APPLICATIONS AND PROBLEMS

3. Copy the following equations into your notebook, then balance them.
   (a) $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$
   (b) $Al_4C_3 + H_2O \rightarrow CH_4 + Al(OH)_3$
   (c) $Ca_3(PO_4)_2 + SiO_2 + C \rightarrow P_4 + CaSiO_3 + CO_2$
   (d) $(NH_4)_2Cr_2O_7 \rightarrow N_2 + Cr_2O_3 + H_2O$
   (e) $FeS_2 + O_2 \rightarrow Fe_2O_3 + SO_2$
   (f) $NH_4NO_3 \rightarrow N_2O + H_2O$
   (g) $Bi_2O_3 + H_2 \rightarrow Bi + H_2O$
   (h) $FeCl_3 + (NH_4)_2S \rightarrow Fe_2S_3 + NH_4Cl$
   (i) $C_{10}H_{16} + Cl_2 \rightarrow HCl + C$
   (j) $NaI + MnO_2 + H_2SO_4 \rightarrow Na_2SO_4 + MnSO_4 + H_2O + I_2$

4. The following reactions are examples of synthesis reactions. Complete the equations by writing the formulas of the products, then balance the equations.
   (a) $Ca + N_2 \rightarrow$
   (b) $CaO + CO_2 \rightarrow$
   (c) $Al + Br_2 \rightarrow$
   (d) $Li + O_2 \rightarrow$
   (e) $P_4 + I_2 \rightarrow$
   (f) $BaO + H_2O \rightarrow$

5. Complete the following equations for decomposition reactions, then balance the equations.
   (a) $HgO \rightarrow$
   (b) $MgCO_3 \rightarrow$
   (c) $HCl \rightarrow$
   (d) $H_2O \rightarrow$

6. Predict whether a reaction will take place for each of the following. Write a balanced equation for any reaction that does occur.
   (a) $Mg + Pb(NO_3)_2 \rightarrow$
   (b) $Cu + ZnCl_2 \rightarrow$
   (c) $Cl_2 + LiI \rightarrow$
   (d) $Sn + AgNO_3 \rightarrow$

   If you don't know how to predict, just write the reaction anyways!

7. In each of the following reactions, a precipitate forms. Noting that all compounds of group I metals are soluble, write a balanced equation for each reaction. Identify the precipitate in each case.
   (a) $AgNO_3 + K_2S \rightarrow$
   (b) $BaCl_2 + Na_2CO_3 \rightarrow$
   (c) $Ca(NO_3)_2 + Li_2SO_4 \rightarrow$
   (d) $CoCl_2 + NaOH \rightarrow$

   If you do not know how to identify the precipitate, leave for later

8. Identify each of the following reactions as a synthesis, decomposition, single replacement, or double replacement reaction.
   (a) $Mg(OH)_2 + 2HNO_3 \rightarrow Mg(NO_3)_2 + 2H_2O$
   (b) $H_2O + SO_3 \rightarrow H_2SO_4$
   (c) $FeCl_3 + 3NaOH \rightarrow Fe(OH)_3 + 3NaCl$
   (d) $Cl_2 + ZnI_2 \rightarrow ZnCl_2 + I_2$
   (e) $H_2SO_4 + Mg \rightarrow MgSO_4 + H_2$
   (f) $K_2O + H_2O \rightarrow 2KOH$
   (g) $2NaClO_3 \rightarrow 2NaCl + 3O_2$
   (h) $2AsCl_3 + 3H_2S \rightarrow As_2S_3 + 6HCl$
   (i) $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$
   (j) $3NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3H_2O$

9. The presence of small amounts of calcium chloride dissolved in water is responsible for one type of water hardness. Hard water does not form a lather with soap, but forms a scum instead. The calcium ions can be removed from the water by the addition of sodium carbonate. A precipitate of calcium carbonate forms, and this can be removed by filtration. Write a balanced equation for the reaction between calcium chloride and sodium carbonate.

10. Each of the following is a neutralization reaction. Complete and balance each equation.
    (a) $KOH + HBr \rightarrow$
    (b) $Ba(OH)_2 + HCl \rightarrow$
    (c) $Mg(OH)_2 + H_2SO_4 \rightarrow$
    (d) $Al(OH)_3 + HNO_3 \rightarrow$
    (e) $Ca(OH)_2 + HClO_4 \rightarrow$

11. Write balanced equations for the following reactions, including the heat term in the equation.
    (a) Hydrogen and chlorine react to form hydrogen chloride, releasing energy in the process.
    (b) When sodium chlorate is heated, it decomposes into sodium chloride and oxygen.
    (c) Calcium reacts with water, releasing hydrogen gas and forming a solution of calcium hydroxide. The temperature of the water increases during the reaction.

12. Write balanced equations for the following reactions. Include the heat term with the equation.
    (a) When calcium oxide is added to water, calcium hydroxide is formed. The temperature of the water increases during the reaction.
    (b) The process of photosynthesis in plants produces glucose, $C_6H_{12}O_6$, and oxygen, from the raw materials carbon dioxide and water. Energy, usually from the sun, is absorbed during photosynthesis.
    (c) Magnesium reacts with sulphuric acid, forming magnesium sulphate and releasing hydrogen gas. The solution becomes warmer as the reaction proceeds.

13. For each of the following reactions, write a balanced equation. Indicate to which of the four types of reaction studied in this chapter each reaction belongs.
    (a) Ammonia gas and hydrogen chloride gas react to form ammonium chloride, a white solid.
    (b) Sulphur dioxide, formed during the burning of sulphur-containing coal, may be removed from smokestack gases by passing the gases over solid calcium oxide. Calcium sulphite is formed by this reaction.
    (c) If a bottle of hydrogen peroxide solution, H_2O_2, is left to stand at room temperature, oxygen gas is slowly released. After a period of time, the bottle contains only water.
    (d) In some water treatment treatment plants, solutions of aluminum sulphate and calcium hydroxide are added to the water. A "sticky" precipitate of aluminum hydroxide forms. This removes some of the small particles in the water as it settles to the bottom.