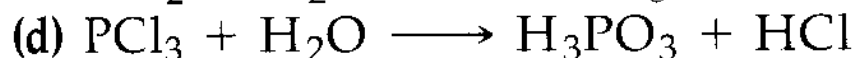
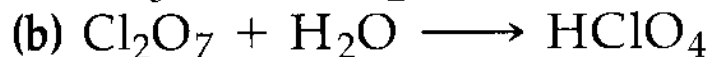
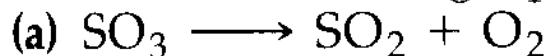
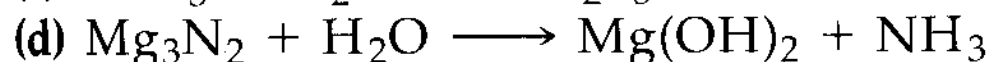
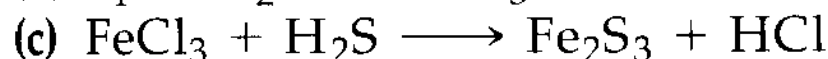
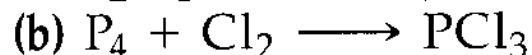
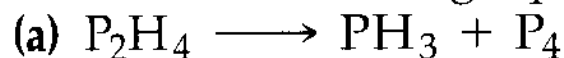


Writing and Balancing Chemical Equations

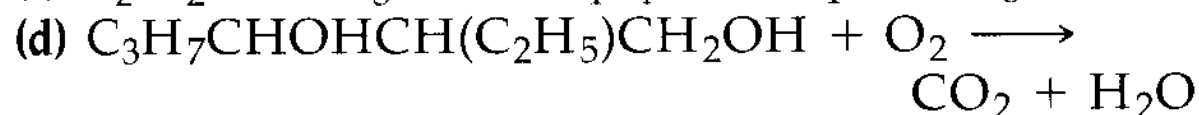
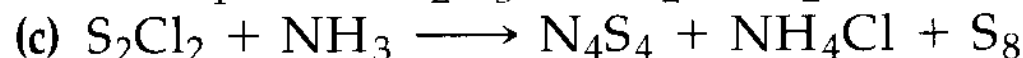
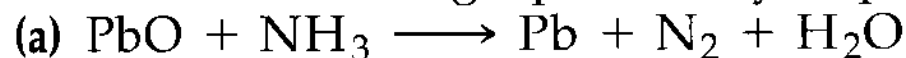
1. Balance the following equations by inspection.



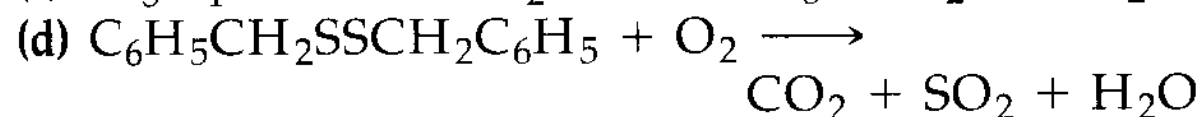
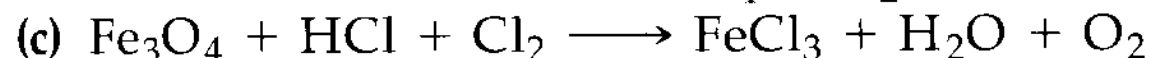
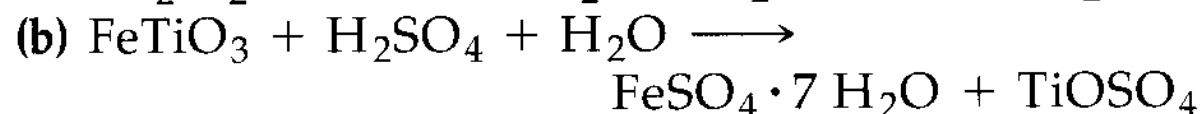
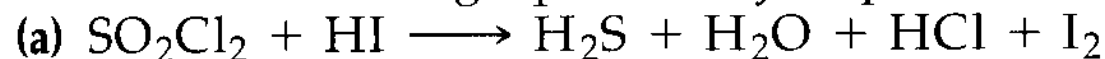
2. Balance the following equations by inspection.



