Problem Set 5: Percent Yield

HCHE 111L: Introduction to Elementary Inorganic Chemistry

Due Date: Friday September 29$^{\text{th}}$, 2017

Problem 1

Aspirin ($C_9H_8O_4$) is produced by treating salicylic acid ($C_7H_6O_3$) with acetic anhydride ($C_4H_6O_3$):

$$C_7H_6O_3 + C_4H_6O_3 \longrightarrow C_9H_8O_4$$

a) Balance the chemical equation

b) If the synthesis has an 87% yield, what mass of salicylic acid should be used to produce 75 g of aspirin?

Problem 2

Calculate the theoretical yield of ZnS, in grams, from the reaction of 0.488 g Zn and 0.503 g S_8.

$$8\,Zn + S_8 \longrightarrow 8\,ZnS$$

If the actual yield is 0.606 g ZnS, what is the percent yield?

Problem 3

Hydrogen fluoride (HF) and calcium sulfate ($CaSO_4$) is produced industrially by the action of sulfuric acid (H_2SO_4) on CaF_2.

a) Write a balanced chemical reaction describing this process.

b) If 365 kg of CaF_2 are treated with excess sulfuric acid and 155 kg of HF are produced, what is the percent yield of this reaction?

Problem 4

A strip of zinc metal having a mass of 2.00 g is placed in an aqueous solution containing 2.50 g of silver nitrate, causing the following reaction to occur;

$$Zn\,(s) + 2\,AgNO_3(aq) \longrightarrow 2\,Ag\,(s) + Zn(NO_3)_2\,(aq)$$

a) Identify the limiting reactant.

b) How many grams of Ag will form?

c) How many grams of $Zn(NO_3)_2$ will form?

d) If you obtain 1.32 g of Ag from your reaction, what is the percent yield of silver?

Problem 5

Silicon nitride (Si_3N_4), a valuable ceramic, is made from the direct combustion of silicon and nitrogen at high temperatures

$$3\,Si + 2\,N_2 \longrightarrow Si_3N_4$$

How much silicon must react with excess nitrogen to prepare 125 g of silicon nitride if the yield of the reaction is 95.0%?

Problem 6

Aspartame ($C_{14}H_{18}N_2O_5$) is a sugar substitute in soft drinks. Under certain conditions, aspartame reacts with water to produce aspartic acid ($C_4H_7NO_4$), methanol (CH_3OH) and phenylalanine. Phenylalanine is 65.44% C, 6.71% H, 8.48% N, and 19.37% O by mass with a molecular mass of 165.19 g/mol.

a) Determine the molecular formula of phenylalanine.

b) Write out a balanced chemical equation to describe the process above.

c) If 25.7 g of aspartame reacts with excess water to form 10.5 g of phenylalanine, calculate the percent yield of this reaction.