1. Give the products or missing reactants for the following reactions. Include stereochemistry.

1a.

\[
\text{propyne} \xrightarrow{\text{Na, NH}_3} \xrightarrow{\text{HBr, light peroxides}}
\]

1b.

\[
\text{Br} + \text{CH}_3\text{OH} \xrightarrow{\text{methanol}}
\]

1c.

\[
\text{Br} \xrightarrow{\text{NaOEt, Excess}}
\]

1d.

\[
\text{NBS} \quad \text{CH}_2\text{Cl}_2 \quad \text{light}
\]

1e.

\[
\text{CHCl}_3 \quad (\text{CH}_3)_2\text{CO}^-\text{K}^+
\]
2. Propose a reasonable mechanism for these reactions:

2a.

\[
\text{\begin{tikzpicture}
  \node (ketone) at (0,0) {\includegraphics[width=0.5cm]{ketone.png}};
  \node (cl2) at (1,0) {\text{Cl}_2};
  \node (acetic) at (2,0) {\text{CH}_3\text{COOH}};
  \node (chloro) at (3,0) {\text{\includegraphics[width=0.5cm]{chloro.png}}};
  \node (hcl) at (4,0) {\text{HCl}};
  \draw[->] (ketone) -- (cl2);
  \draw[->] (cl2) -- (acetic);
  \draw[->] (acetic) -- (chloro);
  \draw[->] (chloro) -- (hcl);
\end{tikzpicture}}
\]

(racemic)

2b.

\[
\text{\begin{tikzpicture}
  \node (schna) at (0,0) {\text{\includegraphics[width=0.5cm]{schna.png}}};
  \node (water) at (1,0) {\text{H}_2\text{O}};
  \node (schnb) at (2,0) {\text{\includegraphics[width=0.5cm]{schnb.png}}};
  \draw[->] (schna) -- (water);
  \draw[->] (water) -- (schnb);
\end{tikzpicture}}
\]

Note the retention of configuration.

You must show any key intermediates.

3. Which of the following statements is not true regarding the S_n2 reaction of (R)-2-bromobutane with sodium cyanide?

a. the reaction proceeds with inversion of configuration

b. the rate is proportional to the concentration of sodium cyanide

c. the rate is proportional to the concentration of (R)-2-bromobutane

d. the rate of the reaction is independent of the identity of the solvent
4. Propose a synthesis for the following products by using the organic starting material provided and any other inorganic reagents, metals and solvents as needed:

4a.

4b.

5. What is the major product obtained from the reaction of 2-methyl-2-butene with hydrogen bromide in the presence of peroxides?
   a. 2,3-dibromo-2-methylbutane
   b. 2-bromo-3-methylbutane
   c. 2-bromo-2-methylbutane
   d. (E)-1-bromo-2-methyl-2-butene

6. Write down the products for the following reactions: