Chapter 9 Worksheet

1) For the following combustion/Redox reaction:
   \[ 2\, \text{Sr} \,(s) + \, \text{O}_2 \,(g) \rightarrow 2\, \text{SrO} \,(s) \]
   How many grams of strontium oxide are formed when 0.494 moles of strontium react with excess oxygen?

2) For the following precipitation/double displacement reaction:
   \[ 3\, \text{Zn(ClO}_3)_2 \,(aq) + 2\, \text{K}_3\text{PO}_4 \,(aq) \rightarrow \text{Zn}_3(\text{PO}_4)_2 \,(s) + 6\, \text{KClO}_3 \,(aq) \]
   How many grams of potassium phosphate are required to form 12.7 g of precipitate?

3) For the following neutralization reaction:
   \[ \text{H}_2\text{O}^+ \,(aq) + \text{Cl}^- \,(aq) + \text{Na}^+ \,(aq) + \text{OH}^- \,(aq) \rightarrow 2\, \text{H}_2\text{O} \,(l) + \text{Na}^+ \,(aq) + \text{Cl}^- \,(aq) \]
   How many grams of water are formed when 0.998 g of hydronium ion react with excess base?

4) How many mg of precipitate are formed when reacting 12.05 g of barium chloride with excess silver nitrate?
   \[ 2\, \text{AgNO}_3 \,(aq) + \text{BaCl}_2 \,(aq) \rightarrow 2\, \text{AgCl} \,(s) + \text{Ba(NO}_3)_2 \,(aq) \]

5) How many mg of Cr(NO\textsubscript{3})\textsubscript{3} (aq) are required to completely react with 0.433 g of (NH\textsubscript{4})\textsubscript{2}S (aq)?
   \[ 2\, \text{Cr(NO}_3)_3 \,(aq) + 3\, (\text{NH}_4)_2\text{S} \,(aq) \rightarrow 6\, \text{NH}_4\text{NO}_3 \,(aq) + \text{Cr}_2\text{S}_3 \,(s) \]

6) Laughing gas, N\textsubscript{2}O, is made by the careful thermal decomposition of ammonium nitrate.
   \[ \text{NH}_4\text{NO}_3(s) \rightarrow \text{N}_2\text{O}(g) + 2\text{H}_2\text{O}(l) \]
   a. If you begin with 1.00x10\textsuperscript{3} g of ammonium nitrate, how many grams of laughing gas can you obtain?
   b. If you begin with 1.00x10\textsuperscript{3} g of ammonium nitrate, how many grams of water can you obtain?

7) Use the precipitation reaction below to answer the following questions.
   \[ \text{Li}_2\text{CO}_3 \,(aq) + \text{Ca(C}_2\text{H}_3\text{O}_2)_2 \,(aq) \rightarrow 2\, \text{LiC}_2\text{H}_3\text{O}_2 \,(aq) + \text{CaCO}_3 \,(s) \]
   a. If you started with 2.99 g of Li\textsubscript{2}CO\textsubscript{3} and an unlimited supply of Ca(C\textsubscript{2}H\textsubscript{3}O\textsubscript{2})\textsubscript{2}, how many grams of CaCO\textsubscript{3} could be produced?
   b. If you started with 4.077 g of Ca(C\textsubscript{2}H\textsubscript{3}O\textsubscript{2})\textsubscript{2} and an unlimited supply of Li\textsubscript{2}CO\textsubscript{3}, how many grams of CaCO\textsubscript{3} could be produced?
   c. Now assume you added the 2.99 g of Li\textsubscript{2}CO\textsubscript{3} to the 4.077 g of Ca(C\textsubscript{2}H\textsubscript{3}O\textsubscript{2})\textsubscript{2}, what mass of CaCO\textsubscript{3} could be produced? You do not need to do any calculations for this question. Look at your solutions to parts a) and b) above and determine your answer.

8) Do this problem after all of the others. This problem involves a lot of estimating and may be more of a chem 180 problem. Calculate how many tons of CO\textsubscript{2} (g) you release in one year driving. Assume the density of gasoline (use octane) to be 0.814 g/ml (For this problem, you will need to estimate the volume of octane/gasoline you use in one year. To do this, you will need to determine the amount of miles you drive in a year and then convert that to gallons of gas consumed using the fuel efficiency/MPG of your car.)
   \[ 2\, \text{C}_8\text{H}_{18} \,(g) + 25\, \text{O}_2 \,(g) \rightarrow 16\, \text{CO}_2 \,(g) + 16\, \text{H}_2\text{O} \,(g) \] combustion of gasoline (as octane)

9) Methyl alcohol (wood alcohol), CH\textsubscript{3}OH, is produced via the reaction
   \[ \text{CO} \,(g) + 2\, \text{H}_2 \,(g) \rightarrow \text{CH}_3\text{OH} \,(l) \]
   A mixture of 15.21 g H\textsubscript{2}(g) and 54.52 g CO(g) are allowed to react.
   a. Which reagent is the limiting reagent?
   b. What is the theoretical yield of CH\textsubscript{3}OH in grams?
   c. How much of the reagent present in excess is left over?
   d. Suppose the actual yield is 22.52 g of CH\textsubscript{3}OH. What is the % yield?

10) Given the following equation:
    \[ \text{Al}_2(\text{SO}_3)_3 + \text{NaOH} \rightarrow \text{Na}_2\text{SO}_3 + \text{Al(OH)}_3 \]
    a. If 10.00 g of Al\textsubscript{2}(SO\textsubscript{3})\textsubscript{3} is reacted with 10.00 g of NaOH, determine the limiting reagent make sure that you carefully examine the chemical reaction before you start this problem).
    b. Determine the number of moles of Al(OH)\textsubscript{3} produced.
    c. Determine the number of grams of Na\textsubscript{2}SO\textsubscript{3} produced.
    d. Determine the number of grams of excess reagent left over in the reaction.
11). a. Nitrogen gas and hydrogen gas can react together to form ammonia gas (NH₃). What is the balanced chemical equation for this reaction?

b. Based on the balanced chemical equation above, if we start with the mixture indicated by the box on the left before the reaction occurs, how many molecules of N₂, H₂, and NH₃ should there be after the reaction is complete?

This is another difficult problem that represents more the type of problem you would encounter in chem 180. Hydrogen peroxide, H₂O₂(aq), decomposes into H₂O(l) and O₂(g). If you have 80.0 mL of a solution that is 35.0% by mass H₂O₂, what is the mass of O₂(g) produced when all of the H₂O₂ decomposes? Assume the H₂O₂(aq) solution has a density of 1.13 g/mL.

If only 12.0 g of O₂ was produced, what was the percent yield of O₂?