QUESTIONS AND PROBLEMS

Chemical Reactions

6.1 Determine whether each of the following equations is balanced or not balanced:

a. $S(s) + O_2(g) \longrightarrow SO_3(g)$

b. $2Al(s) + 3Cl_2(g) \longrightarrow 2AlCl_3(s)$

c. $H_2(g) + O_2(g) \longrightarrow H_2O(g)$

d. $C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(g)$

6.2 Determine whether each of the following equations is balanced or not balanced:

a. $PCl_3(s) + Cl_2(g) \longrightarrow PCl_5(s)$

b. $CO(g) + 2H_2(g) \longrightarrow CH_3OH(g)$

c. $2KClO_3(s) \longrightarrow 2KCl(s) + O_2(g)$

d. $Mg(s) + N_2(g) \longrightarrow Mg_3N_2(s)$

6.3 Balance the following equations:

a. $N_2(g) + O_2(g) \longrightarrow NO(g)$

b. $HgO(s) \longrightarrow Hg(l) + O_2(g)$

c. $Fe(s) + O_2(g) \longrightarrow Fe_2O_3(s)$

d. $Na(s) + Cl_2(g) \longrightarrow NaCl(s)$

6.4 Balance the following equations:

a. $Ca(s) + Br_2(l) \longrightarrow CaBr_2(s)$

b. $P_4(s) + O_2(g) \longrightarrow P_4O_{10}(s)$

c. $Sb_2S_3(s) + HCl(aq) \longrightarrow SbCl_3(s) + H_2S(g)$

d. $Fe_2O_3(s) + C(s) \longrightarrow Fe(s) + CO(g)$

6.5 Balance the following equations:

a. $Mg(s) + AgNO_3(aq) \longrightarrow Mg(NO_3)_2(aq) + Ag(s)$

b. $Al(s) + CuSO_4(aq) \longrightarrow Cu(s) + Al_2(SO_4)_3(aq)$

c. $Pb(NO_3)_2(aq) + NaCl(aq) \longrightarrow PbCl_2(s) + NaNO_3(aq)$

d. $Al(s) + HCl(aq) \longrightarrow AlCl_3(aq) + H_2(g)$

6.6 Balance the following equations:

a. $Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2(g)$

b. $Al(s) + H_2SO_4(aq) \longrightarrow Al_2(SO_4)_3(aq) + H_2(g)$

c. $K_2SO_4(aq) + BaCl_2(aq) \longrightarrow BaSO_4(s) + KCl(aq)$

d. $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

6.2 Types of Reactions

LEARNING GOAL

Identify a chemical reaction as a combination, decomposition, single replacement, or double

A great number of reactions occur in nature, in biological systems, and in the laboratory. However, some general patterns among all reactions help us to classify them. Most fit into four general reaction types.

Electrons are a reactant	Gain of hydrogen

in Table 6.3. Oxidation always involves a loss of electrons, but it may also be seen as the addition of oxygen, or the loss of hydrogen atoms. A reduction always involves a gain of electrons, and it may also be seen as the loss of oxygen, or the gain of hydrogen.

