Name: _____ Section: _____

Chapter 3 Practice Worksheet:
Formulas, Equations, and Moles: Part II

1) **Stoichiometry: Chemical Arithmetic**

For each equation and starting amount and substance shown, calculate the amount of the product produced.

Equation	**Starting amount/substance**	**Product amount/substance**
$S\ (s) + O_2\ (g) \rightarrow SO_2\ (g)$	2.35 moles S	moles SO_2
$Si\ (s) + 2Cl_2\ (g) \rightarrow SiCl_4\ (l)$	4.1 moles Cl_2	grams $SiCl_4$
$3H_2\ (g) + N_2\ (g) \rightarrow 2NH_3\ (g)$	0.03445 grams H_2	grams NH_3
$KCN\ (aq) + HCl\ (aq) \rightarrow KCl\ (aq) + HCN\ (g)$	1.09 grams HCl	moles HCN
$2NH_3\ (g) + H_2SO_4\ (aq) \rightarrow (NH_4)_2SO_4\ (aq)$	0.00568 grams NH_3	grams $(NH_4)_2SO_4$
$2NO\ (g) + O_2\ (g) \rightarrow 2NO_2\ (g)$	6.50 moles O_2	moles NO_2

2) **Yields of Chemical Reactions/Limiting Reactants**

a. MnO_2 reacts with HCl to produce $MnCl_2$, Cl_2, and H_2O. Write a balanced equation for this reaction. If 0.86 moles of MnO_2 and 48.2 grams of HCl react, which reagent will be used up first? How many grams of Cl_2 will be produced? How many moles of the excess reagent will be left over? If 19.8 grams of Cl_2 were obtained in lab, what is the percent yield?

b. ___ CaF_2 + ___ H_2SO_4 → ___ $CaSO_4$ + ___ HF

In the reaction above, you begin with 6.00 g of CaF_2 and 12.592 g H_2SO_4. You obtain 2.86 g of HF as a product. What is the percent yield of HF?

c. ___ K_3PO_4 (aq) + ___ $AgNO_3$ (aq) → ___ KNO_3 (aq) + ___ Ag_3PO_4 (s)

70.5 mg 15.0 mL of 0.050 M

Find the mass of precipitate formed in this reaction.

3) **Concentrations of Reactants in Solution: Molarity**

a. How many moles of solute are in the following solutions?

10.76 mL of 1.54 M HF

250.0 mL of 0.99 M glucose ($C_6H_{12}O_6$)

50.1 mL of a 0.145 M solution of H_2SO_4

b. What is the concentration of a solution made by adding 15.5666 g of KOH in a 250.0 mL flask?

c. What mass of $AgNO_3$ is needed to make 500.0 mL of a 1.500 M solution?

d. Calculate the molarity of a solution that contains 0.0345 mol NH_4Cl in 400 mL of solution.

e. How many grams of HNO_2 are present in 35.0 mL of a 2.20 M solution of nitric acid?

f. What is the concentration of 156 mL of solution made from 2.5 grams of KCl?

g. How many milliliters of 1.50 M KOH solution are needed to give 0.125 mol of KOH?

h. How many grams of $KMnO_4$ are needed to make 500 mL of solution whose concentration is 1.75 M?

4) **Diluting Concentrated Solutions**

a. You have a 1.00 L bottle of 12.0 M HCl on your lab bench. How would you make a 250.0 mL solution of 1.00 M HCl?

b. What is the concentration of a solution made by adding 15.0 mL of 18.0 M H_2SO_4 to 100.0 mL of water?

c. A bottle of 15.0 M HCl has 27.5 mL left. What will the concentration of HCl be if water is added to the bottle to fill it to the 500.0 mL mark?

d. 260.0 mL of water are added to 37.8 mL of 1.66 M HCl. What is the concentration of the diluted solution?

e. How many milliliters of 3.0 M H_2SO_4 are required to make 450 mL of 0.10 M H_2SO_4?

f. How would you prepare 1.45×10^3 mL of a 1.45 M HNO_3 solution using 12.0 M stock solution of HNO_3? (How much water must be added to the stock solution?)

5) **Solution Stoichiometry**

a. ___$CaCO_3$ (s) + ___ HCl (aq) → ___$CaCl_2$ (aq) + ___H_2O (l) + ___CO_2 (g)

What mass of $CaCO_3$ is required to react with 25.0 mL of 0.750 M HCl?

b. ___ HNO_3 (aq) + ___ NaOH (aq) → ___ $NaNO_3$ (aq) + ___ H_2O (l)

250.0 mL of 0.100 M HNO_3 is combined with an excess of NaOH. How much H_2O (in g) will be produced by this reaction?

c. You add 500 mL of 0.100 M $AgNO_3$ solution to a solution containing an excess of NaCl. How many grams of AgCl precipitate will you form? (Hint: Write a net ionic equation for the precipitation of AgCl.)

d. If you mix 0.200 L of 0.100 M $Pb(NO_3)_2$ and 0.300 L of 0.200 M NaCl, how much $PbCl_2$ precipitate will you form? (Hint: Limiting reactant problem!)

f. A 156.7 mL solution of 1.50 M $AgNO_3$ is mixed with a 4.22 g of solid K_3PO_4. When mixed together, a new solid forms. Identify the precipitate. Determine what mass of precipitate will form. Calculate the percent yield if only 6.045 g of precipitate was formed in lab.

g. Calculate the mass of the precipitate formed when 2.27 L of 0.0820 M $AgNO_3$ are mixed with 3.06 L of 0.0664 M K_2SO_4.

6) **Titration**

a. How many milliliters of 0.155 M HCl are needed to neutralize completely 35.0 mL of 0.101 M $Ba(OH)_2$ solution? (Hint: Write a balanced equation first.)

b. How many milliliters of 2.50 M H_2SO_4 are needed to neutralize 75.0 g of NaOH? (Hint: Write a balanced equation first.)

c. What is the molarity of a hydrochloric acid solution if it took 30.0 mL to neutralize 48.0 mL of 0.100 M NaOH? (Hint: Write a balanced equation first.)

d. 25.0 mL of 0.050 M $Ba(OH)_2$ neutralized 40.0 mL of nitric acid (HNO_3). Determine the concentration of the acid.

e. What is the concentration of NaOH if it takes 25 mL of 0.75 M HCl to neutralize 16.7 mL of NaOH? (Write a balanced equation first.)

f. How many grams of solid NaOH are required to neutralize 48.2 mL of 1.25 M H_2SO_4? (Write a balanced equation first.)

Percent Composition and Empirical Formulas

7) What is the mass percent of each element in the following compounds?

a. $CaCl_2$

b. Fe_2O_3

c. $C_6H_{10}S_2O$

8) Calculate the empirical formulas of compounds containing the following percentages of elements. Use the molar mass to calculate the molecular formula for that compound as well.

a. 44.4% C, 6.21% H, 39.5% S, and 9.86% O; molar mass = 486.39 g/mol

b. 20.2% Al, 79.8% Cl; molar mass = 266.6 g/mol

c. 2.1% H, 65.2% O, 32.6% S; molar mass = 195.95 g/mol

d. 19.8% C, 2.50% H, 11.6% N, 66.1% O; molar mass = 360 g/mol