Be certain that your examination has eleven (11) pages including this one.

Put your name on each page of this examination booklet.

By putting your name on this examination booklet you agree to abide by California State University, Northridge policies of academic honesty and integrity.
1. (25 points)

For each of the following five (5) questions draw the structure of the expected major organic product. If relevant, specify the absolute and/or relative stereochemistry of the product.

A.

\[
\begin{align*}
\text{H}_2\text{C} & \quad \text{CH}_3 \\
| & ||
\text{O} & ||
\text{CH}_3 & \quad \text{H}_3\text{C} \\
\rightarrow & \\
\text{a)} \text{LDA} & \\
\text{b)} \text{H}_3\text{CI}
\end{align*}
\]

B.

\[
\begin{align*}
\text{H}_3\text{C} & \quad \text{CH}_2\text{OH} \\
\rightarrow & \\
\text{Ph}_3\text{PCH}_2\text{CH}_2\text{CH}_3 & \quad \text{"sol-fre"}
\end{align*}
\]

C.

\[
\begin{align*}
\text{H}_3\text{C} & \quad \text{CH}_2\text{OH} \\
\rightarrow & \\
\text{a)} \text{aq NaOH} & \\
\text{b)} \text{Br}_2
\end{align*}
\]

D.

\[
\begin{align*}
\text{OH} & \quad \text{CH}_3 \\
\rightarrow & \\
\text{a)} \text{NaH} & \\
\text{b)} \text{Ph}_2\text{CH}_2\text{Br}
\end{align*}
\]

E.

\[
\begin{align*}
\text{H}_3\text{C} & \quad \text{CH}_3 \\
\rightarrow & \\
\text{H}_2\text{Pd/C} & \quad \text{N}_3
\end{align*}
\]
2. (25 points)

For each of the following five (5) questions denote the reagent or reagents necessary to effect the transformation shown. More than one step may be required.

A.

\[
\text{H}_3\text{N}^+ \xrightarrow{\text{CO}_2}\text{Me} \rightarrow \text{t-BuO}^- \xrightarrow{\text{NH}_2} \xrightarrow{\text{CO}_2}\text{Me}
\]

B.

\[
\text{HO} \xrightarrow{\text{CH}_3}\text{C}=\text{CH}_2 \rightarrow \text{HO} \xrightarrow{\text{CN}} \text{OH} \xrightarrow{\text{CN}} \text{CN}
\]

C.

\[
\text{H}_3\text{C}=\text{CH}_3 \rightarrow \text{H}_3\text{C}^-\text{CH}_2\text{CH}_3\text{N}^-\text{CH}_3
\]

D.

\[
\text{HO} \xrightarrow{\text{OH}} \text{HO} \xrightarrow{\text{CH}_3}\text{C}=\text{O} \xrightarrow{\text{OCH}_3}\text{CH}_3 \xrightarrow{\text{CH}_3}\text{OCH}_3 \xrightarrow{\text{OCH}_3}\text{CH}_3 \xrightarrow{\text{OCH}_3}\text{CH}_3
\]

E.

\[
\text{H}_3\text{C} \xrightarrow{\text{C}=\text{C}} \text{H}_3\text{C} \xrightarrow{\text{O}} \text{H}_3\text{C} \xrightarrow{\text{O}} \text{H}_3\text{C}
\]
3. (20 points)

   Draw a specific example of each of the following:

   A. any prostaglandin:

   B. any chain-growth polymer:

   C. any terpene:

   D. any naturally-occurring wax:

   E. any naturally-occurring aldotetrose:

   F. any naturally-occurring phospholipid:

   G. any naturally-occurring neutral α-amino acid (zwitterionic form):

   H. any naturally-occurring unsaturated triacylglycerol:

   I. any steroid:

   J. any dipeptide:
4. (25 points)

The following transformation is a step in Evans' enantioselective synthesis of \( \alpha \)-amino acids. Draw the mechanism of this reaction, using the curved-arrow notation to indicate the reorganization of electron density. Show all intermediates and denote all lone pairs, formal charges and countercharges where appropriate.

\[
\begin{align*}
\text{Bn} & \quad \text{a)aq. Li}^+\text{OH} \quad \text{b) H}_2\text{O}^+\text{Cl}^- \quad \text{workup} \\
\text{Bn} \equiv \text{PhCH}_2
\end{align*}
\]
5. (25 points)

The following transformation is a step in Pattenden's synthesis of cis-jasmone. Draw the mechanism of this reaction, using the curved-arrow notation to indicate the reorganization of electron density. Show all intermediates and denote all lone pairs, formal charges and countercharges where appropriate.
6. (25 points)

Design a synthesis of the following alcohol from isoprene and mono- or difunctional organic starting materials of four carbons or less. Use any inorganic and organic reagents that you deem necessary. Show all reagents and stable synthetic intermediate compounds.
7. (30 points)

Answer the following three (3) questions precisely and succinctly.

A. Why do long-chain carboxylate salts form micelles in water?

B. Describe what occurs during allosteric control of enzyme activity by an effector molecule. Draw a simple schematic to illustrate your answer.

C. Why do terpenes contain multiples of five carbons?
8. (25 points)

The infrared, $^1$H NMR and $^{13}$C NMR spectra of compound A ($C_5H_{10}O$) are shown below. Clearly assign all the resonances that you can identify with certainty and draw the structure of compound A. (Correlation tables are included separately.)

The infrared spectrum is unavailable due to copyright considerations.
8. (cont.)

The $^1$H NMR and $^{13}$C NMR spectra are unavailable due to copyright considerations.
8. (cont.)

Infrared absorption assignments:

<table>
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<th>frequency (cm(^{-1}))</th>
<th>functional group</th>
<th>type of vibration</th>
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</thead>
</table>

\( ^1H \) NMR assignments:

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<thead>
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<th>chemical shift (ppm)</th>
<th>assignment</th>
<th>explanation of multiplicity</th>
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</thead>
</table>

\( ^13C \) NMR assignments:

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<tr>
<th>chemical shift (ppm)</th>
<th>assignment</th>
<th>explanation of multiplicity</th>
</tr>
</thead>
</table>

structure of compound A:

Congratulations!

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Name: ______________________