QUESTIONS AND PROBLEMS

Oxidation–Reduction Reactions

6.13 Indicate whether each of the following is an oxidation or a reduction reaction:

a. $Na^+(aq) + e^- \longrightarrow Na(s)$

b. $Ni(s) \longrightarrow Ni^{2+}(aq) + 2e^-$

c. $Cr^{3+}(aq) + 3e^- \longrightarrow Cr(s)$

d. $2H^+(aq) + 2e^- \longrightarrow H_2(g)$

6.14 Indicate whether each of the following is an oxidation or a reduction reaction:

a. $O_2(g) + 4e^- \longrightarrow 2O^{2-}(aq)$

b. $Al(s) \longrightarrow Al^{3+}(aq) + 3e^-$

c. $Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}(aq)$

d. $2Br^-(aq) \longrightarrow Br_2(g) + 2e^-$

6.15 In the following reactions, identify which reactant is oxidized and which is reduced:

a. $Zn(s) + Cl_2(g) \longrightarrow ZnCl_2(s)$

b. $Cl_2(g) + 2NaBr(aq) \longrightarrow 2NaCl(aq) + Br_2(g)$

c. $2PbO(s) \longrightarrow 2Pb(s) + O_2(g)$

d. $2Fe^{3+}(aq) + Sn^{2+}(aq) \longrightarrow 2Fe^{2+}(aq) + Sn^{4+}(aq)$

6.16 In the following reactions, identify which reactant is oxidized and which is reduced:

a. $2Li(s) + F_2(g) \longrightarrow 2LiF(s)$

b. $Cl_2(g) + 2KI(aq) \longrightarrow 2KCl(aq) + I_2(g)$

c. $Zn(s) + Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$

d. $Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$

6.17 In the mitochondria of human cells, energy for the production of ATP is provided by the oxidation and reduction reactions of the iron ions in the cytochromes of the electron transport chain. Identify each of the following reactions as oxidation or reduction:

a. $Fe^{3+} + e^- \longrightarrow Fe^{2+}$

b. $Fe^{2+} \longrightarrow Fe^{3+} + e^-$

6.18 Chlorine (Cl_2) is a strong germicide used to disinfect drinking water and to kill microbes in swimming pools. If the product Cl^-, was the Cl_2 oxidized or reduced?

6.26 Consider the formula for $Al_2(SO_4)_3$, which is used in antiperspirants.

a. How many moles of sulfur are present in 3.0 moles of $Al_2(SO_4)_3$?

b. How many moles of aluminum ions are present in 0.40 mole of $Al_2(SO_4)_3$?

c. How many moles of sulfate ions $\left(SO_4^{2-}\right)$ are present in 1.5 moles of $Al_2(SO_4)_3$?

6.27 Calculate each of the following:

a. number of C atoms in 0.500 mole of C

b. number of SO_2 molecules in 1.28 moles of SO_2

c. moles of Fe in 5.22×10^{22} atoms of Fe

d. moles of C_2H_5OH in 8.50×10^{24} molecules of C_2H_5OH

6.28 Calculate each of the following:

a. number of Li atoms in 4.5 moles of Li

b. number of CO_2 molecules in 0.0180 mole of CO_2

c. moles of Cu in 7.8×10^{21} atoms of Cu

d. moles of C_2H_6 in 3.754×10^{23} molecules of C_2H_6

6.29 Calculate each of the following quantities in 2.00 moles of H_3PO_4:

a. moles of H **b.** moles of O

c. atoms of P **d.** atoms of O

6.30 Calculate each of the following quantities in 0.185 mole of $(C_3H_5)_2O$:

a. moles of C **b.** moles of O

c. atoms of H **d.** atoms of C

6.5 Molar Mass

LEARNING GOAL

A single atom or molecule is much too small to weigh, even on the most accurate balance.

QUESTIONS AND PROBLEMS

Molar Mass

6.31 Calculate the molar mass for each of the following:

a. KCl (salt substitute)
b. Fe_2O_3 (rust)
c. Li_2CO_3 (antidepressant)
d. $Al_2(SO_4)_3$ (antiperspirant)
e. $Mg(OH)_2$ (antacid)
f. $C_{16}H_{19}N_3O_5S$ (amoxicillin, an antibiotic)

6.32 Calculate the molar mass for each of the following:

a. $FeSO_4$ (iron supplement)
b. Al_2O_3 (absorbent and abrasive)
c. $C_7H_5NO_3S$ (saccharin)
d. C_3H_8O (rubbing alcohol)
e. $(NH_4)_2CO_3$ (baking powder)
f. $Zn(C_2H_3O_2)_2$ (dietary supplement)

6.33 Calculate the mass in grams in each of the following:

a. 2.00 moles of Na **b.** 2.80 moles of Ca
c. 0.125 mole of Sn **d.** 1.76 moles of Cu

6.34 Calculate the mass in grams in each of the following:

a. 1.50 moles of K **b.** 2.5 moles of C
c. 0.25 mole of P **d.** 12.5 moles of He

