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

1. (20 points) Draw the structures of B and C.

\[ \text{Br} \quad \xrightarrow{\text{B}} \quad \text{C} \quad \text{C}_5\text{H}_9\text{N} \]

- \( ^{13}\text{C NMR} \):
  - 122.9, s
  - 27.3, t
  - 27.1, d
  - 17.6, q
  - 1.4, q

- \( ^1\text{H NMR} \):
  - 1.09, t, \( J = 7.6 \) Hz, 3H
  - 1.28, d, \( J = 7.9 \) Hz, 3H
  - 1.63, m, 2H
  - 2.57, m, 1H

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

\[
\begin{align*}
\text{D} & \quad \text{Br} \quad \rightarrow \quad \text{E} \\
& \quad \text{HO} \\
\end{align*}
\]

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

\[
\begin{align*}
\text{OH} & \quad \text{OH} \quad \rightarrow \quad \text{F} \quad \text{H}^+ \\
& \quad \text{C}_9\text{H}_{18}\text{O} \quad - \text{H}_2\text{O} \\
& \quad 13\text{C NMR} \\
& \quad 218.8, \text{ s} \\
& \quad 45.7, \text{ s (2)} \\
& \quad 28.5, \text{ q (6)} \\
& \quad 1\text{H NMR} \\
& \quad 1.25, \text{ s, 18H}
\end{align*}
\]
5. (20 points) Draw a detailed arrow-pushing mechanism for the following transformations. For each transformation, 3 points for correctly showing the mapping of the starting material onto the product, and 7 points for the arrow-pushing mechanism.