Honors Chemistry

Chapter 3 Study Questions

1. Glycerol ($C_3H_8O_3$) is sold in drug stores as glycerine and is commonly found in soaps and shampoos.
   a) What is the molar mass of glycerol?
   b) What is the mass in grams of 1.00 mole of glycerol?
   c) How many molecules are in one mole of glycerol?
   d) How many grams are in 0.217 moles of glycerol?

2. Ammonia (NH_3) is the active ingredient in many kitchen cleansers. How many atoms are in
   a) one molecule of ammonia?
   b) one mole of ammonia?
   c) 3.40 grams of ammonia?

3. Sodium nitrite is a controversial food preservative added to processed meat and thought to form cancer-causing compounds when heated. What are the mass percentages of each element in sodium nitrite?

4. A compound consists of 40.7% C, 5.1% H, and 54.2% O?
   a) What is its empirical formula?
   b) The molar mass of this compound is 118 grams/mole. What is the molecular formula of this compound?

5. A 25.0 gram sample of a compound made up of magnesium, carbon and oxygen contains 7.20 grams magnesium and 3.55 grams carbon.
   a) Find the empirical formula of this compound.
   b) Find the mass percentage of each element in this compound.
   c) What is the mass of magnesium in a 13.9 gram sample of this compound?
   d) What is the mass of this compound that contains 0.290 moles of carbon?

6. A sample of zinc is heated in air to form zinc oxide. Assuming all of the zinc is converted to the oxide, use the data table below to calculate the empirical formula of zinc oxide.

mass of crucible	= 32.00 g
mass of crucible + zinc (before heating)	= 33.64 g
mass of crucible + oxide (after heating)	= 34.04 g

7. Balance the following equations:
   a) the combustion of the rocket fuel diborane,
   $$B_2H_6(l) \; + \; O_2(g) \; \rightarrow \; B_2O_3(s) \; + \; H_2O(l)$$
   b) the combustion of the poisonous gas, PH_3,
   $$PH_3(g) \; + \; O_2(g) \; \rightarrow \; H_2O(l) \; + \; P_4O_{10}(s)$$

8. Write a balanced equation for each of the following reactions:
   a) the reaction of solid lithium with nitrogen to form solid lithium nitride.
   b) the reaction between aqueous solutions of cobalt(III) nitrate and sodium hydroxide to form aqueous sodium nitrate and solid cobalt(III) hydroxide.
   c) the reaction between solid zinc and aqueous hydrochloric acid in a single replacement reaction.
   d) classify the reactions in (a) and (b).

9. Hydrogen sulfide, given off by decaying organic matter, is converted to sulfur dioxide in the atmosphere by the reaction:

$$2\ H_2S(g) + 3\ O_2(g) \rightarrow 2\ SO_2(g) + 2\ H_2O(l)$$

   a) How many moles of H_2S are required to form 8.20 moles of SO_2?
   b) How many grams of O_2 are required to react with 1.00 mole of H_2S?
   c) How many grams of water are produced from 6.82 g H_2S?
   d) If 12.0 grams of SO_2 are formed from 7.98 g of H_2S, what is the percent yield?
   e) How many grams of SO_2 are produced starting from 2.66 g H_2S and 3.00 g O_2? Which reactant is limiting?

10. A gaseous mixture containing 7.50 mol $H_2(g)$ and 9.00 mol $Cl_2(g)$ reacts to form hydrogen chloride (HCl) gas.
   a) Write a balanced equation for the reaction.
   b) Which reactant is limiting?
   c) If all the limiting reactant is consumed, how many moles of hydrogen chloride are formed?
   d) How many moles of the excess reactant remain unreacted?

Chapter 3: Stoichiometry

atomic mass
molar mass
moles
Avogadro's number
conversions: # particles ↔ moles ↔ mass
percent composition
empirical formula
percent composition ↔ formula
finding molecular formula from empirical formula and molar mass
formula from experimental data

percent composition conversions
writing and balancing chemical equations
    reactants, products, coefficients
types of chemical reactions
    combination, decomposition, single replacement, double displacement
stoichiometry: mass/mole conversions in chemical reactions
limiting reactant, excess reactant
theoretical yield, experimental yield
percent yield