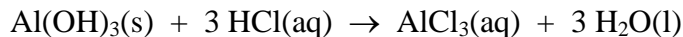


4 • Chemical Equations and Stoichiometry

STOICHIOMETRY PROBLEMS

General Stoichiometry

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

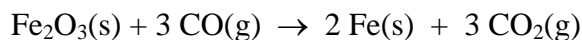


[Molar masses: 78.01 36.46 133.4 18.02]

What quantity of HCl, in grams, can a tablet with 0.750 g of Al(OH)₃ 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 CO₂ can be obtained? That is, what is the theoretical yield of CO₂? [Molar masses: C: 12.011 O₂: 32.00 CO₂: 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, SO₂. The sulfur-containing compound can be removed from other waste gases, however, by the following reaction:
- $$2 \text{SO}_2(\text{g}) + 2 \text{CaCO}_3(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2 \text{CaSO}_4(\text{s}) + 2 \text{CO}_2(\text{g})$$
- [Molar masses: 64.07 100.1 32.00 136.2 44.01]
- (a) Name the compounds involved in the reaction.
- (b) What mass of CaCO₃ is required to remove 155 g of SO₂?
- (c) What mass of CaSO₄ is formed when 155 g SO₂ is consumed completely?

21. Your body deals with excess nitrogen by excreting it in the form of urea, NH₂CONH₂. The reaction producing it is the combination of arginine (C₆H₁₄N₄O₂) with water to give urea and ornithine (C₅H₁₂N₂O₂).

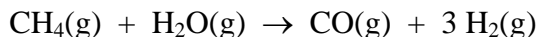


[Molar masses: 174.2 18.02 60.06 132.2]

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

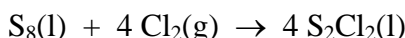
23. The reaction of methane and water is one way to prepare hydrogen:



[Molar masses: 16.04 18.02 28.01 2.02]

If you begin with 995 g of CH_4 and 2510 g of water, what is the maximum possible yield of H_2 ?

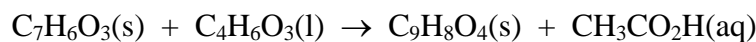
25. Disulfur dichloride, S_2Cl_2 , is used to vulcanize rubber. It can be made by treating molten sulfur with gaseous chlorine:



[Molar masses: 256.6 70.91 135.0]

Starting with a mixture of 32.0 g of sulfur and 71.0 g of Cl_2 , which is the limiting reactant? What mass of S_2Cl_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).

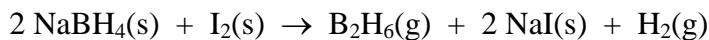


[Molar masses: 138.1 102.1 180.1 60.05]

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, B_2H_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 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:



[Molar masses: 103.0 41.99 108.1 135.0 58.46]

Assume you begin with 5.23 g of SCl_2 and excess NaF . What is the theoretical yield of S_2Cl_2 ? If only 1.19 g of S_2Cl_2 is obtained, what is the percent yield of the compound?