1. (5 points) Arrange the following bonds in order of increasing vibrational stretching frequencies (in cm\(^{-1}\)) in infrared spectroscopy (with 1 being the lowest frequency).

(a) C=C  C–C  C=C

(b) C=C  C=O

2. (6 points) Provide the organic products of the following reactions. If there is more than one product, predict which, if any, will be major.

(a) \[
\begin{align*}
\text{Ph} & \quad \text{H}^+ \\
\text{1. } & \text{HN} \\
\text{2. } & \text{CH}_3\text{I} \\
\text{3. } & \text{H}_2\text{O}
\end{align*}
\]

(b) \[
\begin{align*}
\text{CH}_3 & + \text{CH}_3
\end{align*}
\]

NaOH

(c) \[
\begin{align*}
\text{NaSEt} & \\
\text{HSEt}
\end{align*}
\]

3. (4 points) Provide the reagents necessary to accomplish the following transformations.

(a) \[
\begin{align*}
\text{CH}_3 & + \text{H}_3\text{C}
\end{align*}
\]

(b) \[
\begin{align*}
\text{Br}
\end{align*}
\]