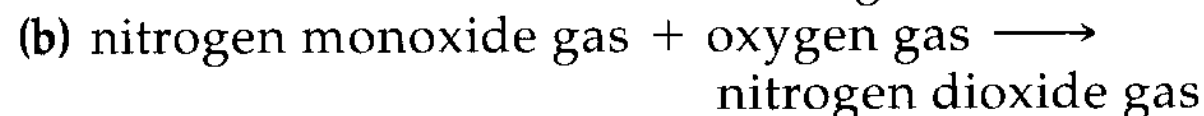
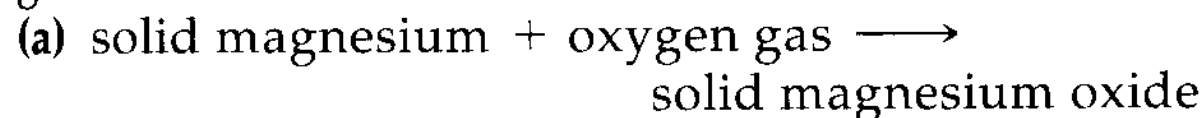
3. Balance the following equations by inspection.



4. Balance the following equations by inspection.



5. Write balanced equations based on the information given.



(c) gaseous ethane(C_2H_6) + oxygen gas \longrightarrow
carbon dioxide gas + liquid water

(d) aqueous silver sulfate +
aqueous barium iodide \longrightarrow
solid barium sulfate + solid silver iodide

6. Write balanced equations based on the information given.

(a) solid magnesium + nitrogen gas \longrightarrow
solid magnesium nitride

(b) solid potassium chlorate \longrightarrow
solid potassium chloride + oxygen gas

(c) solid sodium hydroxide +
solid ammonium chloride \longrightarrow
solid sodium chloride + gaseous ammonia +
water vapor

(d) solid sodium + liquid water \longrightarrow
aqueous sodium hydroxide + hydrogen gas

7. Write balanced equations to represent the complete combustion of (a) butane, C_4H_{10} ; (b) isopropyl alcohol, $CH_3CH(OH)CH_3$; (c) lactic acid, $CH_3CH(OH)COOH$.

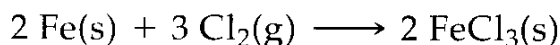
8. Write balanced equations to represent the complete combustion of (a) propylene, C_3H_6 ; (b) glycerol, $CH_2(OH)CH(OH)CH_2OH$; (c) thiobenzoic acid, C_6H_5COSH .

9. Write balanced equations to represent:

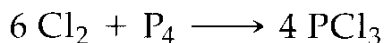
(a) the decomposition, by heating, of solid ammonium nitrate to produce dinitrogen monoxide gas (laughing gas) and water vapor;

Stoichiometry of Chemical Reactions

13. Iron metal reacts with chlorine gas. How many moles of FeCl_3 are obtained when 7.26 mol Cl_2 reacts with excess Fe?

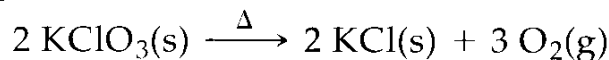


14. If 0.337 mol PCl_3 is produced by the reaction

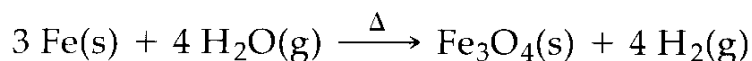


how many grams each of Cl_2 and P_4 are consumed?

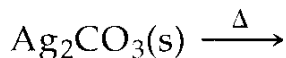
15. A laboratory method of preparing $\text{O}_2\text{(g)}$ involves the decomposition of $\text{KClO}_3\text{(s)}$.



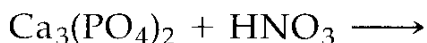
- (a) How many moles of $\text{O}_2\text{(g)}$ can be produced by the decomposition of 32.8 g KClO_3 ?
- (b) How many grams of KClO_3 must be decomposed to produce 50.0 g O_2 ?
- (c) How many grams of KCl are formed, together with 28.3 g O_2 , in the decomposition of KClO_3 ?
16. A commercial method of manufacturing hydrogen involves the reaction of iron and steam.



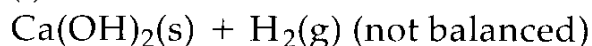
- (a) How many moles of H_2 can be produced from 42.7 g Fe and an excess of $\text{H}_2\text{O(g)}$ (steam)?
- (b) How many grams of H_2O are consumed in the conversion of 63.5 g Fe to Fe_3O_4 ?
- (c) If 7.36 mol H_2 is produced, how many grams of Fe_3O_4 must also be produced?
17. How many grams of Ag_2CO_3 are decomposed to yield 75.1 g Ag in this reaction?



