Exam 3 Fall 99 Chapters 9-13

Name

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Answer all the questions.

1) Give the products formed in the following reactions: (7pts)

(a) \[ \text{Ph}-\text{C}≡\text{C}-\text{H} \xrightarrow{1) \text{NaNH}_2} \xrightarrow{2) \text{CH}_3\text{CH}_2\text{CH}_2\text{Br}} \]

(b) \[ \text{H}_3\text{C}-\text{C}≡\text{C}-\text{CH}_3 \xrightarrow{1 \text{ equiv. H}_2, \text{ Lindlar's catalyst}} \]

(c) \[ \text{C}_6\text{H}_{11}\text{OH} \xrightarrow{\text{PBr}_3} \]

2) Draw curly arrows to show the mechanism of the following reaction. (8pts)

\[ \text{H}_3\text{C} \quad \text{H} \quad \text{CH}_3 \xrightarrow{\text{H}_2\text{SO}_4} \quad \text{H}_3\text{C} \quad \text{H} \quad \text{CH}_3\text{OH} \quad \xrightarrow{+ \text{H}_2\text{O}} \quad \text{CH}_2\text{CH}_3 \]
3) Give an applicable name that describes the reaction in Q2. (2pts)

4) Bearing in mind your alkene reaction chapter, is this reaction a **reversible** reaction? (2pts)

5) Briefly describe what can be done experimentally to this reaction to guarantee the maximum conversion of alcohol to alkene. (3pts)

6) Give the product in the following transformation. (4pts)

\[ \text{OH} \xrightarrow{1\text{) Tos-Cl, Pyridine}} \xrightarrow{2\text{) LiAlH}_4} \]

7) Why do we need to form the tosylate in the first place? (2pts)

8) Could NaBH\(_4\) be used instead of LiAlH\(_4\)? (2pts)

9) Name (in IUPAC form) the following two compounds. (10pts)

\[ \text{OH} \quad \text{Br} \quad \text{OH} \]

\[ \text{OH} \quad \text{O} \]
10) The addition of one equivalent of HF 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)

\[
\text{H-C=CH}_{2}\text{CH}_{2}\text{CH}_{3} + \text{HF} \rightarrow \text{H-C=CH}_{3}\text{CH}_{2}\text{CH}_{2}\text{CH}_{3}
\]

11) For the following alkyne and alcohol, identify the hybridization of each individual carbon atom. (12pts)

\[
\text{CH}_{3}\text{CH}_{2}\text{CH}_{2}-\text{C=CH}-\text{CH}_{3} \quad \text{CH}_{3} \quad \text{OH}
\]
12) Alcohols are weak acids, circle the stronger acid of each pair: (4pts)

a) CF₃CH₂OH
   CH₃CH₂OH

b) 

13) Explain why the tosylate anion is such a good leaving group. (10pts)

H₃C−SO₃⁻

tosylate anion
14) Give reagents for 4 of the following transformations. (if you do all 5, I just grade the 1st 4) (16pts).

(a) \[ \text{I} \rightarrow \text{CH}_2\text{OH} \]

(b) \[ \text{OH} \rightarrow \text{C}=\text{O} \]

(c) \[ \text{HO} \rightarrow \text{OH} \]

(d) \[ \text{OH} \rightarrow \text{C}=\text{O} \]

(e) \[ \text{HO} \rightarrow \text{OH} \]

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

(a) \[ \text{OH} \rightarrow \text{1) Pyridine, Tos-Cl} \]
\[ \text{2) NH}_3 \]

(b) \[ \text{OH} \rightarrow \text{1) Pyridine, Tos-Cl} \]
\[ \text{2) Na}^+\text{C}=\text{CH} \]
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Answer all the questions.

