1. The Evans synthesis of (+)-discodermolide appears in the Ph.D. thesis of David Halstead (Harvard, 1999). A copy of this work is posted on Blackboard for your convenience. Key disconnections are shown below.

\[ 
\begin{array}{c}
\text{A} \\
\text{B} \\
\text{C}
\end{array}
\]

a. Draw the key intermediates that are used to prepare sections A-C then indicate how these intermediates are joined (e.g. how are the \( C_7-C_8 \), \( C_{13}-C_{14} \), and \( C_{21}-C_{22} \) bonds formed; one step each). You may abbreviate the structure, but be sure to include all necessary functionality and reaction conditions. If a name reaction is used, include the name. Include relevant carbon numbers throughout.

b. Explain how stereochemistry was set for each of the Z olefins (there are 3). Be specific. Be sure to explain why the process used gives the desired stereochemistry. For the \( C_{21}-C_{22} \) olefin, also explain why the adjacent double bond was not present in the initial coupling reaction used to form the \( C_{21}-C_{22} \) bond.

c. Synthesis of the key fragments relies heavily on the Evans' asymmetric aldol methodology. In an interesting twist, formation of fragment A and C utilize the \( \beta \)-ketoimide 1 to give the anti-anti (1) and anti-syn (4) products respectively. Syn-syn product (3) are also accessible. While the basis for selectivity using the boron enolate is not well understood, a clear rationale has been established for the other two. As such, draw transition states that account for the stereoselectivity observed in the formation of compounds 3 and 4.
2. Devise an efficient retrosynthetic sequence for the following compounds. Starting material are provided, but you will need to show key intermediates. Keep selectivity issues in mind. Over each retrosynthetic arrow, please indicate what general transformation(s) – e.g. oxidation, reduction, aldol, etc. – would be required to carry out the reactions in the forward sense. You do not need to show the forward sequence; you do not need to identify specific reaction conditions.

a. 

\[
\begin{array}{c}
\text{N} \\
\text{O} \\
\text{O}
\end{array}
\]

\[\Rightarrow\]

\[
\text{O}
\]

b. 

\[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]

\[\Rightarrow\]

\[
\text{O}
\]

c. 

\[
\begin{array}{c}
\text{O} \\
\text{O}
\end{array}
\]

\[\Rightarrow\]

\[
\text{O}
\]

\[
\text{O}
\]

\[
\text{O}
\]