13. (page 224)
    (a) exothermic
    (b) endothermic
    (c) exothermic
    (d) exothermic
    (e) endothermic

14. (page 224)
    (a) $2CO + O_2 \rightarrow 2CO_2 + \text{energy}$
    (b) $2KClO_3 + \text{energy} \rightarrow 2KCl + 3O_2$

Solutions to Understanding Chapter 8

Review (page 225)

1. (b), (c), (e), (g), (i), and (j) are incorrect. Sample corrections are underlined.
    (b) The substances formed during a reaction are the products.
    (c) A decomposition reaction involves the breaking down of a substance into simpler substances.
    (e) The equation $N_2 + 3H_2 \rightarrow 2NH_3$ indicates that 1 mole of nitrogen reacts with 3 moles of hydrogen.
    (g) The equation $Bi_2S_3 + 6HCl \rightarrow 2BiCl_3 + 3H_2S$ represents a double replacement reaction.
    (i) In a balanced equation, the total mass of reactants must equal the total mass of products.
    (j) One mole of sucrose, $C_{12}H_{22}O_{11}$, contains 22 moles of hydrogen atoms.

2. (a) exothermic
    (b) endothermic
    (c) endothermic

Applications and Problems (page 226)

3. (Note: In the first printing of *Understanding Chemistry* there was an error in equation (c). The final substance in the equation is carbon monoxide (CO).)
    (a) $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$
    (b) $Al_4C_3 + 12H_2O \rightarrow 3CH_4 + 4Al(OH)_3$
    (c) $2Ca_3(PO_4)_2 + 6SiO_2 + 10C \rightarrow P_4 + 6CaSiO_3 + 10CO$
    (d) $(NH_4)_2Cr_2O_7 \rightarrow N_2 + Cr_2O_3 + 4H_2O$
    (e) $4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$
    (f) $NH_4NO_3 \rightarrow N_2O + 2H_2O$
    (g) $Bi_2O_3 + 3H_2 \rightarrow 2Bi + 3H_2O$
    (h) $2FeCl_3 + 3(NH_4)_2S \rightarrow Fe_2S_3 + 6NH_4Cl$
    (i) $C_{10}H_{16} + 8Cl_2 \rightarrow 16HCl + 10C$
    (j) $2NaI + MnO_2 + 2H_2SO_4 \rightarrow Na_2SO_4 + MnSO_4 + 2H_2O + I_2$

4. (a) $3Ca + N_2 \rightarrow Ca_3N_2$
    (b) $CaO + CO_2 \rightarrow CaCO_3$
    (c) $2Al + 3Br_2 \rightarrow 2AlBr_3$
    (d) $4Li + O_2 \rightarrow 2Li_2O$
    (e) $P_4 + 6I_2 \rightarrow 4PI_3$
    (f) $BaO + H_2O \rightarrow Ba(OH)_2$

5. (a) $2HgO \rightarrow 2Hg + O_2$
   (b) $MgCO_3 \rightarrow MgO + CO_2$
   (c) $2HCl \rightarrow H_2 + Cl_2$
   (d) $2H_2O \rightarrow 2H_2 + O_2$
6. (a) $Mg + Pb(NO_3)_2 \rightarrow Pb + Mg(NO_3)_2$
   (b) $Cu + ZnCl_2 \rightarrow$ NO REACTION
   (c) $Cl_2 + 2LiI \rightarrow I_2 + 2LiCl$
   (d) $Sn + 2AgNO_3 \rightarrow 2Ag + Sn(NO_3)_2$
7. (a) $2AgNO_3 + K_2S \rightarrow Ag_2S + 2KNO_3$
   The precipitate is Ag_2S.
   (b) $BaCl_2 + Na_2CO_3 \rightarrow BaCO_3 + 2NaCl$
   The precipitate is $BaCO_3$.
   (c) $Ca(NO_3)_2 + Li_2SO_4 \rightarrow CaSO_4 + 2LiNO_3$
   The precipitate is $CaSO_4$.
   (d) $CoCl_2 + 2NaOH \rightarrow Co(OH)_2 + 2NaCl$
   The precipitate is $Co(OH)_2$
8. (a) double replacement
   (b) synthesis
   (c) double replacement
   (d) single replacement
   (e) single replacement
   (f) synthesis
   (g) decomposition
   (h) double replacement
   (i) decomposition
   (j) double replacement
9. $CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaCl$
10. (a) $KOH + HBr \rightarrow KBr + H_2O$
    (b) $Ba(OH)_2 + 2HCl \rightarrow BaCl_2 + 2H_2O$
    (c) $Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$
    (d) $Al(OH)_3 + 3HNO_3 \rightarrow Al(NO_3)_3 + 3H_2O$
    (e) $Ca(OH)_2 + 2HClO_4 \rightarrow Ca(ClO_4)_2 + 2H_2O$
11. (a) $H_2 + Cl_2 \rightarrow 2HCl + energy$
    (b) $2NaClO_3 + energy \rightarrow 2NaCl + 3O_2$
    (c) $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2 + energy$
12. (a) $CaO + H_2O \rightarrow Ca(OH)_2 + energy$
    (b) $6CO_2 + 6H_2O + energy \rightarrow C_6H_{12}O_6 + 6O_2$
    (c) $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2 + energy$