6.35 Calculate the mass in grams in each of the following:

a. 0.500 mole of NaCl **b.** 1.75 moles of Na_2O
c. 0.225 mole of H_2O **d.** 4.42 moles of CO_2

6.36 Calculate the mass in grams in each of the following:

a. 2.0 moles of $MgCl_2$ **b.** 3.5 moles of C_3H_8
c. 5.00 moles of C_2H_6O **d.** 0.488 mole of $C_3H_6O_3$

6.37 a. The compound $MgSO_4$ is called Epsom salts. How many grams will you need to prepare a bath containing 5.00 moles of Epsom salts?
b. In a bottle of soda, there is 0.25 mole of CO_2. How many grams of CO_2 are in the bottle?

6.38 a. Cyclopropane, C_3H_6, is an anesthetic given by inhalation. How many grams are in 0.25 mole of cyclopropane?
b. The sedative Demerol hydrochloride has the formula $C_{15}H_{22}ClNO_2$. How many grams are in 0.025 mole of Demerol hydrochloride?

6.39 How many moles are contained in each of the following?

a. 50.0 g of Ag
b. 0.200 g of C
c. 15.0 g of NH_3
d. 75.0 g of SO_2

6.40 How many moles are contained in each of the following?

a. 25.0 g of Ca
b. 5.00 g of S
c. 40.0 g of H_2O
d. 12.2 g of O_2

6.41 How many moles of S are in each of the following quantities?

a. 25 g of S
b. 125 g of SO_2
c. 2.0 moles of Al_2S_3

6.42 How many moles of C are in each of the following quantities?

a. 75 g of C
b. 0.25 mole of C_2H_6
c. 88 g of CO_2

6.43 How many atoms of N are in each of the following quantities?

a. 40.0 g of N
b. 1.5 moles of N_2O_4
c. 2.0 moles of N_2

6.44 How many atoms of Ag are in each of the following quantities?

a. 5.0 g of Ag
b. 0.40 mole of Ag_2S
c. 0.75 g of AgCl

QUESTIONS AND PROBLEMS

Energy in Chemical Reactions

6.73 a. Why do chemical reactions require activation energy?
b. In an exothermic reaction, is the energy of the products higher or lower than the reactants?
c. Draw an energy diagram for an exothermic reaction.

6.74 a. What is measured by the heat of reaction?
b. In an endothermic reaction, is the energy of the products higher or lower than the reactants?
c. Draw an energy diagram for an endothermic reaction.

6.75 Classify the following as exothermic or endothermic reactions:
a. 55 kcal is released.
b. The energy level of the products is higher than the reactants.
c. The metabolism of glucose in the body provides energy.

6.76 Classify the following as exothermic or endothermic reactions:
a. The energy level of the products is lower than the reactants.
b. In the body, the synthesis of proteins requires energy.
c. 12 kcal is absorbed.

6.77 Classify the following as exothermic or endothermic reactions and give ΔH *for each:*
a. gas burning in a Bunsen burner:

$$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g) + 210 \text{ kcal}$$

b. dehydrating limestone:

$$Ca(OH)_2(s) + 65.3 \text{ kJ} \longrightarrow CaO(s) + H_2O(l)$$

c. formation of aluminum oxide and iron from aluminum and iron(III) oxide:

$$2Al(s) + Fe_2O_3(s) \longrightarrow Al_2O_3(s) + 2Fe(s) + 205 \text{ kcal}$$

6.78 Classify the following as exothermic or endothermic reactions and give ΔH for each of the following:
a. combustion of propane:

$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(g) + 530 \text{ kcal}$$

b. formation of "table" salt:

$$2Na(s) + Cl_2(g) \longrightarrow 2NaCl(s) + 196 \text{ kcal}$$

c. decomposition of phosphorus pentachloride:

$$PCl_5(g) + 67 \text{ kJ} \longrightarrow PCl_3(g) + Cl_2(g)$$

6.79 The equation for the formation of silicon tetrachloride from silicon and chlorine is

$$Si(s) + 2Cl_2(g) \longrightarrow SiCl_4(g) \quad \Delta H = -157 \text{ kcal}$$

How many kilocalories are released when 125 g of Cl_2 reacts with silicon?

