**Review Package #2**

**Percentage Composition, Empirical and Molecular Formulae:**

1. Write the empirical formula for each of the following compounds.

1. P4O10 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Mg2Cl4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Pb2(CO3)4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. N2O2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Calculate the percentage composition by mass of each of the following compounds. a) CO2 b) C4H8O

3. Calculate the percentage composition of the bold species in each of the following compounds. a) Cu(**NO3**)2 b) NaSCN · 5**H2O**

4. a) A compound has the following composition: 24.24% C, 4.04% H and 71.72% Cl. What is the empirical formula of the compound?

b) If the molecular mass of this compound is 99.5 g/mol, what is the molecular formula?

5. The molar mass of a compound is 58 g/mol. What is the molecular formula of the compound if the empirical formula is C2H5?

**Molarity Calculations:**

1. If a 4.50g sample of solid NaOH is dissolved to make 0.500L of solution, what is the molarity of the solution?
2. How many grams of Na2CO3 would be required to produce 400.0mL of 0.600M Na2CO3?
3. If 75.7g of Magnesium chloride are mixed with sufficient water to make a 0.885M solution, what is the volume of the solution?
4. How many mL of 16.4 M H2SO4 are needed to prepare 755mL of 0.25M H2SO4?

**Chemical Reactions and Equations:**

1. Balance and classify the following chemical reactions. Type of Reaction

1. \_\_\_KNO3 → \_\_\_KNO2 + \_\_\_O2  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_CaC2 + \_\_\_O2 → \_\_\_Ca + \_\_\_CO2  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_C5H12  + \_\_\_O2 → \_\_\_CO2 + \_\_\_H2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_K2SO4 + \_\_\_BaCl2 → \_\_\_KCl + \_\_\_BaSO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. \_\_\_KOH + \_\_\_H2SO4  → \_\_\_K2SO4 + \_\_\_H2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. \_\_\_Ca(OH)2 + \_\_\_NH4Cl → \_\_\_NH4OH + \_\_\_CaCl2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. \_\_\_C4H9S + \_\_\_O2 → \_\_\_CO2 + \_\_\_SO2 + \_\_\_H2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. \_\_\_C15H30 + \_\_\_O2 → \_\_\_CO2 + \_\_\_H2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. \_\_\_BN + \_\_\_F2 → \_\_\_BF3 + \_\_\_N2  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_Na + \_\_\_ZnI2 → \_\_\_NaI + \_\_\_Zn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Classify, complete AND balance the following chemical equations. Type of Reaction

a) \_\_\_Ni(s) + \_\_\_Cu(NO3)2(aq) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) \_\_\_Fe (II) (s) + \_\_\_O2(g) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) \_\_\_NaCl(s) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) \_\_\_ H2SO4(aq) + \_\_\_NaOH(aq) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

e) \_\_\_C4H10(l) + \_\_\_O2(g) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

f) \_\_\_Ag(s) + \_\_\_Cl2(g) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

g) \_\_\_Cl2(g) + \_\_\_KI(s) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

h) \_\_\_Fe (III)(s) + \_\_\_AgCl(aq) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

i) \_\_\_AgNO3(aq) + \_\_\_BaCl2(aq) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

j) \_\_\_BaCO3(aq) + \_\_\_Sr(OH)2(aq) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

k) \_\_\_C2H5OH(l) + \_\_\_O2(g) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

l) \_\_\_HNO3(aq) + \_\_\_KOH(aq) → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write a balanced chemical equation for each of the following, and classify each as synthesis, decomposition, single replacement, double replacement, neutralization or combustion.

a) potassium sulphate is mixed with cobalt (III) nitrate

b) liquid propanol (C3H7OH) is burned in air

c) ammonium nitrate is decomposed into it’s elements

d) a piece of zinc is placed in a test-tube containing a solution of silver nitrate

e) bromine reacts with sodium iodide

f) bromine reacts with aluminum

g) rubidium reacts with chlorine gas

h) hydrochloric acid reacts with strontium hydroxide

**Energy of Reactions:**

1. Define ENDOTHERMIC and EXOTHERMIC reactions.

Endothermic:

Exothermic:

2. Classify the following reactions as either endothermic or exothermic.

a) 2C + O2 → 2CO2 + energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) N2O4 + energy → N2 + 2O2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c) AB + C → CB + A + 56.9kJ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d) AB + CD → AD + BC ΔH = -256.4kJ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Stoichiometry:**

1. Ammonia combines with oxygen gas in the following reaction:

* + NH3 + 5O2 → 6H2O + 4NO

1. How many moles of NH3 are needed to combine with 3.57 moles of O2 gas?
2. If 1.5 grams of NO is produced in the above reaction, how many grams of NH3 were reacted?

