Stoichiometry #3 (Limiting Reactant)

1. How many moles of \( \text{H}_2\text{O} \) would be produced if 3.5 mol \( \text{H}_2 \) react with 1.5 mol \( \text{O}_2 \) in the following reaction:
   \[
   2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}
   \]

2. If 12.0 moles of \( \text{S}_8 \) reacted with 100. moles of \( \text{O}_2 \) in the unbalanced equation:
   \[
   \text{S}_8 + \text{O}_2 \rightarrow \text{SO}_3
   \]
   Which reactant is limiting, and how much of the other reactant would be left over?

3. 325 g of \( \text{H}_2\text{O} \) is poured onto a 450 g block of sodium metal. What is the limiting reactant? How many liters of \( \text{H}_2 \) gas are produced at S.T.P.? The equation for this reaction is:
   \[
   2 \text{Na} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaOH} + \text{H}_2
   \]

4. If 120 g of sand (\( \text{SiO}_2 \)) is poured into 0.50 \( \ell \) of 2.0 \( M \) hydrofluoric acid (HF), identify the limiting reactant and determine how much silicon tetrafluoride would be produced? The chemical equation for this reaction is:
   \[
   \text{SiO}_2 + 4 \text{HF} \rightarrow \text{SiF}_4 + 2 \text{H}_2\text{O}
   \]
5. If you add approximately 5.0 g of H₂O to approximately 5.0 g of calcium carbide (CaC₂), the reaction produces enough acetylene gas to make a satisfyingly loud explosion. Identify the limiting reactant and determine how many liters of acetylene (C₂H₂) gas would have been produced at S.T.P., assuming the *unbalanced* equation (which you will need to balance first) is:

\[
\text{CaC}_2 + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_2 + \text{Ca(OH)}_2
\]

(Remember that H₂O is H⁺ + OH⁻ in a chemical reaction.)

6. 3.27 g of Zn are reacted with 100. ml of 1.00 M HCl in the reaction:

\[
\text{Zn} + 2 \text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2
\]

(a) Determine which reactant is limiting.

(b) Determine the number of grams of ZnCl₂ that will be produced.

(c) If the reaction conditions are 0°C and 1 atm pressure (S.T.P.), determine the number of liters of H₂ gas that will be produced.

(d) If the non-limiting reactant is Zn, determine the mass in grams that will be left over.

(e) If the non-limiting reactant is HCl, determine the concentration (molarity) of the HCl after the reaction is complete. (Assume the volume does not change.)