1. (5 pts) a) Draw a detailed mechanism (using curved arrows) for the rearrangement outlined below.

\[ \begin{align*}
\text{H}_3\text{C} & \quad \text{C} \quad \text{C} \quad \text{CH}_3 \quad \text{OH} \quad \text{OH} \quad \text{H}_2\text{SO}_4 \\
\text{CH}_3 & \quad \text{CH}_3
\end{align*} \] 

\[ \begin{align*}
\text{H}_3\text{C} & \quad \text{C} \quad \text{C} \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{CH}_3
\end{align*} \]

b.) Draw an approximate energy diagram for the mechanism you drew in part a and explain why the rearrangement step is favorable in this reaction.
2. (5 pts) Draw the major product(s) for the following reactions.

a) 

\[ \text{Br} \quad \text{Ph} \quad \begin{array}{c}
\text{CH}_3\text{CH}_2\text{OK} \\
\end{array} \]

b) 

\[ \text{F} \quad \begin{array}{c}
\text{1. TsCl/pyridine} \\
\text{2. CH}_3\text{SNa} \\
\end{array} \]

(c) This reaction gives two products in a 95:5 ratio. Show both products. Extra credit if you can correctly identify the major product and provide a plausible explanation for why it predominates.

\[ \begin{array}{c}
\text{N} \\
\text{CH}_3 \\
\end{array} \quad \begin{array}{c}
\text{OH} \\
\Delta \end{array} \]

d) The following reaction gives three major products. (Hint: 1 elimination product and 2 substitution products. Hint 2: Look at resonance in the intermediate.)

\[ \begin{array}{c}
\text{CH}_2\text{Br} \\
\text{ethanol} \\
\Delta \\
\end{array} \]