2. 3Na2CO3 + 2FeCl3 → 6NaCl + Fe2(CO)3

a) How many grams of NaCl will be produced from the reaction of 0.080moles of Na2CO3 with excess FeCl3?

b) How many grams of FeCl3 would be needed to react with 4.2g of Na2CO3?

3. 3Mg + 2AlCl3 → 3MgCl2  + 2Al

1. How many grams of MgCl2 would be formed if 50.0mL of 0.200M AlCl3 is reacted with excess Mg?
2. How many mL of 0.150M AlCl3 would be needed to react completely with 2.00g of Mg?

**Excess and Limiting Reagents/Percent Yield:**

1. 2Fe2S3 + 9O2 → 2Fe2O3 + 6 SO2

In a chemical reaction 6.92g of Fe2S3 is combined with 4.54g of oxygen gas.

1. Which reactant is the **LIMITING** reagent?
2. How many grams of the **EXCESS** reactant will be **left over** after the reaction is complete?
3. How many grams of Fe2O3 can be formed in this reaction?

2. What mass of P4 will be produced when 41.5g of Ca3(PO4)2, 26.3g of SiO2, and 7.80g of C are reacted according to the following balanced equation?

2 Ca3(PO4)2 + 6 SiO2 + 10C → P4 + 6CaSiO3 + 10CO

3. 4Al + 3O2 → 2Al2O3

1. How many grams of aluminum oxide, Al2O3, would be expected to form in the reaction of 15.0g Al with 18.43g of oxygen gas?
2. If the actual yield of Al2O3 produced in the reaction was only 22.4g Al2O3, what would the PERCENT YIELD of the reaction be?

**Extra Stoich Problems:**

1. Given the following balanced equation, answer the questions following it:

2NF3(g) + 3H2(g) 🡪 N2(g) + 6HF(g)

a) If 5.5 moles of H2 are reacted, how many moles of NF3 will be consumed?

Answer \_\_\_\_\_\_\_\_\_\_\_\_

b) In order to produce 0.47 moles of HF, how many moles of NF3 would be consumed?

Answer \_\_\_\_\_\_\_\_\_\_\_\_

c) If you needed to produce 180.6 g of N2, how many moles of H2 would you need to start with?

Answer \_\_\_\_\_\_\_\_\_\_\_\_

d) If you completely react 17.04 g of NF3 , what mass of HF will be produced?

Answer \_\_\_\_\_\_\_\_\_\_\_\_

2. Given the following balanced equation, answer the questions following it:

HBrO3 + 5 HBr 🡪 3 H2O(l) + 3 Br2(g)

a) If 3.56 moles of HBr are reacted, how many Litres of Br2 will be formed at STP?

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) In order to produce 3.311 x 1024 molecules of Br2, what mass of HBr is needed?

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Given the following balanced chemical equation, answer the question below it.  
  
 MgCO3 (s) + 2HCl (aq) 🡪 CO2 (g) + H2O (l)  + MgCl2(aq)

a) What mass of MgCO3 will react completely with 15.0 mL of 1.5 M HCl?

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) Calculate the volume of 2.0 M HCl which would be needed to react completely with 37.935 grams of magnesium carbonate.

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Given the following balanced equation, answer the questions below it.

Ba(OH)2(aq) + 2 HNO3(aq) 🡪 2 H2O(l) + Ba(NO3)2

a) In a titration, 18.20 mL of 0.300 M Ba(OH)2 is required to react completely with a 25.0 mL sample of a solution of HNO3. Find the [HNO3].   
  
  
  
  
  
  
 Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) In a titration, 11.06 mL of 0.200 M HNO3 is required to react completely with   
 a sample of 0.250M Ba(OH)2 . Find the volume of the Ba(OH)2 sample.

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Given the following balanced equation, answer the questions below it.

3 Cu(s) + 8HNO3(l) 🡪 3 Cu(NO3)2(aq) + 2NO(g) + 4 H2O(l)

a) If 317.5 grams of Cu are placed into 756.0 grams of HNO3, determine which reactant is in excess.

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) If the reaction in (a) is carried out, what mass of NO will be formed?

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Given the balanced equation: 2BN + 3F2 🡪 2BF3 + N2 ,  
  
When 161.2 grams of BN are added to an excess of F2, a reaction occurs in which   
326.118 grams of BF3 are formed.

a) Calculate the *theoretical* yield of BF3 in grams.

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) Calculate the *percentage* yield of BF3.

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. When reacting NH3 with O2 according to the reaction:

4 NH3 + 5 O2 🡪 4 NO + 6 H2O  
  
 Using 163.2 grams of NH3 with an excess of O2 produces a 67% yield of NO.

a) Calculate the *theoretical yield* of NO in grams.

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) Calculate the *actual yield* of NO in grams.

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_