6.80 Methanol (CH_3OH), which is used as a cooking fuel, undergoes combustion to produce carbon dioxide and water:

$$2CH_3OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 4H_2O(l) \quad \Delta H = -726 \text{ kJ}$$

How many kilojoules are released when 75.0 g of methanol is burned?

ADDITIONAL QUESTIONS AND PROBLEMS

For instructor-assigned homework, go to ***www.masteringchemistry.com.***

6.95 Balance each of the following unbalanced equations and identify the type of reaction:

a. $NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$

b. $Fe_3O_4(s) + H_2(g) \longrightarrow Fe(s) + H_2O(g)$

c. $Sb(s) + Cl_2(g) \longrightarrow SbCl_3(s)$

d. $NI_3(s) \longrightarrow N_2(g) + I_2(g)$

e. $KBr(aq) + Cl_2(aq) \longrightarrow KCl(aq) + Br_2(l)$

f. $Al_2(SO_4)_3(aq) + NaOH(aq) \longrightarrow Na_2SO_4(aq) + Al(OH)_3(s)$

6.96 Balance each of the following unbalanced equations and identify the type of reaction:

a. $Li_3N(s) \longrightarrow Li(s) + N_2(g)$

b. $Mg(s) + N_2(g) \longrightarrow Mg_3N_2(s)$

c. $Mg(s) + H_3PO_4(aq) \longrightarrow Mg_3(PO_4)_2(s) + H_2(g)$

d. $Cr_2O_3(s) + H_2(g) \longrightarrow Cr(s) + H_2O(g)$

e. $Al(s) + Cl_2(g) \longrightarrow AlCl_3(s)$

f. $MgCl_2(aq) + AgNO_3(aq) \longrightarrow Mg(NO_3)_2(aq) + AgCl(s)$

6.97 Identify each of the following as an oxidation or a reduction reaction:

a. $Zn^{2+} + 2e^- \longrightarrow Zn$

b. $Al \longrightarrow Al^{3+} + 3e^-$

c. $Pb \longrightarrow Pb^{2+} + 2e^-$

d. $Cl_2 + 2e^- \longrightarrow 2Cl^-$

6.98 Write a balanced chemical equation for each of the following oxidation–reduction reactions:

a. Sulfur reacts with molecular chlorine to form sulfur dichloride.

b. Molecular chlorine and sodium bromide react to form molecular bromine and sodium chloride.

c. Aluminum metal and iron(III) oxide react to produce aluminum oxide and elemental iron.

d. Copper(II) oxide reacts with elemental C to form elemental copper and carbon dioxide.

6.99 During heavy exercise and workouts, lactic acid, $C_3H_6O_3$, accumulates in the muscles, where it can cause pain and soreness.

a. What is the molar mass of lactic acid?

b. How many molecules are in 0.500 mole of lactic acid?

c. How many C atoms are in 1.50 moles of lactic acid?

d. How many grams of lactic acid contain 4.5×10^{24} atoms of O?

6.100 Ibuprofen, the anti-inflammatory ingredient in Advil, has the formula $C_{13}H_{18}O_2$.

a. What is the molar mass of ibuprofen?

b. How many molecules are in 0.200 mole of ibuprofen?

c. How many H atoms are in 0.100 mole of ibuprofen?

d. How many grams of ibuprofen contain 7.4×10^{25} atoms of C?

