EXAMINATION 2

Chemistry 3A  
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March 30, 1999

Please check the name of your TA and corresponding section number. Complete the remaining information if applicable.

111    Joe Ringenberg  
121    Polly Berseth  
131    Jun Yin  
141    David Nauman  
151    Jeff Janes  
211    Jennifer Tripp  
221    David Tully  
311    Jason Robinson  
321    Alex Adronov  
331    Matt Purdy  
341    Greg Watkins  
351    Lily Huang  

Making up an I Grade

(If you are, please indicate the semester during which you took previous Chem 3A previously

).

Please write the answer you wish to be graded in the spaces provided. Do scratch work on the back of the pages. This test should have 11 numbered pages. Check to make sure that you have received a complete exam. A good piece of advice: read carefully over the questions (at least twice); make sure that you understand exactly what is being asked; avoid sloppy structures or phrases. It is better to be pedantic in accuracy! Good Luck!

DO NOT WRITE IN THIS SPACE

I. _______ (15)  
II. _______ (60)  
III. _______ (40)  
IV. _______ (30)  
V. _______ (30)  
VI. _______ (25)  

Total: _______ (200)
1. [15 Points]
   Name or draw, as appropriate, the following molecules according to the IUPAC rules. Indicate stereochemistry where necessary (cis, trans, R, S, or meso).

   a. 
   \[ \text{CH}_3 \text{O} \quad \text{OH} \] 
   \[ \text{CH}_3 \quad \text{CH}_3 \] 
   Hint: RO is alkoxy.

   b. \((S)\) -2-(Methylethyl)-1-pentanol

   c. 
   \[ \text{H} \quad \text{OH} \] 
   \[ \text{H} \quad \text{OH} \] 
   \[ \text{CH}_3 \]
II. [60 Points]
Add the missing starting materials, reagents, or products (aqueous work up is assumed where necessary). Don't forget stereochemistry! Do not write a mechanism!

a.  \[ \text{NaBH}_4 \]

b.  \[ \text{1. Mg} \]
\[ \text{2. } \text{H}_2\text{C} = \text{O} \]
\[ \text{C}_5\text{H}_{11}\text{Br} \]

\[ \text{OH} \]

c.  \[ \text{Br} \]
\[ \rightarrow \]
\[ \text{ } \]

d.  \[ \text{ } \]
\[ \text{1. } \]
\[ \text{2. } \]
\[ \text{ } \]

\[ \text{CH}_3\text{CO}^+ \text{Na}^- \]
\[ \text{2. } \text{NaOH, H}_2\text{O} \]

\[ \text{ } \]
f. \[ \text{CH}_3\text{Li} + \text{C}_3\text{H}_4\text{O} \rightarrow \text{HOCH}_3 \]

III. [40 Points]
Explain the following observations by a detailed mechanism (i.e., write a scheme with structures, use arrow-pushing to illustrate the flow of electrons, do not add any reagents!).

a. \[
\begin{array}{c}
\text{Br} \\
\text{CH}_3
\end{array}
\xrightarrow{\text{CH}_3\text{OH}} \text{achiral product}
\]

Mechanism:
b. \[
\text{racemic} \quad \overset{\text{HBr}}{\rightarrow} \quad \begin{array}{c}
\text{Br} \\
\text{CH}_3
\end{array} + \begin{array}{c}
\text{Br} \\
\text{CH}_3
\end{array}
\]

both racemic

Mechanism:

Suggest an explanation for the excess trans product.

