Problem 1  Provide a rational synthesis of the ester below from the indicated starting materials and any necessary reagents.

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{H} & \quad \text{O} \\
\text{Me} & \quad \text{C} \\
\text{Me} & \quad \text{O} \\
\text{Me} & \quad \text{O}
\end{align*}
\]
**Problem 2** Professor N.M. Arr, a famous Knowbell Laureate, needs to make both of the deuterium-labeled compounds shown below from his chiral starting material. It is very important that he isolate pure forms of both diastereomers.
Problem 3 Do this:

\[ \text{Starting material} \rightarrow \text{Product 1} + \text{Product 2} + \text{Product 3} \]
Problem 4  You’d better learn your reactions. We haven’t been covering every single specific example in class and section, but you’ve still got to know them. The Loudon/Stowell study guide is a great place to pick them up. When you see a new reaction, ask yourself two questions:

1) What is the mechanism?
2) How can I use this in synthesis?

Fill in the blanks of this “roadmap” problem:

Solution