6.101 Calculate the molar mass of each of the following:

a. $FeSO_4$, iron(II) sulfate, iron supplement

b. $Ca(IO_3)_2$, calcium iodate, iodine source in table salt

c. $C_5H_8NNaO_4$, monosodium glutamate, flavor enhancer

6.102 Calculate the molar mass of each of the following:

a. $Mg(HCO_3)_2$, magnesium hydrogen carbonate

b. $Au(OH)_3$, gold(III) hydroxide, used in gold plating

c. $C_{18}H_{34}O_2$, oleic acid from olive oil

6.103 How many grams are in 0.150 mole of each of the following?

a. K **b.** Cl_2 **c.** Na_2CO_3

6.104 How many grams are in 2.25 moles of each of the following?

a. N_2 **b.** NaBr **c.** C_6H_{14}

6.105 How many moles are in 25.0 g of each of the following compounds?

a. CO_2 **b.** $Al(OH)_3$ **c.** $MgCl_2$

6.106 How many moles are in 4.00 g of each of the following compounds?

a. NH_3 **b.** $Ca(NO_3)_2$ **c.** SO_3

CHALLENGE QUESTIONS

6.121 Write a balanced equation for each of the following reaction descriptions and identify each type of reaction:

a. An aqueous solution of lead(II) nitrate is mixed with aqueous sodium phosphate to produce solid lead(II) phosphate and aqueous sodium nitrate.

b. Gallium metal heated in oxygen gas forms solid gallium(III) oxide.

c. When solid sodium nitrate is heated, solid sodium nitrite and oxygen gas are produced.

d. Solid bismuth(III) oxide and solid carbon react to form bismuth metal and carbon monoxide gas.

6.122 A toothpaste contains 0.24% by mass sodium fluoride (NaF) used to prevent dental caries and 0.30% by mass triclosan, $C_{12}H_7Cl_3O_2$, a preservative and antigingivitis agent. One tube contains 119 g of toothpaste.

a. How many moles of NaF are in the tube of toothpaste?

b. How many fluoride ions (F^-) are in the tube of toothpaste?

c. How many grams of sodium ion (Na^+) are in 1.50 g of toothpaste?

d. How many molecules of triclosan are in the tube of toothpaste?

6.123 A gold bar is 2.31 cm long, 1.48 cm wide, and 0.0758 cm thick.

a. If gold has a density of 19.3 g/mL, what is the mass of the gold bar?

b. How many atoms of gold are in the bar?

c. When the same mass of gold combines with oxygen, the oxide product has a mass of 5.61 g. How many moles of O are combined with the gold?

d. What is the formula of the oxide product?

6.124 The gaseous hydrocarbon acetylene, C_2H_2, used in welders' torches, releases a large amount of heat when it burns according to the following equation:

$$2C_2H_2(g) + 5O_2(g) \longrightarrow 4CO_2(g) + 2H_2O(g)$$

a. How many moles of water are produced from the complete reaction of 64.0 g of oxygen?

b. How many moles of oxygen are needed to react completely with 2.25×10^{24} molecules of acetylene?

c. How many grams of carbon dioxide are produced from the complete reaction of 78.0 g of acetylene?

d. If the reaction in part **c** produces 186 g of CO_2, what is the percent yield for the reaction?

6.125 Acetylene, C_2H_2, used in welders' torches, burns according to the following equation:

$$2C_2H_2(g) + 5O_2(g) \longrightarrow 4CO_2(g) + 2H_2O(g)$$

a. How many molecules of oxygen are needed to react with 22.0 g of acetylene?

b. How many grams of carbon dioxide could be produced from the complete reaction of the acetylene in part **a.**?

c. If the reaction in part **a.** produces 64.0 g of CO_2, what is the percent yield for the reaction?

6.126 Consider the equation for the reaction of sodium and nitrogen to form sodium nitride:

$$Na(s) + N_2(g) \longrightarrow Na_3N(s)$$

a. Balance the equation.

b. If 80.0 g of sodium is mixed with 20.0 g of nitrogen gas, what mass of sodium nitride forms?

c. If the reaction in part **b.** has a percent yield of 75.0%, how much sodium nitride is actually produced?

6.127 Consider the following equation:

$$Al(s) + O_2(g) \longrightarrow Al_2O_3(s)$$

a. Balance the equation.

b. Identify the type of reaction.

c. How many moles of oxygen must react with 4.50 moles of Al?

d. How many grams of aluminum oxide are produced when 50.2 g of aluminum reacts?

e. When 0.500 mole of aluminum is reacted in a closed container with 8.00 g of oxygen, how many grams of aluminum oxide can form?

f. If 45.0 g of aluminum and 62.0 g of oxygen undergo a reaction that has a 70.0% yield, what mass of aluminum oxide forms?