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

1. \[ \text{Ph-} \text{C}=\text{C-H} \xrightarrow{1) \text{NaNH}_2} \xrightarrow{2) \text{CH}_3\text{CH}_2\text{CH}_2\text{Br}} \text{Ph-} \text{C}=\text{C}-\text{CH}_2\text{CH}_2\text{CH}_3 \]

2. \[ \text{H}_3\text{C-} \text{C}=\text{C-} \xrightarrow{\text{1 equiv. } H_2, \text{ Lindlar's catalyst}} \text{H}_3\text{C-} \text{C}=\text{C-} \]

3. \[ \text{C}_6\text{H}_{11}-\text{OH} \xrightarrow{\text{PBr}_3} \text{C}_6\text{H}_{11}-\text{Br} \]

2) Draw curly arrows to show the mechanism of the following reaction.

\[ \text{H}_3\text{C-} \xrightarrow{\text{H}_2\text{SO}_4} \text{H}_3\text{C}-\text{CH}_3 \]

\[ \text{H}_2\text{O} \]

El or E2 acceptable
3) Give an applicable name that describes the reaction in Q2.

**ELIMINATION; DEHYDRATION; ACID CATALYZED PROCESS**

4) Bearing in mind your alkene reaction chapter, is that reaction a **reversible** reaction?

**Yes it is**

5) Briefly describe what can be done experimentally to this reaction to guarantee the maximum conversion of alcohol to alkene.

Either remove alkene (distillation) or remove water (drying agent) to force equilibrium to the right.

6) Give the product in the following transformation.

\[
\begin{align*}
\text{OH} & \quad \text{1) Tos-Cl, Pyridine} \\
\rightarrow & \quad 2) \text{LiAlH}_4
\end{align*}
\]

7) Why do we need to form the tosylate in the first place?

-OH is a poor leaving group for nucleophilic displacement

8) Could NaBH₄ be used instead of LiAlH₄?

**Yes**

9) Name (in IUPAC form) the following two compounds.

- 4-bromo-2-hexanol
- cyclohex-2-enol (or cyclohex-2-en-1-ol)
10) The addition of one equivalent of HF 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.

![Mechanism diagram]

Give more stable carbocation. (Vinyl carbocation with alkyl substituent is more stable than one with a H substituent)

11) For the following alkyne and alcohol, identify the hybridization of each individual carbon atom.

![Hybridization diagram]
12) Alcohols are weak acids, circle the stronger acid of each pair

a) \[ \text{CF}_3\text{CH}_2\text{OH} \] \[ \text{CH}_3\text{CH}_2\text{OH} \]

b) \[ \text{C}_6\text{H}_5\text{OH} \] \[ \text{C}_6\text{H}_4\text{OH} \]

13) Explain why the tosylate anion is such a good leaving group.

\[ \text{H}_3\text{C}-\text{C}(\text{SO}_3)\text{O}^- \]

tosylate anion

Good leaving group
Since it is a resonance stabilized anion
14) Give reagents for 4 of the following transformations. (if you do all 5, I just grade the 1st 4).

(a) \[
\begin{align*}
&\text{1) Mg, EtOH} \\
&\text{2) H}_3\text{C}=\text{O} \\
&\text{3) H}^+ \\
\end{align*}
\]

(b) \[
\begin{align*}
\text{PCC} & \quad \rightarrow \\
\text{primary OH} \rightarrow \text{aldehyde}
\end{align*}
\]

(c) \[
\begin{align*}
\text{OsO}_4, \text{H}_2\text{O}_2 \\
(6: \text{KMO}_{4}, \text{neutral}) & \quad \rightarrow \\
\text{syn diol}
\end{align*}
\]

(d) \[
\begin{align*}
\text{Chromic Acid} & \quad (\text{or KMO}_{4}; \text{H}^+) \\
& \quad \rightarrow \\
\text{primary OH} \rightarrow \text{acid}
\end{align*}
\]

(e) \[
\begin{align*}
\text{i) RC_3OH} & \quad \rightarrow \\
\text{ii) H}_2\text{O}_2, \text{H}_3\text{O}^+ & \quad \rightarrow \\
\text{anti diol (again)}
\end{align*}
\]

15) Draw the products of the following transformations.

(a) \[
\begin{align*}
1) \text{Pyridine, Ts-Cl} \\
2) \text{NH}_3 \\
\end{align*}
\]

(b) \[
\begin{align*}
1) \text{Pyridine, Ts-Cl} \\
2) \text{Na}^+\text{C}=\text{CH} \\
\end{align*}
\]