not they are equal in energy. If not, circle the structure that is lowest in energy. (6 points)



- 13) Starting from 1-butene and any other reagents you need, show how you would synthesize 3,3,4,4-tetrabromohexane. Show all structures and reagents for each step. (20 points)



USEFULL DATA

Infrared Correlations:

C-H stretches:	alkanes	2850 - 2960 cm^{-1}	medium/strong
	alkenes	3020 - 3100 cm^{-1}	medium
	alkynes	3300 cm^{-1}	strong (sharp)
O-H stretch:	alcohols	3400 - 3650 cm^{-1}	broad/strong
C=O stretch:	carbonyl	1680 - 1750 cm^{-1}	strong
CC triple bond:	alkyne	2100 - 2260 cm^{-1}	medium
CN triple bond	nitrile	2210 - 2260 cm^{-1}	medium

 ^1H NMR Correlations:

C-H	(alkanes)	0.5 - 1.5 ppm
allylic	(adjacent to sp^2 carbon)	1.5 - 2.5 ppm
Y-C-H	(Y = O, N, Br, Cl, etc)	2.5 - 4.5 ppm
C=C-H	(alkenes)	4.5 - 6.5 ppm
sp^2 aromatic	(benzene rings)	6.5 - 8.0 ppm
O=C-H	(aldehydes)	9.5 - 10.0 ppm
CO_2H	(acids)	11.0 - 12.0 ppm

 ^{13}C NMR Correlations:

C	(alkanes)	10 - 60 ppm
Y-C	(Y = O, N, Br, Cl, etc)	40 - 80 ppm
C=C	(alkenes)	100 - 150 ppm
sp^2 aromatic	(benzene rings)	120 - 160 ppm
O=C-O	(esters)	175 - 200 ppm
O=CR ₂	(aldehydes, ketones)	200 - 220 ppm