ANSWERS

ANSWERS TO STUDY CHECKS

6.1 $3Fe(s) + 2O_2(g) \longrightarrow Fe_3O_4(s)$

6.2 $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$ Combination reaction

6.3 Lithium is oxidized: $2Li(s) \longrightarrow 2Li^+(s) + 2e^-(s)$

Fluorine is reduced: $F_2(g) + 2e^- \longrightarrow 2F^-(s)$

6.4 0.432 mole of H_2O

6.5 0.120 mole of aspirin

6.6 138.0 g of salicylic acid

6.7 24.4 g of Au

6.8 0.00621 mole of $CaCO_3$, 0.00550 mole of $MgCO_3$

6.9 0.90 mole of Fe_2S_3

6.10 44.0 g of NO

6.11 27.5 g of CO_2

6.12 84.7%

6.13 13.4 g of SiC

6.14 **a.** endothermic

b. 10.5 kJ

ANSWERS TO SELECTED QUESTIONS AND PROBLEMS

6.1 **a.** not balanced

b. balanced

c. not balanced

d. balanced

6.3 **a.** $N_2(g) + O_2(g) \longrightarrow 2NO(g)$

b. $2HgO(s) \longrightarrow 2Hg(l) + O_2(g)$

c. $4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$

d. $2Na(s) + Cl_2(g) \longrightarrow 2NaCl(s)$

6.5 **a.** $Mg(s) + 2AgNO_3(aq) \longrightarrow Mg(NO_3)_2(aq) + 2Ag(s)$
b. $2Al(s) + 3CuSO_4(aq) \longrightarrow 3Cu(s) + Al_2(SO_4)_3(aq)$
c. $Pb(NO_3)_2(aq) + 2NaCl(aq) \longrightarrow PbCl_2(s) + 2NaNO_3(aq)$
d. $2Al(s) + 6HCl(aq) \longrightarrow 2AlCl_3(aq) + 3H_2(g)$

6.7 **a.** A single reactant breaks into two simpler substances (elements).
b. One element in the reacting compound is replaced by the other reactant.

6.9 **a.** combination reaction
b. single replacement reaction
c. decomposition reaction
d. double replacement reaction
e. double replacement reaction

6.11 **a.** $Mg(s) + Cl_2(g) \longrightarrow MgCl_2(s)$
b. $2HBr(g) \longrightarrow H_2(g) + Br_2(g)$
c. $Mg(s) + Zn(NO_3)_2(aq) \longrightarrow Zn(s) + Mg(NO_3)_2(aq)$
d. $K_2S(aq) + Pb(NO_3)_2(aq) \longrightarrow 2KNO_3(aq) + PbS(s)$

6.13 **a.** reduction **b.** oxidation
c. reduction **d.** reduction

6.15 **a.** Zn is oxidized; Cl_2 is reduced.
b. Br^- in NaBr is oxidized; Cl_2 is reduced.
c. The O^{2-} in PbO is oxidized; the Pb^{2+} is reduced.
d. Sn^{2+} is oxidized; Fe^{3+} is reduced.

6.17 **a.** reduction
b. oxidation

6.19 Linoleic acid gains hydrogen atoms and is reduced.

6.21 1.00 mole contains 6.02×10^{23} atoms of an element, molecules of a covalent substance, or formula units of an ionic substance.

6.23 **a.** 1.20×10^{23} atoms of Ag
b. 4.52×10^{23} molecules of C_3H_8O
c. 0.478 mole of Au

6.25 **a.** 24 moles of H
b. 1.0×10^2 moles of C
c. 0.040 mole of N

6.27 **a.** 3.01×10^{23} atoms of C
b. 7.71×10^{23} molecules of SO_2
c. 0.0867 mole of Fe
d. 14.1 moles of C_2H_5OH

6.29 **a.** 6.00 moles of H
b. 8.00 moles of O
c. 1.20×10^{24} atoms of P
d. 4.82×10^{24} atoms of O

