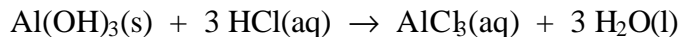


## 4 • Chemical Equations and Stoichiometry

### STOICHIOMETRY PROBLEMS

#### General Stoichiometry

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

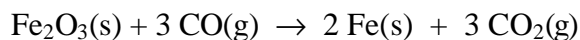


[Molar masses:        78.01            36.46            133.4            18.02]

What quantity of HCl, in grams, can a tablet with 0.750 g of Al(OH)<sub>3</sub> consume? What quantity of water is produced?

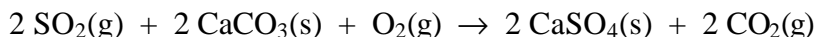
15. If 10.0 g of carbon is combined with an exact, stoichiometric amount of oxygen (26.6 g) to produce carbon dioxide, what mass, in grams, of CO<sub>2</sub> can be obtained? That is, what is the theoretical yield of CO<sub>2</sub>? [Molar masses: C: 12.011    O<sub>2</sub>: 32.00    CO<sub>2</sub>: 44.01]

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



[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 (1.00 lb) of iron(III) oxide?
- (b) What mass of CO is required to reduce the iron(III) oxide to iron metal?
19. Burning coal and oil in a power plant produces pollutants such as sulfur dioxide, SO<sub>2</sub>. The sulfur-containing compound can be removed from other waste gases, however, by the following reaction:



[Molar masses:    64.07            100.1            32.00            136.2            44.01]

- (a) Name the compounds involved in the reaction.
- (b) What mass of CaCO<sub>3</sub> is required to remove 155 g of SO<sub>2</sub>?
- (c) What mass of CaSO<sub>4</sub> is formed when 155 g SO<sub>2</sub> is consumed completely?
21. Your body deals with excess nitrogen by excreting it in the form of urea, NH<sub>2</sub>CONH<sub>2</sub>. The reaction producing it is the combination of arginine (C<sub>6</sub>H<sub>14</sub>N<sub>4</sub>O<sub>2</sub>) with water to give urea and ornithine (C<sub>5</sub>H<sub>12</sub>N<sub>2</sub>O<sub>2</sub>).

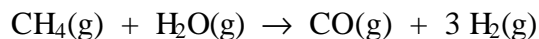


[Molar masses:        174.2            18.02            60.06            132.2]

If you excrete 95 mg of urea, what quantity of arginine must have been used? What quantity of ornithine must have been produced?

## Limiting Reactants

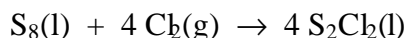
23. The reaction of methane and water is one way to prepare hydrogen:



[Molar masses: 16.04 18.02 28.01 2.02]

If you begin with 995 g of  $\text{CH}_4$  and 2510 g of water, what is the maximum possible yield of  $\text{H}_2$ ?

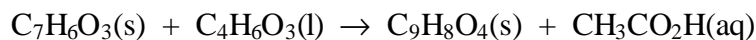
25. Disulfur dichloride,  $\text{S}_2\text{Cl}_2$ , is used to vulcanize rubber. It can be made by treating molten sulfur with gaseous chlorine:



[Molar masses: 256.6 70.91 135.0]

Starting with a mixture of 32.0 g of sulfur and 71.0 g of  $\text{Cl}_2$ , which is the limiting reactant? What mass of  $\text{S}_2\text{Cl}_2$  (in grams) can be produced? What mass of the excess reactant remains when the limiting reactant is consumed?

27. Aspirin ( $\text{C}_9\text{H}_8\text{O}_4$ ) is produced by the reaction of salicylic acid ( $\text{C}_7\text{H}_6\text{O}_3$ ) and acetic anhydride ( $\text{C}_4\text{H}_6\text{O}_3$ ) (page 163).

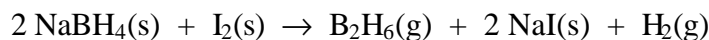


[Molar masses: 138.1 102.1 180.1 60.05]

If you mix 100. g of each of the reactants, what is the maximum mass of aspirin that can be obtained?

## Percent Yield

29. Diborane,  $\text{B}_2\text{H}_6$ , is a valuable compound in the synthesis of new organic compounds. One of several ways this boron compound can be made is by the reaction



[Molar masses: 37.84 253.8 27.67 149.9 2.02]

Suppose you use 1.203 g of  $\text{NaBH}_4$  with an excess of iodine and obtain 0.295 g of  $\text{B}_2\text{H}_6$ . What is the percent yield of  $\text{B}_2\text{H}_6$ ?

31. Disulfur dichloride, which has a revolting smell, can be prepared by directly combining  $\text{S}_8$  and  $\text{Cl}_2$ , but it can also be made by the following reaction:



[Molar masses: 103.0 41.99 108.1 135.0 58.46]

Assume you begin with 5.23 g of  $\text{SCl}_2$  and excess  $\text{NaF}$ . What is the theoretical yield of  $\text{S}_2\text{Cl}_2$ ? If only 1.19 g of  $\text{S}_2\text{Cl}_2$  is obtained, what is the percent yield of the compound?