CAS CH 203  Organic Chemistry I  
Exam 3  3 December 2009, 8:00 A.M.–9:20 A.M.

Name

ID Number

Instructions

(A) Make sure you have 5 pages with 8 questions.

(B) Write all answers on the pages provided.

(C) Only answers written in ink will be considered for regrading.

(D) Good luck!

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
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<tr>
<td>H</td>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
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<tr>
<td>Na</td>
<td>Mg</td>
<td>Al</td>
<td>Si</td>
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<td>S</td>
<td>Cl</td>
<td>Ar</td>
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<tr>
<td>K</td>
<td>Ca</td>
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<td>As</td>
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<td>Rb</td>
<td>Sr</td>
<td>In</td>
<td>Sn</td>
<td>Sb</td>
<td>Te</td>
<td>I</td>
<td>Xe</td>
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<thead>
<tr>
<th>Page</th>
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<td>1</td>
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<td>/18</td>
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<td>Total</td>
<td>/100</td>
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</table>
(1) Circle the chirality centers in this molecule. (4 points)

(2) Each of these molecules has one chirality center: determine its absolute configuration (R or S); write your answer in the space provided. (6 points)

(3) In the boxes provided write the reagents needed or draw the structure of the products obtained in this scheme. *Note* Only one reagent or structure per box. (10 points)
(4) Draw the structure of the organic product(s) of these reactions; in those reactions marked § show the stereochemistry of the product(s). Note Some of these reactions afford significant amounts of two organic products: draw both of them. (20 points)

(a)

(b§)

(c§)

(d)

(e)
When benzene is used as the solvent, \((R)\)-sec-butyl tosylate reacts with chloride \((\text{Cl}^-)\) to produce \((S)\)-sec-butyl chloride. However, when 1,4-dioxane is used as the solvent, \((R)\)-sec-butyl chloride is produced:

Write a detailed mechanism that explains the stereochemistry of the product when 1,4-dioxane is used as the solvent. Use curved arrows to show the movement of electrons. (8 points)

Check the appropriate box to indicate whether each structure represents (a) a meso compound and (b) an optically active compound (some may be neither). (10 points)
(7) Propose a sequence of reactions for accomplishing the following transformations. Show the reagents needed in each step and draw the product formed after each step. Do not present mechanisms. (15 + 9 = 24 points)

(a)  
\[
\begin{align*}
\text{C}_8\text{H}_5\text{CH}_3 & + \text{H}_3\text{C}-\text{C}≡\text{C}-\text{H} \quad \overset{\text{several steps}}{\longrightarrow} \quad \text{C}_8\text{H}_5\text{OH-CCH}_3 \\
\text{C}_8\text{H}_5\text{CH}_3 & \overset{\text{NBS or Br}_2, \text{light}}{\longrightarrow} \quad \text{C}_8\text{H}_5\text{Br} \\
\text{H}_3\text{C}-\text{C}≡\text{C-H} & \overset{\text{NaNH}_2 \text{ or NaH}}{\longrightarrow} \quad \text{H}_3\text{C}-\text{C}≡\text{C}^- \\
\text{C}_8\text{H}_5\text{Br} & \underset{\text{H}_2, \text{Lindlar or Na, NH}_3}{\longrightarrow} \quad \text{C}_8\text{H}_5\text{CH}≡\text{CHCH}_3 \\
\end{align*}
\]

(b)  
\[
\begin{align*}
\text{C}_7\text{H}_9\text{CH}_3 & \overset{\text{several steps}}{\longrightarrow} \quad \text{C}_7\text{H}_9\text{CH}_3 \\
\text{C}_7\text{H}_9\text{CH}_3 & \overset{(1) \text{OsO}_4}{\longrightarrow} \quad \text{C}_7\text{H}_9\text{CH}≡\text{CHCH}_3 \\
\text{C}_7\text{H}_9\text{CH}_3 & \overset{(2) \text{NaHSO}_3}{\longrightarrow} \quad \text{C}_7\text{H}_9\text{CH}_3 \\
\end{align*}
\]

\[
\begin{align*}
\text{C}_7\text{H}_9\text{CH}_3 & \overset{(1) \text{BH}_3}{\longrightarrow} \quad \text{C}_7\text{H}_9\text{CH}_3 \\
\text{C}_7\text{H}_9\text{CH}_3 & \overset{(2) \text{H}_2\text{O}_2 \text{ or PBr}_3}{\longrightarrow} \quad \text{C}_7\text{H}_9\text{CH}_3 \\
\text{C}_7\text{H}_9\text{CH}_3 & \overset{\text{SOCl}_2, \text{pyr or PBr}_3}{\longrightarrow} \quad \text{C}_7\text{H}_9\text{CH}_3 \\
\text{C}_7\text{H}_9\text{CH}_3 & \overset{\text{KI, acetone}}{\longrightarrow} \quad \text{C}_7\text{H}_9\text{CH}_3 \\
\end{align*}
\]

\[(X = \text{Cl, Br})\]
(8) Write a detailed mechanism for each of these reactions. Use curved arrows to show the movement of electrons. (9 + 9 = 18 points)

(a) \[
\begin{align*}
\text{ClCH}_3\text{HO} & \quad \text{heat} \quad \text{ClCH}_3\text{OCH}_3 + \text{HCl} \\
\end{align*}
\]

(b) \[
\begin{align*}
\text{BrCCH}_3 & \quad \text{heat} \quad \text{H}_3\text{C} + \text{HBr} \\
\end{align*}
\]
Scratch paper
Do not write any answers you wish to be graded on this page