Sample Problems

Answers

1. When solid sodium is dropped in water, hydrogen gas and aqueous sodium hydroxide are produced.

2. $S(s) + O_2(g) \rightarrow SO_2(g)$

3. $3CO + Fe_2O_3 \rightarrow 2Fe + 3CO_2$
4. $2C + O_2 \rightarrow 2CO$
5. a. $FeCl_3 + 3NaOH \rightarrow Fe(OH)_3 + 3NaCl$
   b. $CS_2 + 3Cl_2 \rightarrow CCl_4 + S_2Cl_2$
   c. $2KI + Pb(NO_3)_2 \rightarrow PbI_2 + 2KNO_3$
   d. $2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$
6. a. $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$
   b. $2Na + 2H_2O \rightarrow 2NaOH + H_2$

Lesson Check Answers

7. Write the formulas of the reactants to the left of the reaction arrow and the formulas of the products to the right.

8. Write the skeleton equation with the correct formulas of the reactants on the left and the correct formulas of the products on the right. Then balance the equation by using coefficients so that it obeys the law of conservation of mass.

9. a. $CuS(s) + O_2(g) \xrightarrow{heat} Cu(s) + SO_2(g)$

   b. $NaHCO_3(s) \xrightarrow{heat} Na_2CO_3(s) + CO_2(g) + H_2O(l)$

10. a. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$
    b. $Fe_2O_3(s) + 3H_2(g) \rightarrow 2Fe(s) + 3H_2O(l)$
    c. $4P(s) + 5O_2(g) \rightarrow P_4O_{10}(s)$
    d. $2Al(s) + N_2(g) \rightarrow 2AlN(s)$

11. a. $2Fe(s) + 3Cl_2(g) \rightarrow 2FeCl_3(s)$
    b. $Al_2(CO_3)_3(s) \rightarrow Al_2O_3(s) + 3CO_2(g)$
    c. $Mg(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Mg(NO_3)_2(aq)$

Sample Problems

FIGURE 11.5 Both involve two elements and one compound. In Figure 11.4, a compound is being formed from the elements; in Figure 11.5, a compound is being decomposed into its elements.
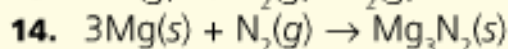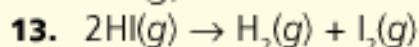
12. $HBr(g)$
13. $2HI(g) \rightarrow H_2(g) + I_2(g)$
14. $3Mg(s) + N_2(g) \rightarrow Mg_3N_2(s)$

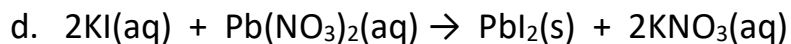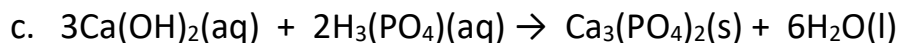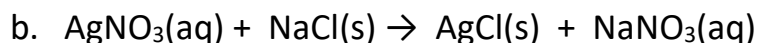**FIGURE 11.6** to prevent their reaction with water vapor and oxygen in the air

15. a. $Fe(s) + Pb(NO_3)_2(aq) \rightarrow Fe(NO_3)_2(aq) + Pb(s)$
    b. $Cl_2(aq) + 2NaI(aq) \rightarrow 2NaCl(aq) + I_2(aq)$
    c. $Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)$

    d. $Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$

16. a. $3NaOH(aq) + Fe(NO_3)_3(aq) \rightarrow Fe(OH)_3(s) + 3NaNO_3(aq)$
    b. $3Ba(NO_3)_2(aq) + 2H_3PO_4(aq) \rightarrow Ba_3(PO_4)_2(s) + 6HNO_3(aq)$

