STOICHIOMETRY AND LIMITING REACTANT REVIEW

1. Calcium carbonate reacts with phosphoric acid to produce calcium phosphate, carbon dioxide, and water.
   a. How many grams of phosphoric acid react with excess calcium carbonate to produce 3.74 g of calcium phosphate? ***(2.36 g H_3PO_4)***
   b. Calculate the number of grams of carbon dioxide formed with .773 g of water is produced. ***(1.89 g CO_2)***
2. Nitric acid and zinc react to form zinc nitrate, ammonium nitrate, and water.
   a. How many atoms of zinc react with 1.49 g of nitric acid? ***(5.70 x 10^{21} atoms Zn)***
   b. Calculate the number of grams of zinc that must react with an excess of nitric acid to form 29.1 g of ammonium nitrate. ***(95.2 g Zn)***
3. Hydrazine (N_2H_4) is used as a rocket fuel. It reacts with oxygen to form nitrogen and water.
   a. How many liters of Nitrogen gas (at STP) form when 1.0 kg of hyrdrazine reacts with 1.0 kg of oxygen gas? ***(7.0 x 10^2 L N_2)***
   b. How many grams of the excess reactant remain after the reaction? *(no reactant in excess)*
4. When 50.0 g of silicon dioxide is heated with an excess of Carbon, 32.2 g of silicon carbide (SiC) - another product is carbon monoxide.
   a. What is the percent yield of this reaction? ***(96.4%)***
   b. How many grams of carbon monoxide gas are made? ***(45.0 g)***
5. If the reaction below proceeds with a 96.8% yield, how many kilograms of Calcium sulfate are formed when 5.24 kg sulfur dioxide reacts with excess of Calcium carbonate and oxygen? ***(10.7 kg $CaSO_4$)***

   $$CaCO_3 + SO_2 + O_2 \rightarrow CaSO_4 + CO_2$$

6. Ammonium nitrate will decompose explosively at high temperatures to form nitrogen, oxygen, and water vapor. ($NH_4NO_3 \rightarrow N_2 + H_2O + O_2$) What is the total number of liters of gas formed when 228 g of ammonium nitrate is decomposed? (Assume STP) ***(224 L of gas)***
7. Ethyl alcohol (C_2H_5OH) can be produced by the fermentation of glucose ($C_6H_{12}O_6$). If it takes 5.0 hr to produce 8.0 kg of alcohol, how many days will it take to consume 1.0 x 10^3 kg of glucose? ***(13 days)***

   $$C_6H_{12}O_6 \rightarrow C_2H_5OH + CO_2$$

8. What is the limiting reactant when 150.0 g of N_2 reacts with 32.1 g of H_2 to produce NH_3? ***(no LR)***
9. A 500 g sample of aluminum sulfate is reacted with 450 g of calcium hydroxide. A total of 596 g of calcium sulfate is produced. What is the limiting reactant in this reaction, and how many moles of excess reactant are unreacted? ***(LR is $Al_2(SO_4)_3$; 1.69 mol $Ca(OH)_2$ remaining)***
10. If 5.0 g of Hydrogen are reacted with excess carbon monoxide, how many grams of CH_3OH are produced, based on a yield of 86%. $CO + H_2 \rightarrow CH_3OH$ ***(34 g CH_3OH)***
11. The decomposition of potassium chlorate yields oxygen gas. If the yield is 95%, how many grams of potassium chlorate are needed to produce 10.0 L of oxygen; the other product is KCl? ***(38.4 g $KClO_3$)***
12. For the reaction of the synthesis sodium chloride, how many grams of sodium chloride could be produced from 103.0 g of sodium and 13.0 L of chlorine (at STP)? ***(67.3 g NaCl)***
13. Identify which of these unbalanced equations represent redox reactions.
    a. $Li + H_2O \rightarrow LiOH + H_2$
    b. $K_2Cr_2O_7 + HCl \rightarrow KCl + CrCl_3 + H_2O + Cl_2$
    c. $Al + HCl \rightarrow AlCl_3 + H_2$
    d. $P_4 + S_8 \rightarrow P_2S_5$
14. For each redox equation in problem 13, identify what is oxidized and what is reduced.
15. Determine the oxidation number of phosphorus in each substance.
    a. P_4O_6 b. PO_3^{-3} c. PO_2^{-3} d. P_4O_8 e. P_2O_5 f. $H_2PO_3^{-1}$
16. Write the complete ionic equation and net ionic equation for each of the following:
    a. $Zn + HCl \rightarrow H_2 + ZnCl_2$
    b. $Pb(NO_3)_2 + NaI \rightarrow NaNO_3 + PbI_2$
17. Balance the following with the half reaction method in an acidic or neutral solution:
    a. $H_2S + NO_3^{-1} \rightarrow SO_4^{-2} + NO_2$
    b. $NH_4^{+1} + O_2 \rightarrow NO_3^{-1} + H_2O$
18. Balance the following with the half reaction method in a basic solution:
    a. $Br_2 + C_6H_6O_6 \rightarrow Br^{-1} + C_6H_4O_6$
    b. $Zn + VO_3^{-1} \rightarrow V^{+2} + Zn^{+2}$