Be certain that your examination has seven (7) 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, clearly specify absolute and/or relative stereochemistry.

A.\[ \text{H}_2\text{C} = \text{CH}_2 \xrightarrow{\text{T:Cl}_3, \text{Et}_3\text{Al}} \]

B.\[ \text{HO} \xrightarrow{\text{MeI, Ag}_2\text{O}} \]

C.\[ \text{CH}_3 \xrightarrow{\text{MeNHPH, H}_2\text{O}} \]

D.\[ \text{Me} \xrightarrow{1) \text{NaNO}_2, H_2\text{SO}_4, \text{aq}} \xrightarrow{2) \text{CuBr}} \]

E.\[ \text{HO} \xrightarrow{\text{dil. hot HNO}_3} \]
2. (25 points)

Answer the following two (2) questions precisely, succinctly and with correct grammar.

A. A rubber band gets warm when it is stretched. What is the chemical basis for this fact? Draw annotated diagrams to illustrate your answer.

B. What is the structural difference between amylose and cellulose? Amylose is a direct food source for humans but cellulose is not. What is the biochemical basis for this difference?
(25 points)

Draw the mechanism of the following 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. Show all canonical forms for resonance-stabilized species.

\[
\begin{align*}
2 & \quad \text{Me} \quad \text{O}^{-} \quad \text{Me} \\
\xrightarrow{\text{a.) Na}^{+} \text{Me}^{-}} & \quad \text{Me} \quad \text{O}^{-} \quad \text{Me} \\
\xrightarrow{\text{b.) H}_2\text{O}^+ \text{Cl}^{-}} & \quad \text{Me} \quad \text{O}^{-} \quad \text{Me} + 2 \text{MeOH} + \text{H}_2\text{O} + \text{Na}^{+} \text{Cl}^{-}
\end{align*}
\]
4. (25 points)

The infrared, $^1$H NMR and $^{13}$C NMR (broadband $^1$H decoupled) spectra of compound A (C$_8$H$_{10}$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.
The $^1$H NMR and $^{13}$C NMR spectra are unavailable due to copyright considerations.
4. (cont.)

**Infrared absorption assignments:**

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<th>frequency (cm(^{-1}))</th>
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<th>type of vibration</th>
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**\(^1\)H NMR assignments:**

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

**\(^13\)C NMR assignments:**

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<tr>
<th>chemical shift (ppm)</th>
<th>assignment</th>
<th>explanation of multiplicity</th>
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**structure of compound A:**

Congratulations!

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