18. How many kilograms of HNO_3 are consumed to produce 125 kg $\text{Ca(H}_2\text{PO}_4)_2$ in this reaction?



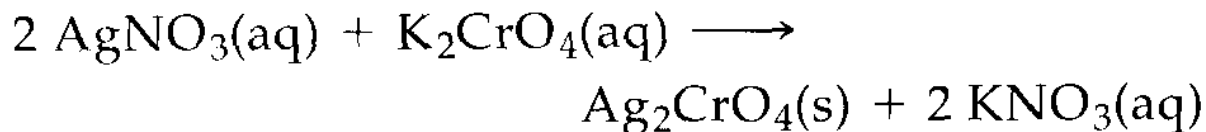
19. The reaction of calcium hydride with water can be used to prepare small quantities of hydrogen gas, as is done to fill weather-observation balloons.



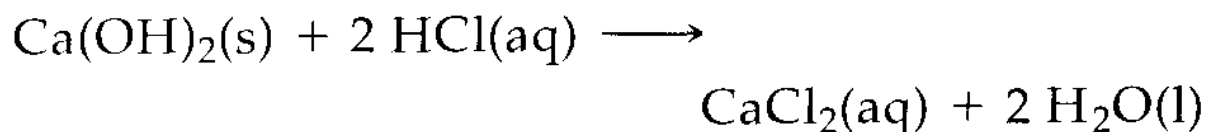
Molarity

27. What are the molarities of the following solutes when dissolved in water?
- 2.92 mol CH_3OH in 7.16 L of solution
 - 7.69 mmol $\text{C}_2\text{H}_5\text{OH}$ in 50.00 mL of solution
 - 25.2 g $\text{CO}(\text{NH}_2)_2$ in 275 mL of solution
28. What are the molarities of the following solutes when dissolved in water?
- 2.25×10^{-4} mol $\text{CH}_3\text{CH}_2\text{OH}$ in 125 mL of solution
 - 57.5 g $(\text{CH}_3)_2\text{CO}$ in 525 mL of solution
 - 18.5 mL of $\text{C}_3\text{H}_5(\text{OH})_3$ ($d = 1.26$ g/mL) in 375 mL of solution
29. What are the molarities of the following solutes?
- sucrose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) if 150.0 g is dissolved per 250.0 mL of water solution
 - urea, $\text{CO}(\text{NH}_2)_2$, if 98.3 mg of the 97.9% pure solid is dissolved in 5.00 mL of aqueous solution
 - methanol, CH_3OH , ($d = 0.792$ g/mL) if 125.0 mL is dissolved in enough water to make 15.0 L of solution
30. What are the molarities of the following solutes?
- aspartic acid ($\text{H}_2\text{C}_4\text{H}_5\text{NO}_4$) if 0.405 g is dissolved in enough water to make 100.0 mL of solution
 - acetone, $\text{C}_3\text{H}_6\text{O}$, ($d = 0.790$ g/mL) if 35.0 mL is dissolved in enough water to make 425 mL of solution
 - diethyl ether, $(\text{C}_2\text{H}_5)_2\text{O}$, if 8.8 mg is dissolved in enough water to make 3.00 L of solution
31. How much
- glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, in grams, must be dissolved in water to produce 75.0 mL of 0.350 M $\text{C}_6\text{H}_{12}\text{O}_6$?
 - methanol, CH_3OH ($d = 0.792$ g/mL), in milliliters, must be dissolved in water to produce 2.25 L of 0.485 M CH_3OH ?
32. How much
- ethanol, $\text{C}_2\text{H}_5\text{OH}$ ($d = 0.789$ g/mL), in liters, must be dissolved in water to produce 200.0 L of 1.65 M $\text{C}_2\text{H}_5\text{OH}$?
 - concentrated hydrochloric acid solution (36.0% HCl by mass; $d = 1.18$ g/mL), in milliliters, is required to produce 12.0 L of 0.234 M HCl?

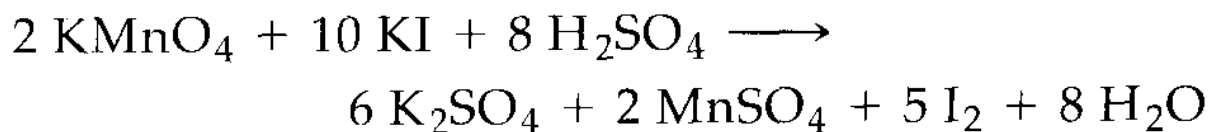
45. How many milliliters of 0.650 M K_2CrO_4 are needed to precipitate all the silver in 415 mL of 0.186 M AgNO_3 as $\text{Ag}_2\text{CrO}_4(\text{s})$?



