Worksheet: Stoichiometry

PROBLEMS. Show work with proper Significant Figures and Units to receive credit. 8 pts for each question unless otherwise noted.

1) How many moles of water are needed to react with 40.3 moles of carbon dioxide in the following photosynthesis reaction?  
\[ 6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \]

40.3 mol H₂O

2) For the following combustion reactions,
   \[ \text{CH}_4(g) + 2\text{O}_2(g) \rightarrow \text{CO}_2(g) + 2\text{H}_2\text{O}(g) \]
   \[ 2\text{C}_8\text{H}_{18}(l) + 25\text{O}_2(g) \rightarrow 16\text{CO}_2(g) + 18\text{H}_2\text{O}(g) \]
   A. When each reaction producing 1000. kilojoules of heat energy, 20.0 g of methane is required against 22.5 g of octane. Which reaction will produce more carbon dioxide to generate the same amount of heat energy?
   B. From your calculation, which fuel would be more friendly to environment?

   A. For 1000. kJ energy
   20.0g CH₄ \rightarrow 54.9g CO₂
   22.5g C₈H₁₈ \rightarrow 69.4g CO₂
   B. CH₄ for less CO₂ produced.

3) The effervescence effect when Alka-Seltzer tablet is dissolved in water is produced by the baking soda (sodium bicarbonate) and citric acid reacting to form sodium citrate and carbon dioxide gas.

   \[ \text{C}_6\text{H}_8\text{O}_7(\text{aq}) + 3\text{NaHCO}_3(\text{aq}) \rightarrow 3\text{H}_2\text{O}(l) + 3\text{CO}_2(\text{g}) + \text{Na}_3\text{C}_6\text{H}_5\text{O}_7(\text{aq}) \]

   For every one gram of citric acid (C₆H₈O₇), how many grams of baking soda is needed to completely react with?

   \[ 1.312 \text{ g} \]

4) How many grams of carbon dioxide will be produced when 55.0 g of sugar (C₁₂H₂₂O₁₁) is completely metabolized in the reaction?  
\[ \text{C}_12\text{H}_{22}\text{O}_{11} + 12\text{O}_2 \rightarrow 12\text{CO}_2 + 11\text{H}_2\text{O} \]

84.9 g CO₂
5) When 10.0 moles of KMnO₄ are reacted with 10.0 moles of HCl in the following reaction,

\[ 2\text{KMnO}_4 + 14\text{HCl} \rightarrow 2\text{MnCl}_2 + 2\text{KCl} + 8\text{H}_2\text{O} + 5\text{Cl}_2 \]

A. Calculate to determine which is the limiting reactant, KMnO₄ or HCl?

\[
\begin{align*}
10.0\text{mol KMnO}_4 & \rightarrow 25.0\text{mol Cl}_2 \\
10.0\text{mol HCl} & \rightarrow 3.57\text{mol Cl}_2
\end{align*}
\]

B. Based on your answer to A, calculate the theoretical yield of chlorine gas produced in this reaction.

3.57 mol Cl₂

C. If the actual yield of chlorine gas is 2.00 moles, calculate the percent yield of chlorine.

56.0%

6) When 10.0 g of KMnO₄ are reacted with 10.0 g of HCl in the following reaction,

\[ 2\text{KMnO}_4 + 14\text{HCl} \rightarrow 2\text{MnCl}_2 + 2\text{KCl} + 8\text{H}_2\text{O} + 5\text{Cl}_2 \]

A. Calculate to determine which is the limiting reactant, KMnO₄ or HCl?

\[
\begin{align*}
10.0\text{g KMnO}_4 & \rightarrow 0.158\text{mol Cl}_2 \\
10.0\text{g HCl} & \rightarrow 0.0980\text{mol Cl}_2
\end{align*}
\]

B. Based on your answer to A, calculate the theoretical yield of chlorine gas produced in this reaction.

0.0980mol or 6.95g

C. If the actual yield of chlorine gas is 2.00 g, calculate the percent yield of chlorine.

28.8%