This is an open-book, open notes exam. Please show your work in detail.

1. (20 points) Draw the structures of B and C, and give IUPAC names for A, B, and C. You do not have to show mechanisms, but you do need to show stereochemistry clearly.

   ![Chemical structures](image)

2. (20 points) Indicate the expected major product. Explain your reasoning in detail.

   ![Chemical structures](image)
3. (20 points) Outline the synthesis steps to convert D into E. In addition to D, you may use any piece that contributes three or fewer carbons to the final product.

\[
\text{HO} \quad \text{D} \quad \rightarrow \quad \text{...} \quad \text{E}
\]

4. (20 points) Deduce the structure of F, and draw an arrow-pushing mechanism for the transformation.

\[
\text{F} \quad \text{H}^+ \quad \text{C}_{9}H_{10}O
\]

\[\begin{array}{l}
1^3C \text{ NMR} \\
14.6, \text{ q} \\
53.0, \text{ d} \\
127.5, \text{ d} \\
128.3, \text{ d (2)} \\
129.0, \text{ d (2)} \\
137.8, \text{ s} \\
200.8, \text{ d}
\end{array}\]

\[\begin{array}{l}
1^H \text{ NMR} \\
1.42, \text{ d, J = 7.3 Hz, 3H} \\
3.63, \text{ dq, J = 4.2, 7.3 Hz, 1H} \\
7.22, \text{ dd, J = 8.1, 2.4 Hz, 2H} \\
7.31, \text{ dd, J = 8.1, 8.2 Hz, 2H} \\
7.38, \text{ td, J = 8.2, 2.4 Hz, 1 H} \\
9.65, \text{ d, J = 4.2 Hz, 1H}
\end{array}\]
5. (20 points) Draw a detailed arrow-pushing mechanism for the following transformation. 5/20 points for correctly showing the mapping of the starting material onto the product.