Fall 06 Exam 2 Chapters 5-8

Name

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) 
\[ \begin{array}{c}
\text{Cl} \\
\text{HO} \\
\text{\textbullet} \\
\text{F} \\
\text{CH}_3
\end{array} \]

(b) 
\[ \begin{array}{c}
\text{CO}_2\text{H} \\
\text{Cl} \\
\text{H} \\
\text{H} \\
\text{CF}_3
\end{array} \]

(c) 
\[ \begin{array}{c}
\text{F} \\
\text{H} \\
\text{F} \\
\text{\textbullet} \\
\text{Cl} \\
\text{CH}_2
\end{array} \]

2) (4pts) Within +/- 5kcal/mol, what is a typical bond strength value for:

   a C-C \( \sigma \) bond?

   an alkene \( \pi \) bond?

3) (12pts) Name these compounds IUPAC form.

\[ \begin{array}{c}
\text{CH}_3 \\
\text{\textbullet} \\
\text{CH}_3 \\
\text{\textbullet} \\
\text{\textbullet}
\end{array} \]
4) (12pts) Draw the 6 different **alkene** isomers of \( \text{C}_5\text{H}_{10} \).

*\textbf{BONUS}\*
*\textit{There is a bonus 3 points for anyone who can draw a \textit{chiral} isomer of C}_5\text{H}_{10} \textit{which has zero }\pi\textit{ bonds.}*

5) (10pts) For each set of molecules, circle the one which will undergo \( \text{SN}1 \) type reactions the quickest.

(a) \( \begin{align*} &\text{Br} \\
&\text{Br} \\
&\text{Br} \end{align*} \)

(b) \( \begin{align*} &\text{CH}_3 \\
&\text{F} \\
&\text{Cl} \end{align*} \)

(c) \( \begin{align*} &\text{Br} \\
&\text{Br} \\
&\text{Br} \end{align*} \)

(d) \( \begin{align*} &\text{CH}_2\text{F} \\
&\text{F} \\
&\text{CH}_2\text{F} \end{align*} \)

(e) \( \begin{align*} &\text{Br} \\
&\text{Br} \\
&\text{Br} \end{align*} \)
6) (6pts) Write a mechanism (i.e. curly arrows) for this E2 elimination.

\[
\begin{align*}
\text{Br} & \quad \text{K}^+ \cdot \text{OCH}_3, \text{CH}_3\text{OH} & \quad \text{alkene} \\
\end{align*}
\]

7) (2pts) Draw another possible elimination product which could be formed in small amounts in this reaction.

8) (9pts) Draw and label an Energy Level Diagram for a typical S_N1 reaction which is slightly exothermic.
9) The below dibromide has two chiral centers:

i) (4pts) assign $R$ or $S$ to each chiral center.

ii) (2pts) is this molecule chiral?

iii) (3pts) draw the alkene which would react with Bromine to generate this product.
10) (15pts) Give the products formed in the following transformations of the below cyclic alkene, *paying attention to stereo- and regio-chemistry where relevant.*

![Diagram of cyclic alkene transformations with reactions involving OsO4, H2O2, CH3CO3H, I2, H2, Pt, Cl2, H2O]

11) (7pts) Provide a mechanistic explanation for the observation that when an alkene reacts in an *electrophilic addition* reaction, that a *carbocation* intermediate is formed when the alkene reacts with HBr, but a *bromonium ion* intermediate is formed when the same alkene reacts with Br2.
12) (8pts) Write the mechanism for either of the ANTI additions reactions in Q (10).
1) (6pts) Assign (R) or (S) to all the chiral centers in the following molecules.

(a) 
(b) 
(c) 

2) (4pts) Within +/- 5kcal/mol, what is a typical bond strength value for:
   a C-C σ bond? 83kcal/mol
   an alkene π bond? 63kcal/mol

3) (12pts) Name these compounds IUPAC form.

3-methyl-1-butene
2,3-dimethyl-2-butene
Z-2-butene
methylpropane
4) (12pts) Draw the 6 different alkene isomers of C₅H₁₀.

*BONUS*
There is a bonus 3 points for anyone who can draw a chiral isomer of C₅H₁₀ which has zero π bonds.

5) (10pts) For each set of molecules, circle the one which will undergo S_N1 type reactions the quickest.

(a) Br-CH₂CH₂CH₂CH₃  Br-CH₂CH₂CH₃  Br-CH₂CH₂CH₂CH₃

(b) Br-C₅H₄  Br-C₅H₄  Br-C₅H₄

(c) Br-CH₂CH₂CH₂CH₃  Br-CH₂CH₂CH₂CH₃  Br-CH₂CH₂CH₂CH₃

(d) Br-C₅H₄  Br-C₅H₄  Br-C₅H₄

(e) Br-C₅H₄  Br-C₅H₄  Br-C₅H₄
6) (6pts) Write a mechanism (i.e. curly arrows) for this E2 elimination.

\[
\begin{align*}
\text{Br} & \quad \text{K}^+ \cdot \text{OCH}_3, \text{CH}_3\text{OH} & \quad \text{H}_2\text{C} = \text{CH} \cdot \text{CH}_2 \\
\end{align*}
\]

7) (2pts) Draw another possible elimination product which could be formed in small amounts in this reaction.

8) (9pts) Draw and label an Energy Level Diagram for a typical S_N1 reaction which is slightly exothermic.
9) The below dibromide has two chiral centers:

i) (4pts) assign R or S to each chiral center.

ii) (2pts) is this molecule chiral?

   NO (meso cpd)

iii) (3pts) draw the alkene which would react with Bromine to generate this product.

   only the E or TRANS alkene would give that product.
10) (15pts) Give the products formed in the following transformations of the below cyclic alkene, paying attention to stereo- and regio-chemistry where relevant.

11) (5pts) Provide a mechanistic explanation for the observation that when an alkene reacts in an electrophilic addition reaction, that a carbocation intermediate is formed when the alkene reacts with HBr, but a bromonium ion intermediate is formed when the same alkene reacts with Br₂.
12) (8pts) Write the mechanism for either of the ANTI additions reactions in Q (10).