46. For the reaction

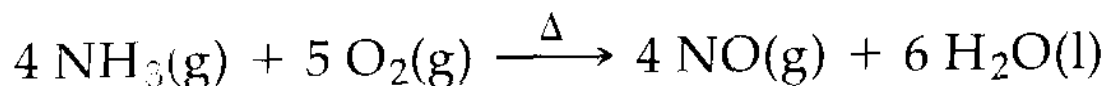


- (a) How many grams of $\text{Ca}(\text{OH})_2$ are required to react completely with 415 mL of 0.477 M HCl ?
- (b) How many kilograms of $\text{Ca}(\text{OH})_2$ are required to react with 324 L of a HCl solution that is 24.28% HCl by mass, and has a density of 1.12 g/mL?
47. Refer to Example 4-7 and equation (4.2). For the conditions stated in Example 4-7, determine (a) the number of moles of AlCl_3 and (b) the molarity of the $\text{AlCl}_3(\text{aq})$ if the solution volume is simply the 23.8 mL calculated in the example.
48. Refer to the Integrative Example on page 132.. If 138 g Na_2CO_3 in 1.42 L of aqueous solution is treated with an excess of $\text{NO}(\text{g})$ and $\text{O}_2(\text{g})$, what is the molarity of the $\text{NaNO}_2(\text{aq})$ solution that results? (Assume that the reaction goes to completion.)
49. How many grams of Ag_2CrO_4 will precipitate if excess $\text{K}_2\text{CrO}_4(\text{aq})$ is added to the 415 mL of 0.186 M AgNO_3 in Exercise 45?
50. What volume of 0.0797 M $\text{KMnO}_4(\text{aq})$ is necessary to convert 9.13 g KI to I_2 in the reaction



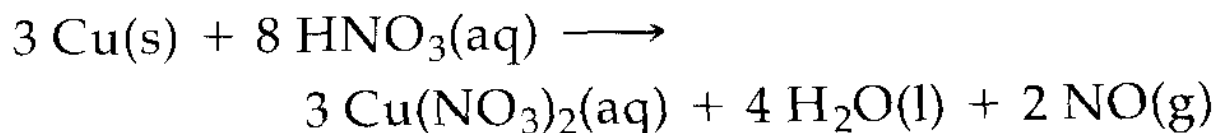
Determining the Limiting Reactant

55. How many moles of $\text{NO}(\text{g})$ can be produced in the reaction of 3.00 mol $\text{NH}_3(\text{g})$ and 4.00 mol $\text{O}_2(\text{g})$?



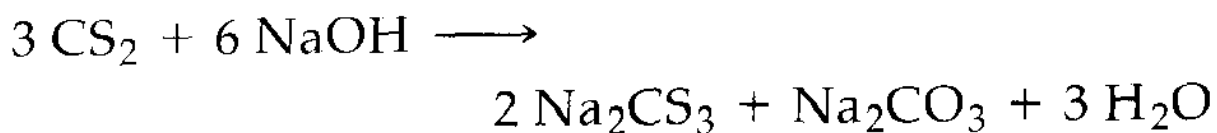
56. The reaction of calcium hydride and water produces calcium hydroxide and hydrogen as products. How many moles of $\text{H}_2(\text{g})$ will be formed in the reaction between 0.82 mol $\text{CaH}_2(\text{s})$ and 1.54 mol $\text{H}_2\text{O}(\text{l})$?

57. A 0.696-mol sample of Cu is added to 136 mL of 6.0 M $\text{HNO}_3(\text{aq})$. Assuming the following reaction is the only one that occurs, will the Cu react completely?



58. How many grams of $\text{H}_2(\text{g})$ are produced by the reaction of 1.84 g Al with 75.0 mL of 2.95 M HCl ?
[Hint: Recall equation (4.2).]

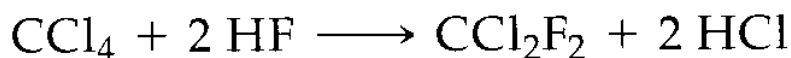
59. A side reaction in the manufacture of rayon from wood pulp is



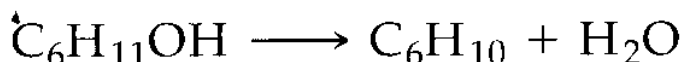
How many grams of Na_2CS_3 are produced in the reaction of 92.5 mL of liquid CS_2 ($d = 1.26 \text{ g/mL}$) and 2.78 mol NaOH ?

