Chemistry 2211  
Spring 2020

Department of Chemistry  
University of South Florida

Exam II  
March 06, 2020

Name: ____________________________  
Section: ____________________________

This exam is a closed book, closed notes.  
Calculators and a molecular model set are allowed.  
You must show your work in order to receive partial credited.

Question I (13 points): __________________
Question II (27 points): __________________
Question III (34 points): __________________
Question IV (26 points): __________________

Total (out of 100) : __________________
Question 1. (13 points)
A) Provide a systematic (IUPAC) name for each of the following structures or draw the structure for each compound below: (0.5 point each, 3 points total)

(2Z, 4E)-Hepta-2,4-diene  
(3R, 4R)-3,4-Dihydroxy-2-pentanone

Aniline

B) Which of the following is least likely to undergo an S_N1 reaction with EtOH?
Which is most likely? Why? (3 points):

B) Which of the following is least likely to undergo an S_N1 reaction with EtOH?
Which is most likely? Why? (3 points):

C) Explain the vast difference in pKa values for the following two apparently similar compounds: (2 points)

D) Identify which of the following compounds is most activated toward electrophilic aromatic substitution. Which compound is least activated? (2 points):

- a) 
- b) 
- c) 
- d)

The more stable the conjugated base, the more acidic of the compound.

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least

least
E) Draw the structure of the alkyl halide needed to prepare each of the following Wittig reagents and then determine which Wittig reagent will be the more difficult to prepare. Explain your choice. (3 points)

Question II. Reactions: provide major product or the starting materials for the following reactions, making sure to consider the regio- and stereo-chemical outcome (3 points each, 27 points total)
Question III. Multiple step synthesis & NMR question (34 points total)

a) Using toluene and acetylene as your sources of carbon atoms, show how you would prepare the following compound: (4 points)

Starting Materials: Toluene, acetylene

\[
\begin{align*}
\text{NBS} & \quad \text{BuBr} & \quad \text{NaH} \\
\text{LiAlH}_4 & \quad \text{H}_2 & \quad \text{NMAH}_3 & \quad \text{Ph}
\end{align*}
\]
b) Propose a reasonable synthetic route for the following transformation: (3 points)

\[
\begin{align*}
\text{Starting with benzene and using any other reagents of your choice, design a synthesis for following compound. (4 points):}
\end{align*}
\]

\[
\begin{align*}
\text{d) Propose a reasonable synthetic route for the following transformation: (4 points)}
\end{align*}
\]
e) Propose a reasonable synthetic route for the following transformation: (4 points)

\[ \text{cyclohexane} \xrightarrow{\text{HgSO}_4/\text{H}_2\text{O}^+} \xrightarrow{\text{NaBH}_4} \xrightarrow{\text{Jones}} \xrightarrow{\text{Ph}_3\text{P}} \text{alkene} \]

f) Propose a reasonable synthetic route for the following transformation: (3 points)

\[ \text{benzene} \xrightarrow{\text{Br}_2} \xrightarrow{\text{Al}d_3} \xrightarrow{\text{Br}_2} \xrightarrow{\text{Fe}} \text{alkene} \]

\[ \xrightarrow{2n(\text{Hg})_2\text{H}_4} \xrightarrow{\Delta} \text{cyclohexane} \]

g) Propose a reasonable synthetic route for the following transformation: (4 points)

\[ \text{cyclohexane} \xrightarrow{\text{H}_2\text{O}, \text{H}^+} \xrightarrow{\text{D}_2\text{O}} \xrightarrow{\text{Li/AlH}_4} \xrightarrow{\text{H}_2\text{O}} \xrightarrow{\text{H}^+} \]

\[ \xrightarrow{\text{H}_2\text{O}} \text{alkene} \]
h) Propose a reasonable synthetic route for the following transformation: (4 points)

\[
\begin{align*}
\text{HCV} & \xrightarrow{\Delta} \text{PhCO} \\
\text{O} & \xrightarrow{\text{NBS}} \text{Cl} & \xrightarrow{\text{NaOH}} \text{Ph} & \xrightarrow{\text{OCH}_3} \text{Ph} \\
\end{align*}
\]

h) Deduce the structure of a compound with the molecular formula C₉H₁₀O that exhibits a strong signal at 1687 cm⁻¹ in its IR spectrum. The \(^1\text{H NMR}, \, ^{13}\text{C NMR}\) spectra are shown below: (4 points)

\begin{align*}
\text{\(^1\text{H NMR}\)} & \\
9 & 8 & 7 & 6 & 5 & 4 & 3 & 2 & 1 & 0 \\
2H & 2H & 1H & 2H & 3H & \\
\text{PPM} & \\
\text{\(^{13}\text{C NMR}\)} & \\
220 & 200 & 180 & 160 & 140 & 120 & 100 & 80 & 60 & 40 & 20 & 0 \\
\end{align*}

There is two unsolved lines at 128.
Question IV. Mechanism (26 points total)

a) Give an example of Birch reduction and detailed mechanism. (3 points)

b) Predict the major product of the following reaction and propose a plausible mechanism for the following transformation: (4 points)

(c) Predict the major product of the following reaction and propose a plausible mechanism for the following transformation: (4 points)
d) Give an example of Baeyer-Villiger oxidation and detailed mechanism. (4 points)

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\begin{center}
\includegraphics[width=\textwidth]{example_baeyer_villiger.png}
\end{center}
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e) Draw a plausible mechanism for the following transformation: (4 points)

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\begin{center}
\includegraphics[width=\textwidth]{example_baeyer_villiger.png}
\end{center}
```

f) Draw a plausible mechanism for the following transformation: (4 points)

```
\begin{center}
\includegraphics[width=\textwidth]{example_baeyer_villiger.png}
\end{center}
```
g) Draw a plausible mechanism for the following transformation: (3 points)

The end!