1) (6pts) Assign (R) or (S) to all the chiral centers in the following molecules.

(a) \[ \text{Cl} \quad \text{OH} \quad \text{CH}_3 \]

(b) \[ \text{Br} \quad \text{Br} \]
\[ \text{H} \quad \text{Cl} \quad \text{CF}_3 \]

(c) \[ \text{OH} \quad \text{HO} \quad \text{CH}_2 \]

2) (12pts) Name these C₄H₈ isomers in IUPAC form.

3) (4pts) Indicate which one of the alkenes in (2) is the most stable, and also indicate which is the least stable.
4) (12pts) The following compound is the active ingredient in the eye medicine “Clear Eyes”, as advertised on TV by Ben Stein.

\[
\begin{align*}
\text{HN} & \quad \text{N} \\
\text{I} & \quad \text{I} \\
\end{align*}
\]

a) How many Hydrogens are in this molecule?
b) How many Carbons?
c) How many sp\(^2\) hybridized Carbons?
d) How many \(\pi\) bonds?
e) How many chiral centers?
f) How many lone pairs (non-bonded pairs) of electrons?

5) (10pts) For each threesome of molecules, circle the one which will undergo SN1 type reactions the quickest.

(a) \[
\begin{align*}
\text{I} & \quad \text{CH}_2\text{I} & \quad \text{CH}_3 \\
\end{align*}
\]

(b) \[
\begin{align*}
\text{Br} & \quad \text{Br} \quad \text{CH}_2\text{Br} \quad \text{CH}_3 \text{Br} \\
\end{align*}
\]

(c) \[
\begin{align*}
\text{F} & \quad \text{Br} & \quad \text{Cl} \\
\end{align*}
\]

(d) \[
\begin{align*}
\text{Br} & \quad \text{Br} & \quad \text{Br} \\
\end{align*}
\]

(e) \[
\begin{align*}
\text{CH}_2\text{F} & \quad \text{F} & \quad \text{F} \\
\end{align*}
\]
6) (8pts) Write a mechanism (i.e. curly arrows) for this E2 elimination.

\[ \text{Br} \quad \text{K}^+\text{-OtBu} \rightarrow \quad \text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_3 \]

7) (9pts) Write a mechanism (i.e. curly arrows) for this E1 elimination.

\[ \text{Br} \quad \text{CH}_3\text{OH} \rightarrow \quad \text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_3 \]
8)  (7pts) The below enantiomer undergoes $S_N2$ reaction with sodium ethoxide.

\[
\begin{align*}
\text{H}_3\text{C} & \quad \text{CH}_3\text{CH}_2\text{O}^+\text{Na}^+ \\
\text{F}_3\text{C} \quad \text{Br} & \quad \text{S}_N2
\end{align*}
\]

(i)  Draw the product or products.

(ii) Will the product of this reaction be totally (R), totally (S) or a mixture of both?

(iii) If three times as much nucleophile was added, what would happen to the rate of this reaction?
9) (22pts) i) Give the products formed in the following transformations of the below cyclic alkene, paying attention to stereo- and regio-chemistry where relevant.

- **H-Cl**
- **H-Br**
- **RO-OR**
- **OsO₄**
- **H₂O₂**
- **Br₂**

1) CH₃CO₃H
2) H₃O⁺

ii) How many of these 6 transformations give *Markovnikov* products?

iii) How many of these 6 transformations are pure *anti additions*?
10) (10pts) Write the mechanism for either the H-Cl addition OR the HBr/Peroxides addition in (9), and briefly explain why the reaction is regioselective.
Fall 07 Exam 2  Chapters 5-8  100 points

Name  
M.T. ROSE O'SEATS

If you do not want your graded exam placed in the box outside my office, then please tick here_____

Answer all the questions.

1) (6pts) Assign (R) or (S) to all the chiral centers in the following molecules.

(a) 

(b) 

(c) 

2) (12pts) Name these C₄H₈ isomers in IUPAC form.

\[
\begin{align*}
\text{Z-2-BUTENE} & \quad \text{METHYLPENTANE} & \quad \text{1-BUTENE} & \quad \text{E-2- BURANE} \\
\end{align*}
\]

3) (4pts) Indicate which one of the alkenes in (2) is the most stable, and also indicate which is the least stable.
4) (12pts) The following compound is the active ingredient in the eye medicine “Clear Eyes”, as advertised on TV by Ben Stein.

![Chemical structure]

a) How many Hydrogens are in this molecule? 14
b) How many Carbons? 14

c) How many sp² hybridized Carbons? 11

d) How many π bonds? 6

e) How many chiral centers? 0

f) How many lone pairs (non-bonded pairs) of electrons? 2

5) (10pts) For each threesome of molecules, circle the one which will undergo SN1 type reactions the quickest.

(a) ![Molecules]

(b) ![Molecules]

(c) ![Molecules]

(d) ![Molecules]

(e) ![Molecules]
6) (8pts) Write a mechanism (i.e. curly arrows) for this **E2** elimination.

![E2 mechanism diagram]

7) (9pts) Write a mechanism (i.e. curly arrows) for this **E1** elimination.

![E1 mechanism diagram]
8) (7 pts) The below enantiomer undergoes $S_N2$ reaction with sodium ethoxide.

(i) Draw the product or products.

(ii) Will the product of this reaction be totally (R), totally (S) or a mixture of both?

SINGLE ENANTIOMER ($S_N2$ = stereospecific): Inversion: Totally R.

(iii) If three times as much nucleophile was added, what would happen to the rate of this reaction?

$S_N2$ Rate = $k [\text{substrate}] [\text{nucleophile}]

Therefore, increase $x3$
9) (22pts) i) Give the products formed in the following transformations of the below cyclic alkene, *paying attention to stereo- and regio-chemistry where relevant.*

ii) How many of these 6 transformations give *Markovnikov* products? 

iii) How many of these 6 transformations are pure *anti additions*? 

ONE

TWO
10) (10pts) Write the mechanism for either the H-Cl addition OR the HBr/Peroxides addition in (9), and briefly explain why the reaction is regioselective.

Protonation of the π bond could generate two cations. Only the more stable cation (more highly allyl substituted) is formed. The chloride anion then reacts with the cation to give the addition product.

The dilaIlyl peroxide breaks apart to generate two radicals, which abstract a hydrogen atom from HBr to produce a Br radical. The radical adds to the double bond to produce the more stable radical (i.e. 3° vs. 2°). This radical then abstracts a hydrogen from HBr to give the product.