NAME: **HONORS CHEMISTRY**

SECTION: Stoichiometry Review Sheet

**After studying chapter 9, you should be able to:**

* Interpret balanced chemical equations in terms of interacting moles, representative particles, and masses
* Construct mole ratios from balanced chemical equations and apply these ratios in calculating mole-mole stoichiometric quantities.
* Calculate stoichiometric quantities from balanced chemical equations using units of mass.
* Calculate stoichiometric quantities from balanced chemical equations using units of moles, mass, and representative particles
* Identify the limiting reagent in a reaction and use it to calculate stoichiometric quantities and the amount of excess reagent(s).
* Calculate the theoretical yield, actual yield, and/or percent yield for a chemical reaction.
* Construct equations that show the heat changes for chemical and physical processes.
* Determine the heat of reaction for a chemical reaction in which a specified amount of substance is involved.

1. What is meant by the term “mole ratio”? Give an example of a mole ratio. How is the mole ratio used in solving problems?
2. Consider the reaction represented by the *unbalanced* equation: \_\_NH3 + \_\_O2 →\_\_ NO + \_\_H2O
   1. For every four molecules of NH3 that react, \_\_\_\_ molecules of O2 are required.
   2. For every 1.00 mol of NH3 that reacts, \_\_\_\_ mol of O2 is required.
3. The compound freon-12 (CCl2F2) was formerly used as a coolant in refrigerators and air conditioners. It is produced through the following *unbalanced* equation:

\_\_\_CCℓ4 + \_\_\_SbF3 → \_\_\_CCℓ2F2 + \_\_\_SbCℓ3

If 1800 grams of freon need to be produced, calculate the mass required for each reactant.

1. Zinc oxide can be prepared industrially by treating zinc sulfide with oxygen. The by-product is sulfur dioxide. An engineer expects to obtain a 78% yield of zinc oxide by this process. How much zinc sulfide should the chemical plant have on hand to prepare 2.0 x 104 kg of zinc oxide? Start by writing a balanced chemical equation for the reaction.
2. A 60.0 mL sample of aqueous Ca(OH)2 requires 38.44 mL of 0.0975 M nitric acid, HNO3, for neutralization.
   1. Write a balanced chemical equation for this reaction.
   2. Calculate the molarity of the original solution of calcium hydroxide.
3. When a limiting reactant is present, in what way is the reaction “limited”? What happens to a reaction when the limiting reactant is used up?
4. Consider the reaction Mg(s) + I2(s) → MgI2(s)

Identify the limiting reagent in each of the reaction mixtures below:

* 1. 100 atoms of Mg and 100 molecules of I2
  2. 150 atoms of Mg and 100 molecules of I2
  3. 0.16 mol Mg and 0.25 mol I2
  4. 0.12mol Mg and 0.08 mol I2
  5. 6.078 g Mg and 53.455 g I2
  6. 1.00 g Mg and 2.00 g I2

1. Chlorine gas is a very reactive element and will combine with most metals. For example,

2 K(s) + Cl2(g) → 2 KCl (s)

Ca(s) + Cl2(g) → CaCl2(s)

2 Al(s) + 3 Cl2(g) → 2 AlCl3(s)

* 1. Suppose an individual 25.0 g sample of potassium metal is reacted with a 50.0 g sample of Cl2(g). Determine whether the metal or chlorine is the limiting reactant, and calculate the theoretical yield for this reaction.
  2. Suppose you run the reaction between potassium and chlorine and you collect 31.2 g of potassium chloride. Determine your percent yield.

1. Your teacher gives you 5.00 g of a mixture of two salts—silver nitrate and potassium nitrate—and asks you to determine the percent silver nitrate by mass in the mixture. You dissolve the mixture in water and add an excess of aqueous sodium chloride. You collect and dry the white solid that precipitates and find that it has a mass of 1.48 g. Provide balanced equations for all reactions that occur in this process and determine the percent silver nitrate by mass in the original mixture. (Hint: your solubility table might be useful here.)
2. The dissociation of ammonia into its elements is an endothermic reaction, absorbing 92.2 kJ of energy according to the equation:

2 NH3 (g) + 92.2 kJ → 3 H2(g) + N2(g)

How much energy will be required to decompose 85.0 grams of ammonia?

1. Phosphorus burns in air to produce dense white clouds of P4O10 gas. When this gas is dissolved in rain water, phosphoric acid is produced. How much energy is released when 14.2 g of P4O10 reacts?

P4O10(g) + 6 H2O(l) → 4 H3PO4(aq) + 424 kJ

1. For the following balanced chemical reaction:

2H2S + 3O2 → 2SO2 + 2H2O

If the reaction of 53.2 grams of H2S and 72.95 grams of O2 produces 20.03 grams of H2O, what is the % yield?

1. What mass of solid AgBr is produced when 100.0 mL of 0.150 M AgNO3 is added to 20.0 mL of 1.00M NaBr? (Hint: start with a balanced equation)
2. Hydrogen cyanide gas is prepared commercially by the reaction of methane, CH4(g), ammonia, NH3(g), and oxygen, O2(g); the other product is gaseous water.
   1. Write a chemical equation for the reaction.
   2. What mass of HCN can be obtained from 20.0 g methane, 20.0 g ammonia, and 20.0 g oxygen?

Answers to selected problems

4. 3.1 x 104 kg ZnS

8b. 65.4% yield

10. +231 kJ

11. -21.2 kJ

12. 73.21% yield

13. 2.82 g