1. Consider the following primary amine:

\[
\text{NH}_2
\]

a. Draw all alkenes that may result if the amine is reacted with excess ethyl iodide and then heated with silver oxide in a second step.

b. Predict the preference for each alkene to form. Which has the highest preference? Which has the lowest preference?

c. Consider the following tertiary amine. Draw the product obtained when treated with excess methyl iodide and then heated with silver oxide in a second step.

\[
\text{N(CH}_3)_2
\]

d. Draw the preferred product if the tertiary amine in part c is reacted with MCPBA.

2. L-Histidine is a so-called essential amino acid. It is a required \(\alpha\)-amino acid for humans but it cannot be synthesized de novo. Therefore it must be supplied in the diet.

\[
\text{O} \\
\text{N} \\
\text{NH}_2 \\
\text{N} \\
\text{NH}_2 \\
\text{C} \\
\text{C} \\
\text{C} \\
\text{C} \\
\text{C}
\]

a. Which nitrogen is reacted to form protein chains?

b. Which nitrogen is the most basic? Why?

c. Which nitrogen is the least basic? Why?
3. Shown are three $^1$H NMR’s for $\text{C}_5\text{H}_{13}\text{N}_1$ isomers. Draw the structure for each. Only 1 compound will have a peak disappear if $\text{D}_2\text{O}$ is added. Which one is this and why does the peak disappear?