Exam 3. Chapters 9-13

Answer all the questions.

1) Give the products (if any !!) formed in the following reactions: (10 pts)

(a) \( \text{H}_3\text{C} = \text{C} \equiv \text{H} \xrightarrow{1) \text{NaNH}_2} \xrightarrow{2) \text{CH}_3\text{Br}} \)

(b) \( \text{H}_3\text{C} = \text{C} \equiv \text{CH}_3 \xrightarrow{1) \text{NaNH}_2} \xrightarrow{2) \text{CH}_3\text{Br}} \)

(c) \( \text{H} = \text{C} \equiv \text{H} \xrightarrow{1) 2 \text{NaNH}_2} \xrightarrow{2) 2 \bigtriangleup} \xrightarrow{3) \text{H}_3\text{O}^+} \)

2) Draw curly arrows to show the mechanism of the following elimination reaction, and draw the final product. (Hint: the product only shows a single \(^1\)H NMR resonance). (10pts)

\( \text{H}_3\text{C} - \text{CH}_3 \xrightarrow{\text{Excess KOH}} \text{Heat} \)
3) Give reagents to do each of the following transformations. (6pts)

\[ \text{H}_3\text{C} - \text{C} = \text{C} - \text{CH}_3 \rightarrow \text{H}_3\text{C} - \text{CH} = \text{CH}_3 \]

3b) Label the two products as either E or Z. (2pts)

4) Name (in IUPAC form) the following two compounds. (6pts)

\[ \text{H} - \text{C} = \text{C} - \text{CH}_2\cdot\text{C} - \text{CH}_3 \]

\[ \text{H}_3\text{C} - \text{C} = \text{C} - \text{CH} - \text{CH}_3 \]

4b) Outline a simple chemical test which would allow you to distinguish between these two isomers. (4pts)

4c) How many different signals would each isomer give in a \(^1\text{H}\) NMR spectrum? (6pts)
5) The addition of one equivalent of HBr to the following alkyne gives only one product (regio-isomer). Write the mechanism of this addition reaction, and explain why only one product is observed.

(10pts)

\[ \ce{H_3C-C≡C-H + HBr → H_3C-C≡C-Br} \]

6) For the following alkyne, identify the hybridization of every carbon atom.

(6pts)

\[ \ce{\text{H}_3\text{C-C≡C-CH}+\text{CH}_3} \]
7) Name (in IUPAC form) the following molecules:
(8pts)

8) Explain why phenol is $10^8$ times more acidic than cyclohexanol.
(12pts)
9) Give reagents for the following transformations. (12pts)

(a) \[
\begin{array}{c}
\text{I} \\
\text{I}
\end{array} 
\xrightarrow{\text{reagents}} \begin{array}{c}
\text{D} \\
\text{D}
\end{array}
\]

(b) \[
\begin{array}{c}
\text{CH}_2\text{OH} \\
\text{CH}_2\text{OH}
\end{array} 
\xrightarrow{\text{reagents}} \begin{array}{c}
\text{CH}_2\text{OH} \\
\text{CH}_2\text{OH}
\end{array}
\]

(c) \[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array} 
\xrightarrow{\text{reagents}} \begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]

10) Draw the products of the following transformations. (8pts)

(a) \[
\begin{array}{c}
\text{OH} \\
\text{OH}
\end{array} 
\xrightarrow{\text{Pyridine, Ts-Cl}} \begin{array}{c}
\text{OH} \\
\text{OH}
\end{array}
\]

1) Pyridine, Ts-Cl

2) \text{NH}_3

(b) \[
\begin{array}{c}
\text{OH} \\
\text{OH}
\end{array} 
\xrightarrow{\text{Pyridine, Ts-Cl}} \begin{array}{c}
\text{OH} \\
\text{OH}
\end{array}
\]

1) Pyridine, Ts-Cl

2) \text{Na}^+\text{C}=\text{CH}
Exam 3. Chapters 9-13

Name: Simon Tupid

Answer all the questions.

