1. Write the mechanism of the following reaction showing all intermediates and electron-pushing arrows.

\[
\begin{align*}
\text{Ph} & \quad \text{Ph} \\
\text{HO} & \quad \text{HO} \\
\text{HO} & \quad \text{HO} \\
\text{Ph} & \quad \text{Ph} \\
\text{H}_2\text{SO}_4 & \longrightarrow \\
\text{Ph} & \quad \text{Ph} \\
\end{align*}
\]

2. Show how you would synthesize the following alcohol in three ways making the indicated bonds.

\[
\begin{align*}
\text{Ph} & \quad \text{H} \\
\text{H} & \quad \text{OH} \\
\text{OH} & \quad \text{Ph} \\
\end{align*}
\]
3. Write the complete mechanism for enamine formation showing all intermediates and all resonance structures of each.

\[
\text{HCl} \xrightarrow{\text{N}} \text{H}_2\text{O} + \text{enamine}
\]

4. In the formation of imines and enamines the pH of the reaction solution is kept at about 4-5. The reaction works best at this pH. Explain why this is the case, taking into consideration the mechanism of imine and enamine formation.
5. Write the complete mechanism for the acid hydrolysis of the following imine. Consider the microscopic reverse of imine formation. This imine has a special name. It is called an oxime.

\[
\begin{array}{c}
\text{HO} \\
\text{N} \\
\text{H}_3\text{O}^+ \\
\text{H}_2\text{O} \\
\text{O} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{N} \\
\text{+} \\
\text{OH}
\end{array}
\xrightarrow{\text{H}_3\text{O}^+} \xrightarrow{\text{H}_2\text{O}}
\begin{array}{c}
\text{O} \\
\text{+} \\
\text{N} \\
\text{H} \\
\text{H} \\
\text{OH}
\end{array}
\]

6. Write the complete mechanism of acetal formation showing all intermediates and all resonance structures for each.

\[
\begin{array}{c}
\text{O} \\
\text{H}_2\text{SO}_4 \\
\text{H}_2\text{O}
\end{array}
\xrightarrow{\text{HO} \text{--O} \text{H}}
\begin{array}{c}
\text{O} \\
\text{+} \\
\text{H}_2\text{O}
\end{array}
\]