6.31 **a.** 74.6 g/mole **b.** 159.8 g/mole
c. 73.8 g/mole **d.** 342.3 g/mole
e. 58.3 g/mole **f.** 365.1 g/mole

6.33 **a.** 46.0 g **b.** 112 g
c. 14.8 g **d.** 112 g

6.35 **a.** 29.3 g **b.** 109 g
c. 4.05 g **d.** 194 g

6.37 **a.** 602 g **b.** 11 g

6.39 **a.** 0.463 mole **b.** 0.0167 mole
c. 0.882 mole **d.** 1.17 moles

6.41 **a.** 0.78 mole of S
b. 1.95 moles of S
c. 6.0 moles of S

6.43 **a.** 1.72×10^{24} atoms of N
b. 1.8×10^{24} atoms of N
c. 2.4×10^{24} atoms of N

6.45 **a.** $\frac{2 \text{ moles } SO_2}{1 \text{ mole } O_2}$ and $\frac{1 \text{ mole } O_2}{2 \text{ moles } SO_2}$

$\frac{2 \text{ moles } SO_2}{2 \text{ moles } SO_3}$ and $\frac{2 \text{ moles } SO_3}{2 \text{ moles } SO_2}$

$\frac{2 \text{ moles } SO_3}{1 \text{ mole } O_2}$ and $\frac{1 \text{ mole } O_2}{2 \text{ moles } SO_3}$

b. $\frac{4 \text{ moles P}}{5 \text{ moles } O_2}$ and $\frac{5 \text{ moles } O_2}{4 \text{ moles P}}$

$\frac{4 \text{ moles P}}{2 \text{ moles } P_2O_5}$ and $\frac{2 \text{ moles } P_2O_5}{4 \text{ moles P}}$

$\frac{5 \text{ moles } O_2}{2 \text{ moles } P_2O_5}$ and $\frac{2 \text{ moles } P_2O_5}{5 \text{ moles } O_2}$

6.47 **a.** 1.0 mole of O_2 **b.** 10. moles of H_2
c. 5.0 moles of H_2O

6.49 **a.** 1.25 moles of C **b.** 0.96 mole of CO
c. 1.0 mole of SO_2 **d.** 0.50 mole of CS_2

6.51 **a.** 77.5 g of Na_2O **b.** 6.26 g of O_2
c. 19.4 g of O_2

6.53 **a.** 192 g of O_2 **b.** 3.79 g of N_2
c. 54.0 g of H_2O

6.55 **a.** 3.65 g of H_2O **b.** 3.43 g of NO
c. 7.53 g of HNO_3

6.57 **a.** $2PbS(s) + 3O_2(g) \longrightarrow 2PbO(s) + 2SO_2(g)$
b. 6.00 g of O_2
c. 17.4 g of SO_2
d. 137 g of PbS

6.59 **a.** 70.9% **b.** 63.2%

6.61 70.8 g of Al_2O_3

6.63 60.4%

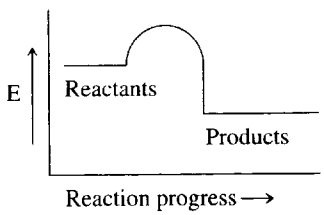
6.65 **a.** 8 taxis can be used to pick up passengers.
b. 7 taxis can be driven.

6.67 **a.** 5.0 moles of H_2 **b.** 4.0 moles of H_2
c. 3.0 moles of N_2

6.69 **a.** 2.00 moles of SO_3 **b.** 0.500 mole of Fe_3O_4
c. 1.27 moles of CO_2

6.71 **a.** 0.188 mole of $AlCl_3$ **b.** 0.750 mole of H_2O
c. 0.417 mole of SO_2

6.73 **a.** The activation energy is the energy required to break the bonds of the reacting molecules.
b. In exothermic reactions, the energy of the products is lower than the reactants.
c.



