HC Stoichiometry, Limiting Reactant & % Yield

S U P P L E M E N T A L P R A C T I C E P R O B L E M S

General Stoichiometry

1. Several brands of antacid tablets use aluminum hydroxide to neutralize excess acid.

$$Al(OH)_3(s) + 3\ HCl(aq) \rightarrow AlCl_3(aq) + 3\ H_2O(l)$$

[Molar masses: 78.01 36.46 133.4 18.02]

If 0.750 g of $Al(OH)_3$ is completely reacted:

a) What mass of HCl (aq) is required?

b) What mass of water is produced?

2. The equation for one of the reactions in the process of reducing iron ore to the metal is

$$Fe_2O_3(s) + 3\ CO(g) \rightarrow 2\ Fe(s) + 3\ CO_2(g)$$

[Molar masses: 159.7 28.01 55.85 44.01]

a) What is the maximum mass of iron, in grams, that can be obtained from 454 g of iron(III) oxide?

b) What volume of CO_2 (g) can be produced when 454 g of iron(III) oxide react completely?

Limiting Reactants

3. The reaction of methane and water is one way to prepare hydrogen:

$$CH_4(g) + H_2O(g) \rightarrow CO(g) + 3\,H_2(g)$$

[Molar masses: 16.04 18.02 28.01 2.02]

If you begin with 995 g of CH_4 and 2510 g of water, what is the maximum mass of H_2 that can be produced?

4. Disulfur dichloride, S_2Cl_2, is used to vulcanize rubber. It can be made by treating molten sulfur with gaseous chlorine:

$$S_8(l) + 4\,Cl_2(g) \rightarrow 4\,S_2Cl_2(l)$$

[Molar masses: 256.6 70.91 135.0]

Starting with a mixture of 32.0 g of sulfur and 71.0 g of Cl_2, which is the limiting reactant? What is the maximum mass of S_2Cl_2 that can be produced?

Percent Yield

29. Diborane, B_2H_6, is a valuable compound in the synthesis of new organic compounds. One of several ways this born compound can be made is by the reaction

$$2\ NaBH_4(s) + I_2(s) \rightarrow B_2H_6(g) + 2\ NaI(s) + H_2(g)$$

[Molar masses: 37.84 253.8 27.67 149.9 2.02]

Suppose you use 1.203 g of $NaBH_4$ with an excess of iodine and obtain 0.295 g of B_2H_6. What is the percent yield of B_2H_6?

31. Disulfur dichloride, which has a revolting smell, can be prepared by directly combining S_8 and Cl_2, but it can also be made by the following reaction:

$$3\ SCl_2(l) + 4\ NaF(s) \rightarrow SF_4(g) + S_2Cl_2(l) + 4\ NaCl(s)$$

[Molar masses: 103.0 41.99 108.1 135.0 58.46]

a) Assume you begin with 5.23 g of SCl_2 and excess NaF. What is the theoretical yield of S_2Cl_2?

b) If only 1.19 g of S_2Cl_2 is obtained, what is the percent yield of the compound?