Chapter 8: Chemical Reactions

I. Indications of a chemical reaction
   a. Energy is released or absorbed
      i. Heat
      ii. Light
   b. Production of a gas
   c. Formation of a precipitate
      i. Precipitate - a solid that is produced as a result of a chemical reaction in solution and that separates from that solution
   d. Color Change
   e. Exothermic reaction - releases heat (get warmer)
   f. Endothermic reaction - absorbs heat (gets colder)

II. Characteristics of Chemical Equations
   a. The equation must represent known facts
   b. The equation must contain the correct formulas for the reactants and products
   c. The law of conservation of mass must be satisfied. You must have the same elements on both sides of the equation.

III. Common Symbols for Chemical Equations
   a. => means "yields", indicates result of reaction
   b. <=> means reaction can be reversible
   c. (s) means reactant or product is in the solid state
   d. (l) means reactant or product is in the liquid state
   e. (aq) means reactant or product is dissolved in water
   f. (g) means reactant or product is in the gaseous state

IV. Significance of a Chemical Equation
   a. The coefficients of a chemical reaction indicate relative, not absolute amounts of reactants and products
   b. The relative masses of reactants and products can be determined from coefficients, because coefficients indicate the amount of moles of each substance.
   c. Reverse reactions have the same relative amounts as forward reactions

V. Balancing Chemical Equations
   a. Identify reactants and products
   b. Make sure your formulas for each reactant and product are correct
   c. Balance the equation using the law of conservation of mass (make sure you have the same amount of elements on both sides of the equation)
      i. Balance the different types of atoms one at a time
      ii. First balance the atoms of elements that are combined and that only appear once on each side of the equation

VI. Types of Chemical Reactions
   a. Synthesis Reaction - two or more substances combine to form one new substance
      i. $16\text{Rb} + S_8 \rightarrow 8\text{Rb}_2S$
      ii. $8\text{Ba} + S_8 \rightarrow 8\text{Ba}_2S$
   b. Decomposition Reaction - a single compound undergoes a reaction to form two or more substances
      i. $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
      ii. $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
      c. Single-Displacement Reaction - one element replaces a similar element in a compound
         i. $2\text{Al} + 3\text{Fe}(\text{NO}_3)_2 \rightarrow 3\text{Fe} + 2\text{Al}(\text{NO}_3)_3$
         ii. $\text{Mg} + 2\text{HCl} \rightarrow \text{H}_2 + \text{Cl}_2$
      d. Double-Displacement Reaction - ions of two compounds exchange places
         i. $2\text{KI} + \text{Pb(NO}_3)_2 \rightarrow \text{PbI}_2 + 2\text{KNO}_3$
         ii. $\text{HCL} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
      e. Combustion Reaction - a substance reacts with oxygen to produce $\text{CO}_2$ and $\text{H}_2\text{O}$
         i. $\text{C}_2\text{H}_4 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$
         ii. $\text{C}_6\text{H}_{12} + 2\text{O}_2 \rightarrow 12\text{CO}_2 + 12\text{H}_2\text{O}$

VII. Activity Series of the Elements
   a. Activity Series - a list of elements organized according to the ease with which the elements undergo certain chemical reactions.
   b. For metals, greater activity means electrons are more easily and likely to be given up
   c. For non-metals, greater activity means electrons are more easily and likely to be gained

CONTINUE ON TO CH 8 ANSWER KEY
# Activity Series of Elements

<table>
<thead>
<tr>
<th>Activity of Metals</th>
<th>Can react with cold water and acids, replacing hydrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li</td>
<td></td>
</tr>
<tr>
<td>Rb</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td></td>
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<td>Ba</td>
<td></td>
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<tr>
<td>Sr</td>
<td></td>
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<tr>
<td>Ca</td>
<td></td>
</tr>
<tr>
<td>Na</td>
<td></td>
</tr>
<tr>
<td>Mg</td>
<td>Can react with steam and acids, replacing hydrogen</td>
</tr>
<tr>
<td>Al</td>
<td></td>
</tr>
<tr>
<td>Mn</td>
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<td>Cr</td>
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<td>Fe</td>
<td></td>
</tr>
<tr>
<td>Cd</td>
<td></td>
</tr>
<tr>
<td>Co</td>
<td>Can react with acids, replacing hydrogen</td>
</tr>
<tr>
<td>Ni</td>
<td></td>
</tr>
<tr>
<td>Sn</td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td></td>
</tr>
<tr>
<td>H₂</td>
<td>React with oxygen, forming oxides</td>
</tr>
<tr>
<td>Sb</td>
<td></td>
</tr>
<tr>
<td>Bi</td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td></td>
</tr>
<tr>
<td>Hg</td>
<td></td>
</tr>
<tr>
<td>Ag</td>
<td>Fairly unreactive, form oxides only indirectly</td>
</tr>
<tr>
<td>Pt</td>
<td></td>
</tr>
<tr>
<td>Au</td>
<td></td>
</tr>
</tbody>
</table>

## Activity of Halogens

| F₂, Cl₂, Br₂ | Very reactive with metals. |

---

**Use Solubility Rules for Double Replacement Reactions (Solid Formed?)**

Solubility rules for Chem II. Test

Note: soluble is here defined as 0.1 mole per liter.

