1. Show all products of hydrolysis by acid.

\[
\begin{align*}
\text{H}_2\text{N} - \text{C} & - \text{O} \\
\text{H}_2\text{N} & - \text{C} - \text{O} \\
\text{H}_2\text{N} & - \text{C} - \text{O} \\
\text{H}_3\text{O}^+ \text{, } \text{H}_2\text{O} & \text{heat} \\
\text{H}_2\text{N} - \text{C} & - \text{O} \\
\text{H}_2\text{N} & - \text{C} - \text{O} \\
\text{H}_2\text{N} & - \text{C} - \text{O} \\
\text{H}_2\text{N} & - \text{C} - \text{O} \\
\text{H}_2\text{N} & - \text{C} - \text{O} \\
\end{align*}
\]

2. Identify compound A. Explain mechanistically how compound A is converted to glutamic acid.

\[
\begin{align*}
\text{EtO} & - \text{C} - \text{O} \\
\text{EtO} & - \text{C} - \text{O} \\
\text{H} & - \text{EtO} \\
\text{NaOEt, EtOH} & \text{A} \\
\text{H}_3\text{O}^+ \text{, } \text{H}_2\text{O} & \text{heat} \\
\text{H}_2\text{O}^+ \text{, } \text{H}_2\text{O} & \text{hydrolysis of ester, amide, nitrile}
\end{align*}
\]
3. The tert-butyloxycarbonyl (Boc) group is used as a protecting group for the amino group. Give the mechanisms of the following two reactions which involve putting the group on and taking it off.

4. Another protecting group for the amino group is the 9-fluorenylethoxycarbonyl (Fmoc) group. Show the mechanisms for the reactions used to put it on and take it off. The second reaction is not an $S_N 2$ reaction.
5. The following compound is a very strong base. Its conjugate acid has a pKa of 13.5. Give the structure of its conjugate acid and show that it is stabilized by resonance.

6. Draw the mechanism of the following reaction. Show all intermediates and electron-pushing arrows. This is a variation of the Mannich reaction.