    c. $FeS(s) + 2HCl(aq) \rightarrow FeCl_2(s) + H_2S(g)$

17. a. $3KOH(aq) + H_3PO_4(aq) \rightarrow K_3PO_4(aq) + 3H_2O(l)$

    b. $AgNO_3(aq) + NaCl(s) \rightarrow AgCl(s) + NaNO_3(aq)$

    c. $3Ca(OH)_2(aq) + 2H_3(PO_4)(aq) \rightarrow Ca_3(PO_4)_2(s) + 6H_2O(l)$

    d. $2KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$

    e. $3H_2SO_4(aq) + 2Al(OH)_3(aq) \rightarrow Al_2(SO_4)_3(aq) + 6H_2O(l)$

FIGURE 11.8 energy in the form of heat and light

18. a. $CH_2O + O_2 \rightarrow CO_2 + H_2O$
    b. $C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$
    c. $2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(g)$
19. a. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
    b. $C_3H_6O(l) + 4O_2(g) \rightarrow 3CO_2(g) + 3H_2O(g)$
    c. $2C_5H_{11}OH(l) + 15O_2(g) \rightarrow$
    $$10CO_2(g) + 12H_2O(l)$$
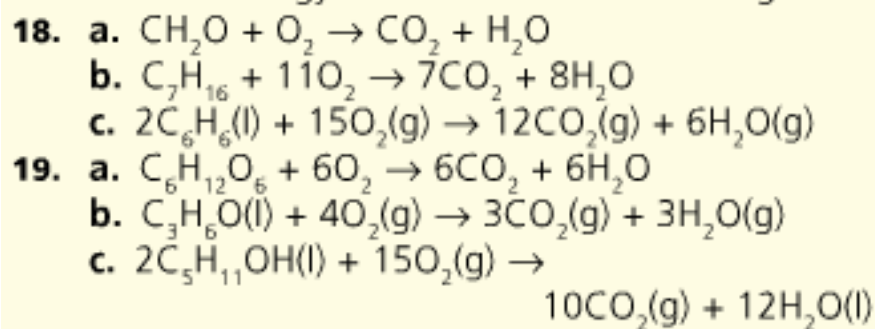
Lesson Check Answers

20. combination, decomposition, single-replacement, double-replacement, and combustion

21. a. combustion;
    $2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$
    b. decomposition;
    $2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$
    c. combination; $4Li + O_2 \rightarrow 2Li_2O$
    d. single-replacement;
    $Zn + 2AgNO_3 \rightarrow 2Ag + Zn(NO_3)_2$

22. a. double replacement; two different compounds
    b. decomposition; two or more elements and/or compounds
    c. combination; a compound

d. combustion; carbon dioxide and water

23. a. $CaI_2 + Hg(NO_3)_2 \rightarrow HgI_2 + Ca(NO_3)_2$
    b. $2Al + 3Cl_2 \rightarrow 2AlCl_3$
    c. no reaction
    d. $2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$

24. **BIG**IDEA The combustible compounds in wood react with O_2 to produce CO_2 and H_2O during combustion, leaving the non-combustible components behind as ash. The law is not violated because the total mass of the wood and O_2 before combustion is equal to the total mass of the ash, CO_2 and H_2O produced by the reaction.

Sample Problems

Answers

READING SUPPORT The spectators at a football game are present at the game, but they don't participate in it.

FIGURE 11.10 Metal and bone both absorb x-rays. You can examine the lighter areas of the x-ray to see if there are shapes other than bones in the image and determine if those shapes resemble metal objects.

25. $OH^-(aq) + H^+ \rightarrow H_2O$ (l)
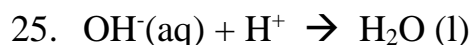
26. complete ionic equation: $3Ca^{2+}(aq) + 6OH^-(aq) + 6H^+(aq) + 2PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(s) + 6H_2O(l)$
    net ionic equation: same as complete ionic equation

FIGURE 11.11 sodium and nitrate

27. $2Cl^-(aq) + Pb^+(aq) \rightarrow PbCl_2(s)$
28. $Fe^{3+}(aq) + 3NO_3^-(aq) + 3Na^+(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s) + 3Na^+(aq) + 3NO_3^-(aq)$
    $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$

Lesson Check Answers

29. A net ionic equation shows only those particles involved in the reaction and is balanced with respect to both mass and charge.
30. Use the general rules for solubility of ionic compounds (Table 11.3).
31. a. $Pb^{2+}(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s)$
    b. $Pb^{2+}(aq) + 2Cl^-(aq) \rightarrow PbCl_2(s)$
    c. $Fe^{3+}(aq) + PO_4^{3-}(aq) \rightarrow FePO_4(s)$
    d. $Co^{2+}(aq) + S^{2-}(aq) \rightarrow CoS(s)$
32. a. $BaSO_4(s)$ b. $Al(OH)_3(s)$
    c. $Ag_2S(s)$ d. $PbCl_2(s)$
    e. $CaCO_3(s)$

33. Ca^{2+}, complete: $3Ca^{2+}(aq) + 6Na^+(aq) + 2PO_4^{3-}(aq) \rightarrow 6Na^+(aq) + Ca_3(PO_4)_2(s)$
    Ca^{2+}, net: $3Ca^{2+}(aq) + 2PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(s)$
    Mg^{2+}, complete: $3Mg^{2+}(aq) + 6Na^+(aq) + 2PO_4^{3-}(aq) \rightarrow 6Na^+(aq) + Mg_3(PO_4)_2(s)$
    Mg^{2+}, net: $3Mg^{2+}(aq) + 2PO_4^{3-}(aq) \rightarrow Mg_3(PO_4)_2(s)$