1. (2 pts) Two products can form from the halogenation of 1-bromoethane. If the reaction happens randomly to give a statistical mix of products, what percent of each should form?

\[
\text{CH}_3\text{CH}_2\text{Br} \xrightarrow{\text{Cl}_2, \text{light}} \quad \text{pdt A} \quad \text{CH}_3\text{CHClBr} \quad 40\% \quad \text{pdt B} \quad \text{CH}_2\text{ClCH}_2\text{Br} \quad 60\%
\]

2. (4 points) Product B has a longer retention time on a GC column than product A. Fred Chemist gets a GC spectrum where a peak at 2.3 minutes has an area of 100 and a peak at 4.22 minutes has an area of 900. What is the experimental product distribution?

\[
\text{CH}_3\text{CH}_2\text{Br} \xrightarrow{\text{Cl}_2, \text{light}} \quad \text{pdt A} \quad \text{CH}_3\text{CHClBr} \quad 10\% \quad \text{pdt B} \quad \text{CH}_2\text{ClCH}_2\text{Br} \quad 90\%
\]

3. (3pts) What is the selectivity factor (preference factor) for abstracting a primary hydrogen (giving product B)? Please show all work.

\[
\text{pdt A} \quad \frac{10\%}{2 \text{H}} = 5\% \text{ per H} \quad \text{selectivity} = \frac{30\%}{5\%} = 6
\]

\[
\text{pdt B} \quad \frac{90\%}{3 \text{H}} = 30\% \text{ per H}
\]

4. (3pts) Mark each of these statements by circling true or false.

True or false: The retention time of a compound on GC will increase if the temperature is increased.

True or false: The areas under the peaks of a GC spectrum can only be used to determine relative product distributions if the response factors for each compound are different.

True or false: A GC generally gives better separation than fractional distillation because GC columns usually have more theoretical plates than a fractionation column.
5. (3 pts) The major mechanism of each of these reactions is E1, E2, S_N1, or S_N2. Fill in the blanks with the major mechanism:

Reaction A: \( \text{E2} \)  
Reaction B: \( \text{E1} \)  
Reaction C: \( \text{S_N1} \)

Reaction A.

\[
\begin{align*}
\text{HO-} & \quad \rightarrow \\
\text{Br} & \quad \rightarrow \\
\end{align*}
\]

Reaction B.

\[
\begin{align*}
\text{H}_2\text{SO}_4 & \quad \rightarrow \\
\text{OH} & \quad \rightarrow \\
\end{align*}
\]

Reaction C.

\[
\begin{align*}
\text{OH} & \quad \rightarrow \\
\text{HCl} & \quad \rightarrow \\
\end{align*}
\]

5. (2pts) Give one advantage and one disadvantage of fractional distillation compared to simple distillation:

Advantage - better separation, more pure product
Disadvantage - more time consuming

6. (3 pts) Refer to the drawing:

What is missing here?
thermometer

What is the purpose of a condenser?
Causes vapor to turn back to liquid for collection

Which flask contains the more purified substance? (left or right?)
right