1) Give the products (if any !!) formed in the following reactions:
(10 pts)

(a) \( \text{H}_3\text{C} \equiv \text{C} \equiv \text{C} \equiv \text{H} \)  
   1) \( \text{NaNH}_2 \)  
   2) \( \text{CH}_3\text{Br} \)  
   \( \text{H}_3\text{C} \equiv \text{C} \equiv \text{C} \equiv \text{CH}_3 \)

(b) \( \text{H}_3\text{C} \equiv \text{C} \equiv \text{C} \equiv \text{CH}_3 \)  
   1) \( \text{NaNH}_2 \)  
   2) \( \text{CH}_3\text{Br} \)  
   \( \text{No Reaction} \)

(c) \( \text{H} \equiv \text{C} \equiv \text{H} \)  
   1) 2 \( \text{NaNH}_2 \)  
   2) 2 \( \Delta \)  
   3) \( \text{H}_2\text{O}^+ \)  
   \( \text{HO}^\text{-} \equiv \text{C} \equiv \text{C} \equiv \text{L-OH} \)

2) Draw curly arrows to show the mechanism of the following elimination reaction, and draw the final product. (Hint: the product only shows a single \(^1\text{H}\) NMR resonance).
(10pts)

\[ \begin{array}{c}
\text{H}_3\text{C} \equiv \text{C} \equiv \text{C} \equiv \text{H} \\
\text{Br} \quad \text{H} \\
\text{H} \quad \text{Br} \\
\text{H}_3\text{C} \equiv \text{C} \equiv \text{C} \equiv \text{CH}_3 \\
\text{Excess KOH} \\
\text{Heat} \\
\text{single \(^1\text{H}\) NMR resonance}
\end{array} \]
3) Give reagents to do each of the following transformations.
(6pts)

3b) Label the two products as either E or Z.
(2pts)

4) Name (in IUPAC form) the following two compounds.
(6pts)

4b) Outline a simple chemical test which would allow you to distinguish between these two isomers.
(4pts)

4c) How many different signals would each isomer give in a $^1$H NMR spectrum?
(6pts)
5) The addition of one equivalent of HBr to the following alkyne gives only one product (regio-isomer). Write the mechanism of this addition reaction, and explain why only one product is observed.

\[ \text{H}_3\text{C} \equiv \text{C} - \text{H} \quad \text{HBr} \rightarrow \text{H}_3\text{C} \equiv \text{C} - \text{H} \quad \text{more stable, highly substituted carbocation} \]

\[ \text{H}_3\text{C} \quad \text{H} \quad \text{Br} \]

Gives \[ \text{H}_3\text{C} \quad \text{C} \equiv \text{C} - \text{H} \quad \text{H}_3\text{C} \equiv \text{C} - \text{H}_2 \quad \text{Br} \]

Not \[ \text{H}_3\text{C} \equiv \text{C} \quad \text{H} \quad \text{H}_3\text{C} \quad \text{C} \equiv \text{C} \quad \text{H}_2 \quad \text{Br} \]

6) For the following alkyne, identify the hybridization of every carbon atom.

(6pts)

\[ \text{H}_3\text{C} \equiv \text{C} - \text{CH} - \text{CH}_3 \quad \text{sp} \]

\[ \text{sp}^3 \quad \text{sp}^3 \]
7) Name (in IUPAC form) the following molecules: (8pts)

- 2-methyl-1-propanol
- 3-Fluorophenol

8) Explain why phenol is $10^8$ times more acidic than cyclohexanol. (12pts)

No resonance forms.
9) Give reagents for the following transformations.
(12pts)

(a) \[
\text{CH}_2\text{CH}_2\text{I} \xrightarrow{\text{Mg}} \xrightarrow{\text{D}_2\text{O}} \text{CH}_2\text{CH}_2\text{D}
\]

(b) \[
\text{CH}_3\text{CH}_2\text{CO}_2\text{H} \xrightarrow{\text{LiAlH}_4} \text{CH}_3\text{CH}_2\text{OH}
\] (LiAlH$_4$ not strong enough!)

(c) \[
\text{CH}_2\text{O} \xrightarrow{\text{NaBH}_4} \text{CH}_2\text{O}
\] (LiAlH$_4$ would react with the ester!)

10) Draw the products of following transformations.
(8pts)

(a) \[
\text{CH}_2\text{OH} \xrightarrow{1) \text{Pyridine, Ts-Cl}} \text{CH}_2\text{NH}_2
\] 2) \text{NH}_3

(b) \[
\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{1) \text{Pyridine, Ts-Cl}} \text{CH}_2\text{CH}_2\text{CH}=\text{CH}
\] 2) \text{Na}^+\text{C}=\text{CH}