Organic Chemistry II Drill (CHEM2220D) Module 7. Sample Problems

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1. (4 points) Circle the compound or compounds that would be soluble in 5% NaHCO₃.

2. (4 points) Rank the compounds by strongest to weakest base. (1=strongest).

3. (17.5 points) Predict the product or products of each reaction. You must show stereochemistry, if any, with wedges, dashes or with an asterisk (*).

4. (3.5 points) Draw a structure with the Chemical Formula: C₇H₁₄O₂ that has the following spectroscopy data: 0.95ppm, doublet, 6H; 1.21ppm, triplet, 3H; 1.97ppm, multiplet, 1H; 2.51ppm, quartet, 2H; 3.86ppm, doublet, 2H.
5. (8 points) Propose a mechanism for this reaction. You must include all arrows and intermediates to receive full credit.

\[
\begin{align*}
\text{Cl} & \quad \text{H}_2\text{N} \\
\overset{\text{Cl}}{\text{O}} & \quad \rightarrow \\
\overset{\text{H}}{\overset{\text{N}}{\text{O}}} & \quad \overset{\text{H}}{\text{O}}
\end{align*}
\]

6. Propose a synthetic scheme for each transformation. You must show all Reagents needed and EACH synthetic intermediate to receive full credit.

(5 points)

\[
\begin{align*}
\overset{\text{?}}{\text{ }} & \quad \rightarrow \\
\overset{\text{O}}{\overset{\text{H}}{\text{O}}} & \quad \overset{\text{O}}{\overset{\text{H}}{\text{O}}}
\end{align*}
\]

(8 points)

\[
\begin{align*}
\overset{\text{?}}{\text{ }} & \quad \rightarrow \\
\overset{\text{O}}{\text{ }} & \quad \overset{\text{O}}{\text{ }}
\end{align*}
\]
7. Circle the molecule(s) that can form an enol. (3 pts)

- Benzaldehyde
- Acrolein
- Pentanal

8. List TWO bases that can deprotonate acetone to a synthetically-valuable extent. List ONE base that will NOT deprotonate acetone. (3 pts)

Will deprotonate: 1.  
2.  
Will NOT deprotonate:

9. Complete these reactions. There may be more than one important product, or it is possible that no reaction occurs. **Stoichiometry is not given. If you need more than 1 you have it** (20 pts)

(a)

(b)

(c)

(d)

3(e)

3(f)
10. Propose a mechanism for each of these reactions. Be sure to show all intermediates and mechanistic arrows. (8 pts)

a) 

\[
\begin{align*}
\text{propene} \quad \xrightarrow{\text{H}_3\text{O}^+} & \quad \text{propene oxide} \\
\end{align*}
\]

b) 

\[
\begin{align*}
\text{acetaldehyde} \quad \xrightarrow{\text{NaOCH}_3} & \quad \text{esterification product} \\
2 \text{acetaldehyde} \quad & \quad \text{esterification product} \\
\end{align*}
\]

11. Propose syntheses of these compounds. (12 pts)

a) 

\[
\begin{align*}
\text{tetrahydrofuran} \quad \text{from} & \quad \text{1-propanol} \\
\end{align*}
\]

b) 

\[
\begin{align*}
\text{propene oxide} \quad \text{from} & \quad \text{acetaldehyde} \\
\end{align*}
\]
12. Provide the IUPAC name for this compound (4 points):

\[
\begin{array}{c}
\text{Br} \\
\text{O} \\
\text{Me} \\
\end{array}
\]

13. Which of the following is the most soluble in water? (4 points)

A. CH₃CH₂COOH  B. CH₅(CH₂)₂COOH  C. C₆H₅COOH  D. C₆H₅CH₂OH

19. Circle the strongest acid? (4 points)

14. Complete these reactions. Write “no reaction” if appropriate (16 pts).

(a)  
\[
\text{H}_2\text{CrO}_4 \\
\text{SOCl}_2 \\
\text{CH}_3\text{CH}_2\text{NH}_2
\]

(b)  
\[
\text{N} \\
\text{xs, LAH} \\
\text{H}_3\text{O}^+
\]

(c)  
\[
\text{1)} \text{O}_3 \\
\text{2)} \text{H}_2\text{O} \\
\text{3)} \text{CH}_3\text{OH}, \text{H}^+
\]

(d)  
\[
\text{1)} \text{SOCl}_2 \\
\text{2)} \text{Excess CH}_3\text{MgBr; H}_2\text{O}
\]
15. Propose syntheses of these molecules (12 points):
(a) 
\[
\begin{array}{c}
\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \\
\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_2\text{OH}
\end{array}
\]

(b) 
\[
\begin{array}{c}
\text{PhCH}_2\text{OH} \\
\text{PhCONHCH}_3
\end{array}
\]

16. Draw the structure of a C\textsubscript{9}H\textsubscript{10}O\textsubscript{2} compound that has an IR band at 1720 cm\textsuperscript{-1} and \textsuperscript{1}H NMR signals at 1.24 ppm, triplet, 3H; 4.30 ppm, quartet, 2H; 7.6-8.1 ppm, multiplet, 5H; and has a \textsuperscript{13}C NMR signal at 165 ppm, among others. (4 pts)

17. Propose a mechanism for this reaction. (6 pts)
\[
\begin{array}{c}
\text{CH}_3\text{CO}_2\text{H} \\
\text{CH}_3\text{CH}_2\text{OH,} \text{H}^+ \\
\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_3
\end{array}
\]
18. Name the following compounds (2 points each):

- [Image of named compound]

19. Draw structures of the following compounds (2 points each):
   a) benzyl acetate
   b) 3-chlorohexane nitrile

20. Rank the following acids in the order of increasing their acidity (from the weakest to the strongest or clearly specify what you mean) (5 points):

   A
   B
   C
   D

21. Give the structure of the major organic product or products expected from the following reactions. “No reaction” might be an appropriate answer in some cases.

   Show the stereochemistry of the products if applicable. (5 points each)

   a)
   b)
22. Give a short, efficient synthesis of the target compound from the indicated starting material and any other needed reagents (7 points each).

![Chemical structures]

23. Propose a reasonable mechanism for acid catalyzed amide hydrolysis (8 points):

\[ \text{CH}_3\text{C(O)NH}_2 + \text{H}_2\text{O} + \text{H}^+ \text{ (catalytic amount)} \rightarrow \text{CH}_3\text{COOH} + \text{NH}_4^+ \]