1. Draw the arenium ion intermediates when either toluene or $\alpha,\alpha,\alpha$-trifluorotoluene are reacted with Cl$_2$ and AlCl$_3$ at both the para and meta positions.

\[
\begin{align*}
\text{toluene} & \quad \text{Cl}_2 \quad \text{AlCl}_3 \\
\text{CF}_3 & \quad \text{Cl}_2 \quad \text{AlCl}_3
\end{align*}
\]

Which resonance structure is the most stable?

Which resonance structure is the least stable?

Predict the rate of reaction for all four scenarios (toluene at para, toluene at meta, trifluorotoluene at para and trifluorotoluene at meta) relative to benzene.

List in order the relative rate versus benzene for the four scenarios.

2. Consider the following reaction scheme.

\[
\text{Br} \quad \text{O} \quad \text{H}
\]

Indicate reagents to cause each interconversion.

Draw the product obtained if each of the four structures shown are reacted with HNO$_3$ and H$_2$SO$_4$.

Which structure would react the fastest with HNO$_3$/H$_2$SO$_4$?

Indicate a method to synthesize the compound shown from benzene.
3. Consider the following reaction.

Draw the product obtained when 1 equivalent of AlCl$_3$ is used.

When 3 equivalents of AlCl$_3$ are used, however, a different product is obtained. Draw this product.

Explain why two different products are obtained with different amounts of AlCl$_3$. 