6.75 **a.** exothermic **b.** endothermic
c. exothermic

6.77 **a.** exothermic $\Delta H = -210$ kcal
b. endothermic $\Delta H = 65.3$ kJ
c. exothermic $\Delta H = -205$ kcal

6.79 138 kcal

6.81 **a.** 1, 1, 2 combination reaction
b. 2, 2, 1 decomposition reaction

6.83 **a.** $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$
b. combination reaction

6.85 **a.** $2NI_3(s) \longrightarrow N_2(g) + 3I_2(g)$
b. decomposition reaction

6.87 **a.** $2Cl_2(g) + O_2(g) \longrightarrow 2OCl_2(g)$
b. combination reaction

6.89 **(1) a.** S_2Cl_2 **b.** 135.2 g/mole **c.** 0.0740 mole
(2) a. C_6H_6 **b.** 78.0 g/mole **c.** 0.128 mole

6.91 **a.** 252.2 g/mole **b.** 0.0991 mole
c. 0.991 mole of C

6.93 **a.** 47.1 g of CuO **b.** 0.296 mole of O_2

6.95 **a.** $NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$ Combination
b. $Fe_3O_4(s) + 4H_2(g) \longrightarrow 3Fe(s) + 4H_2O(g)$ Single replacement
c. $2Sb(s) + 3Cl_2(g)_3(s)$ Combination
d. $2NI_3(s) \longrightarrow N_2(g) + 3I_2(g)$ Decomposition
e. $2KBr(aq) + Cl_2(aq) \longrightarrow 2KCl(aq) + Br_2(l)$ Single replacement
f. $Al_2(SO_4)_3(aq) + 6NaOH(aq) \longrightarrow 3Na_2SO_4(aq) + 2Al(OH)_3(s)$ Double replacement

6.97 **a.** reduction **b.** oxidation
c. oxidation **d.** reduction

6.99 **a.** 90.0 g/mole
b. 3.01×10^{23} molecules
c. 2.71×10^{24} atoms of C
d. 220 g of lactic acid

6.101 **a.** 152.0 g/mole **b.** 389.9 g/mole
c. 169.0 g/mole

6.103 **a.** 5.87 g **b.** 10.7 g **c.** 15.9 g

6.105 **a.** 0.568 mole **b.** 0.321 mole
c. 0.262 mole

6.107 **a.** 1.35 moles of glucose
b. 123 g of ethanol

6.109 $2NH_3(g) + 5F_2(g) \longrightarrow N_2F_4(g) + 6HF(g)$
a. 1.33 moles of NH_3 and 3.33 moles of F_2
b. 143 g of F_2
c. 10.4 g of N_2F_4

6.111 **a.** 682 g of Cl_2
b. 365 g of HCl

6.113 81.4%

6.115 **a.** 48 g of C_5H_{12}
b. 27.5 g of CO_2
c. 92.8 g of CO_2

6.117 16.8 g of NaCl

6.119 **a.** 1.08 kcal
b. $2NO(g) \longrightarrow N_2(g) + O_2(g) + 21.6$ kcal
c. 1.80 kcal

6.121 **a.** $3Pb(NO_3)_2(aq) + 2Na_3PO_4(aq) \longrightarrow Pb_3(PO_4)_2(s) + 6NaNO_3(aq)$ Double replacement
b. $4Ga(s) + 3O_2(g) \longrightarrow 2Ga_2O_3(s)$ Combination
c. $2NaNO_3(s) \longrightarrow 2NaNO_2(s) + O_2(g)$ Decomposition
d. $Bi_2O_3(s) + 3C(s) \longrightarrow 2Bi(s) + 3CO(g)$ Single replacement

6.123 **a.** 5.00 g of gold
b. 1.53×10^{22} Au atoms
c. 0.038 mole of oxygen
d. Au_2O_3

6.125 **a.** 1.27×10^{24} molecules of O_2
b. 74.5 g of CO_2
c. 85.9% yield

6.127 **a.** $4Al(s) + 3O_2(g) \longrightarrow 2Al_2O_3(s)$
b. This is a combination reaction.
c. 3.38 moles of oxygen
d. 94.8 g of aluminum oxide
e. 17.0 g of aluminum oxide
f. 59.5 g of aluminum oxide