The exam is open book,
Open notes. Models are permitted
Show your work in detail

WRITE YOUR NAME ON EVERY PAGE

NAME           KEY
1. Draw the structures of A and B. You do not need to provide mechanisms (25 pts)

\[
\text{HO-CH}_2-CH-CH_2-\text{COOH} + \text{DCC, Et}_3\text{N} \quad \xrightarrow{\text{DCC, Et}_3\text{N}} \quad A \quad \xrightarrow{1) \text{O}_3} \quad B \\
\]

\[
\begin{align*}
A & \quad \text{HO-CH}_2-CH-CH_2-\text{COOMe} \\
B & \quad \text{HO-CH}_2-CH-CH_2-\text{CON}\text{Me}
\end{align*}
\]

2. The reactions below would not proceed as shown. Explain why (be concise), and indicate which product would be formed instead.

\[
\text{HO-CH}_2-CH-CH_2-\text{COOH} \quad \xrightarrow{1) \text{MeLi (2 equiv)}} \quad \text{HO-CH}_2-CH-CH_2-\text{COO}^- \\
\quad \xrightarrow{2) \text{H}^+} \\
\]

This substrate has 2 hydroxyls, so the MeLi is completely consumed by deprotonating the two hydroxyls. Addition of acid regenerates the starting material.
The reactions below would not proceed as shown. Explain why (be concise), and indicate which product would be formed instead.

2. (continued)

b. 

\[
\text{benzyl alcohol} \xrightarrow{\text{H}_2\text{CrO}_4/\text{H}_2\text{SO}_4/\text{H}_2\text{O, acetone}} \text{benzaldehyde} \]

(20 pts)

overoxidizes to the acid

\[
\text{benzaldehyde} \xrightarrow{\text{H}_2\text{O}} \text{benzyl alcohol}
\]

c.

\[
\text{cis-1,2-dideuteriobutene} \xrightarrow{\text{H}_2/\text{Pd/C}} \text{1,2-dideuteriobutane}
\]

(25 pts)

Pd catalyzed hydrogenation occurs by cis-addition across the double bond. The product above is that of trans addition.

either of the enantiomers below were accepted

\[
\begin{align*}
\text{cis enantiomer} & \quad \text{trans enantiomer}
\end{align*}
\]
3. Propose a synthesis for 1 starting with any materials that contain 3 carbons or less. You may also use reagents that contain more than 3 carbons (e.g. BuLi, Ph₃P, LDA, MCPBA, DIBAL, DCC, pyridine, TsCl, NaOtBu, Et₃N). However, Grignard and Wittig reagents must be prepared.

One possible answer:

1) PPh₃
2) NaOtBu

1) combine
2) H₃O⁺
4. Propose the structure of 2 (10 points). Explain how the spectroscopic data helped you make your stereochemical assignment. (25 points).

\[
\text{Ph}_3\text{PC}O \rightleftharpoons \text{CO}_2\text{Me} \xrightarrow{\text{ONa}} \text{Br}^- \xrightarrow{\text{2}} \text{C}_{10}\text{H}_{10}\text{O}_2
\]

**\(^{13}\text{C NMR}\)**

- 167.3, s
- 144.8, d
- 134.5, s
- 130.2, d
- 128.9, d, 2 carbons
- 128.8, d, 2 carbons
- 117.9, d
- 51.5, q

**\(^{1}\text{H NMR}\)**

- 7.67 (1H, d, \(J = 15.8\) Hz)
- 7.6–7.2 (m, 5H)
- 6.40 (d, 1H, \(J = 15.8\) Hz)
- 3.80 (s, 3H)

10 points for connectivity

25 points:

15.8 Hz coupling constant indicates that this is a trans alkene

(35 total pts)
5. Propose a detailed mechanism for the rearrangement below.

\[ \begin{align*}
X^- + H^+ & \rightarrow \text{Product} \\
\text{Product} & \rightarrow \text{Other Product} \\
\text{Other Product} & \rightarrow \text{Final Product}
\end{align*} \]