Instructions: This is a closed book examination. You may not use any notes, books or external materials during the course of the examination. Please **print** your name and social security number on the front page of the examination. Print your name on the top of each page of the exam.

<u>Be sure to allot your time in a manner that is related to the</u> <u>point value of the question.</u> <u>Be sure to show your reasoning</u> <u>wherever possible for partial credit.</u>

Correlation tables for IR, 1H NMR and 13C NMR are attached to the last page of the exam.

All material to be graded must be on one of the pages of the exam. If you need more space than is available on the page with the questions, use the back page of the previous page and label the number of the question on that page.

Your Name: _____

Your Soc. Sec. Number: _____

Time of the exam: 50 minutes.

Question 1:	10 points
Question 2:	10 points
Question 3:	20 points
Question 4:	20 points
Question 5:	30 points
Question 6:	10 Points

Total: 100 Points

1. (<u>10 Points</u>) Consider the two tertiary bromides, A and B. One of these bromides is very reactive to elimination under basic conditions and is also reactive to nucleophilic substitution under acidic conditions, while the other is completely inert to both elimination and substitution under the same conditions. Which bromide, A or B, is inert and why?



2. (10 Points) Circle the compound in each of the following pairs that react with NaI in acetone at the fastest rate. Explain your reasoning for full credit.

(a) 1-chlorohexane or cyclohexyl chloride

(b) 1-bromopentane or 1-fluoropentane

3. (20 points). Give the structural relationship between the following pairs of structures as one of the following (a) constitutional isomers, (b) enantiomers, (c) diastereomers or (d) identical.



4. (20 Points). Draw a Lewis structure consistent with the following NMR spectra and molecular compositions.

(a) Molecular composition C_8H_{18} ; 1H NMR consists of a singlet at = 0.9 ppm

(b) Molecular composition C_8H_8 ; 1H NMR consists of a singlet at = 5.8 ppm

(c) Molecular composition $C_2H_3Cl_3$; 1H NMR consists of a singlet at = 2.7

(d) Molecular composition C_3H_5Br ; ¹³C NMR consists of three signals at = 33 ppm (triplet), = 118 ppm (triplet) and = 134 ppm (doublet).

(e) Molecular composition C_3H_5Br ; ¹³C NMR spectrum consists of two signals at = 12 ppm (triplet) and 17 ppm (doublet).

5. (30 Points. 10 Points for each spectrum) Suggest a structure that is consistent with the IR, 1H NMR and 13C NMR spectra shown on the following pages for the molecular compositions $A = C_5H_{10}O$, $B = C_6H_{10}$ and $C = C_5H_{12}O$. Indicate briefly how each structure is consistent with each spectra. The number of protons responsible for each signal is indicated under or next to the signal on the spectrum.

The suggested structure for A is



My reasoning for suggesting the struture for A:

The suggested structure for B is



My reasoning for suggesting the structure of B is

The suggested structure for C is



My reasoning for suggesting the structure of C is

6. (10 Points) From your knowledge of the theory of signal intensities in infrared spectroscopy, predict whether the symmetric or the antisymmetric stretch of carbon dioxide will be more intense in the infrared spectrum of this molecule. Indicate your reasoning.

0=c=0	0 = c = 0
\leftarrow \rightarrow	\rightarrow \rightarrow
Symmetric	Antisymmetric