Explanation:
IV. [30 Points]
For each pair of reactions shown below, mark the box on the right with an “X” indicating which will go faster and circle the mechanism by which it proceeds (e.g. \( S_N2 \), \( S_N1 \), \( E_2 \), \( E_1 \)). In one complete, grammatically correct sentence, provide a brief explanation in each case in the bottom box provided (i.e., explain why so-and-so is a better nucleophile, leaving group, solvent, etc.). No credit will be given for the right answer with an incorrect reason.

a.  
\[
\text{Br} \quad \text{NaCN, CH}_3\text{OH} \quad \text{CN} \linebreak \text{Br} \quad \text{NaCN, CH}_3\text{OH} \quad \text{CN}
\]
\( S_N2 \) \( S_N1 \) \( E_2 \) \( E_1 \)

b.  
\[
\text{OH} \quad \text{NaBr} \quad \text{Br}
\]
\[
\text{OH} \quad \text{HBr} \quad \text{Br}
\]
\( S_N2 \) \( S_N1 \) \( E_2 \) \( E_1 \)
c. 
\[
\begin{align*}
\text{H}_3\text{C} & \quad \text{I} \\
\text{cyclohexane} & \quad \rightarrow \\
\text{CH}_3\text{CCH}_2 & \quad \text{cyclohexene}
\end{align*}
\]

\[\text{SN}_2\] 

\[\text{SN}_1\] 

\[\text{E}_2\] 

\[\text{E}_1\]

d. 
\[
\begin{align*}
\text{H} & \quad \text{Cl} \\
\text{H} & \quad \text{H} \\
\text{CH}_3 & \quad \rightarrow \\
\text{CH}_3\text{S},\text{CH}_3\text{OH} & \quad \text{CH}_3\text{S} \\
\text{H} & \quad \text{H} \\
\text{CH}_3 & \\
\text{CH}_3 & \quad \rightarrow \\
\text{CH}_3\text{S},\text{CH}_3\text{OH} & \quad \text{CH}_3\text{S} \\
\text{H} & \quad \text{H} \\
\text{H}_3\text{C} & \quad \rightarrow \\
\text{CH}_3 & \\
\text{CH}_3 & \quad \rightarrow \\
\text{CH}_3\text{S},\text{CH}_3\text{OH} & \quad \text{CH}_3\text{S} \\
\text{H} & \quad \text{H} \\
\text{H}_3\text{C} & \\
\text{CH}_3 & \\
\text{SN}_2 & \quad \text{SN}_1 & \quad \text{E}_2 & \quad \text{E}_1
\end{align*}
\]
c. CH₃CH₂I $\xrightarrow{\text{NaNH}_2}$ CH₃CH₂NH₂

CH₃CH₂I $\xrightarrow{\text{NaOH}}$ CH₃CH₂OH

Sₙ² Sₙ¹ E₂ E₁
V. [30 Points]
Provide a viable synthetic route from starting material to product. Use the back of the page(s) for retrosynthetic analyses. Write the answer in the forward direction indicating all necessary reagents. Do not show mechanisms (arrows).

a. (as the only organic starting material) (mixture of diastereomers)

b. optically pure optically pure
VI. [25 Points]
Consider the following transformation:

\[
\begin{align*}
\text{CH}_3\text{CH}_2\text{F} & \xrightarrow{\text{NH}_3} \text{CH}_3\text{CH}_2\text{NH}_2\text{F} \\
\end{align*}
\]

a. Provide two ways with which you could distinguish between an \(S_N2\) and an \(S_N1\) mechanism.

1st Method :
(specify)

Expected result for \(S_N2\) :

Expected result for \(S_N1\) :

2nd Method :
(specify)

Expected result for \(S_N2\) :

Expected result for \(S_N1\) :
b. Draw rough potential energy diagrams for both processes.

$$S_{N2}$$

$$E \quad \quad \quad \quad \quad SM \quad \quad \quad \quad \quad P$$

SM = starting materials, P = product

$$S_{N1}$$

$$E \quad \quad \quad \quad \quad SM \quad \quad \quad \quad \quad P$$

MISS PEACH

BOOK

ROOM.

THIS NEW

TEXTBOOK

CONFUSES

ME...

HOW?

THEY PUT A LOT

OF STUFF IN IT.

I DON'T KNOW.

MELL LAZARUS