Theoretical, Actual, and Percent Yields

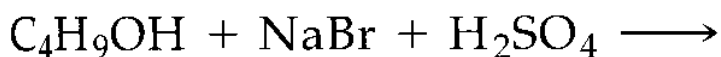
63. In the reaction of 1.80 mol CCl_4 with an excess of HF, 1.55 mol CCl_2F_2 is obtained. What are the (a) theoretical, (b) actual, and (c) percent yields of this reaction?



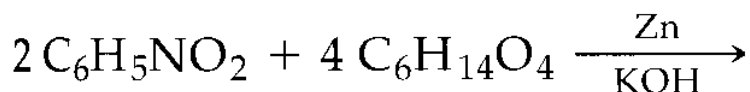
64. In the reaction shown, 100.0 g $\text{C}_6\text{H}_{11}\text{OH}$ yielded 64.0 g C_6H_{10} . (a) What is the theoretical yield of the reaction? (b) What is the percent yield? (c) What mass of $\text{C}_6\text{H}_{11}\text{OH}$ would produce 100.0 g C_6H_{10} if the percent yield is that determined in part (b)?



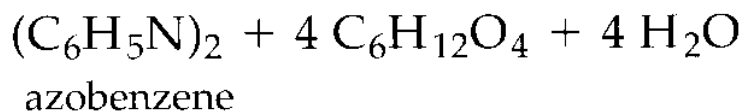
65. The reaction of 15.0 g $\text{C}_4\text{H}_9\text{OH}$, 22.4 g NaBr, and 32.7 g H_2SO_4 yields 17.1 g $\text{C}_4\text{H}_9\text{Br}$ in the reaction shown. What are the (a) theoretical yield, (b) actual yield, and (c) percent yield of this reaction?



66. Azobenzene, an intermediate in the manufacture of dyes, can be prepared from nitrobenzene by reaction with triethylene glycol in the presence of Zn and KOH. In one reaction, 0.10 L of nitrobenzene ($d = 1.20 \text{ g/mL}$) and 0.30 L of triethylene glycol ($d = 1.12 \text{ g/mL}$) yields 55 g azobenzene. What are the (a) theoretical yield, (b) actual yield, and (c) percent yield of this reaction?

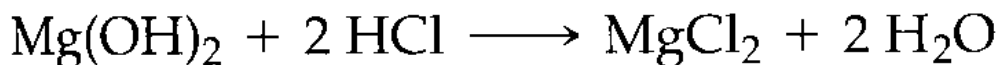


nitrobenzene triethylene glycol



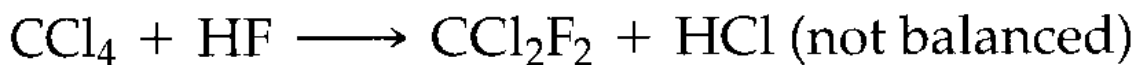
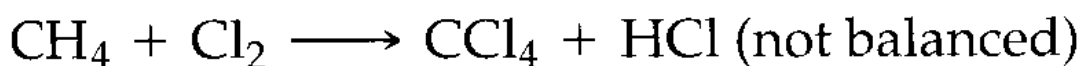
Consecutive Reactions, Simultaneous Reactions

71. How many grams of HCl are consumed in the reaction of 425 g of a mixture containing 35.2% MgCO_3 and 64.8% $\text{Mg}(\text{OH})_2$, by mass?



72. How many grams of CO_2 are produced in the complete combustion of 406 g of a bottled gas that consists of 72.7% propane (C_3H_8) and 27.3% butane (C_4H_{10}), by mass?

73. Dichlorodifluoromethane, once widely used as a refrigerant, can be prepared by the reactions shown. How many moles of Cl_2 must be consumed in the first reaction to produce 2.25 kg CCl_2F_2 in the second? Assume that all the CCl_4 produced in the first reaction is consumed in the second.



74. $\text{CO}_2(\text{g})$ produced in the combustion of a sample of ethane is absorbed in $\text{Ba}(\text{OH})_2(\text{aq})$, producing 0.506 g $\text{BaCO}_3(\text{s})$. How many grams of ethane (C_2H_6) must have been burned?