1. All nitrates (NO₃⁻) and chlorates (ClO₃⁻) are soluble.

2. All alkali metal (lithium, sodium, potassium, rubidium and cesium) compounds are soluble.

3. All ammonium (NH₄⁺) compounds are soluble.

4. All hydroxides (OH⁻) are insoluble except those of the alkali metals. Those of the alkaline earth metals (magnesium, calcium, barium, strontium) are slightly soluble.

5. Halides (chlorides, bromides, iodides, and fluorides) are soluble except Ag⁺, mercurous Hg²⁺ and lead (II) Pb²⁺.

6. Common sulfates (SO₄²⁻) are soluble except calcium, barium, and strontium, and lead.

7. Common sulfides (S²⁻) are insoluble except those of the IA and IIA families and ammonium.

8. Common carbonates (CO₃²⁻), phosphates (PO₄³⁻), and silicates (SiO₃²⁻) are insoluble except those of the alkali metals and ammonium.

9. Chromates (CrO₄²⁻) are insoluble except ammonium, magnesium, calcium, tin (IV) and the alkali metals.

(aq) "soluble" = aqueous

(s) "insoluble" = solid forms
CHAPTER 8 REVIEW

Chemical Equations and Reactions

SECTION 1

SHORT ANSWER  Answer the following questions in the space provided.

1. Match the symbol on the left with its appropriate description on the right.

   - d  \( \triangle \)  (a) A precipitate forms.
   - a  \( \downarrow \)  (b) A gas forms.
   - b  \( \uparrow \)  (c) A reversible reaction occurs.
   - f  (l)  (d) Heat is applied to the reactants.
   - e  (aq)  (e) A chemical is dissolved in water.
   - c  \( \rightleftharpoons \)  (f) A chemical is in the liquid state.

2. Finish balancing the following equation:

   \[3\text{Fe}_2\text{O}_3 + \underline{8} \text{Al} \rightarrow \underline{4} \text{Al}_2\text{O}_3 + \underline{9} \text{Fe}\]

3. In each of the following formulas, write the total number of atoms present.
   - 12 atoms         a. 4\text{SO}_2
   - 16 atoms         b. 8\text{O}_2
   - 51 atoms         c. 3\text{Al}_2(\text{SO}_4)_3
   - 3 \times 10^{24} \text{atoms}     d. 6 \times 10^{23} \text{HNO}_3

4. Convert the following word equation into a balanced chemical equation:
   aluminum metal + copper(II) fluoride \( \rightarrow \) aluminum fluoride + copper metal

   \[2\text{Al}(s) + 3\text{CuF}_2(aq) \rightarrow 2\text{AlF}_3(aq) + 3\text{Cu}(s)\]

5. One way to test the salinity of a water sample is to add a few drops of silver nitrate solution with a known concentration. As the solutions of sodium chloride and silver nitrate mix, a precipitate of silver chloride forms, and sodium nitrate is left in solution. Translate these sentences into a balanced chemical equation.

   \[\text{NaCl}(aq) + \text{AgNO}_3(aq) \rightarrow \text{AgCl}(s) + \text{NaNO}_3(aq)\]

6. a. Balance the following equation: \(\text{NaHCO}_3(s) \xrightarrow{\text{ }} \text{Na}_2\text{CO}_3(s) + \text{H}_2\text{O}(g) + \text{CO}_2(g)\)

   \[2\text{NaHCO}_3(s) \xrightarrow{\text{ }} \text{Na}_2\text{CO}_3(s) + \text{H}_2\text{O}(g) + \text{CO}_2(g)\]
b. Translate the chemical equation in part a into a sentence.

When solid sodium hydrogen carbonate (bicarbonate) is heated, it decomposes into solid sodium carbonate while releasing carbon dioxide gas and water vapor.

7. The poisonous gas hydrogen sulfide, H₂S, can be neutralized with a base such as sodium hydroxide, NaOH. The unbalanced equation for this reaction follows:

\[
\text{NaOH}(aq) + \text{H}_2\text{S}(g) \rightarrow \text{Na}_2\text{S}(aq) + \text{H}_2\text{O}(l)
\]

A student who was asked to balance this equation wrote the following:

\[
\text{Na}_2\text{OH}(aq) + \text{H}_2\text{S}(g) \rightarrow \text{Na}_2\text{S}(aq) + \text{H}_2\text{O}(l)
\]

Is this equation balanced? Is it correct? Explain why or why not, and supply the correct balanced equation if necessary.

It is balanced but incorrect. In two of the formulas the subscripts were changed, which changed the compounds involved. Water is not H₃O, and sodium hydroxide is not Na₂OH. The correct balanced equation is \(2\text{NaOH} + \text{H}_2\text{S} \rightarrow \text{Na}_2\text{S} + 2\text{H}_2\text{O}\).

PROBLEM Write the answer on the line to the left. Show all your work in the space provided.

8. Recall that coefficients in a balanced chemical equation give relative amounts of moles as well as numbers of molecules.

30 mol a. Calculate the number of moles of CO₂ that form if 10 mol of C₃H₄ react according to the following balanced equation:

\[
\text{C}_3\text{H}_4 + 4\text{O}_2 \rightarrow 3\text{CO}_2 + 2\text{H}_2\text{O}
\]

40 mol b. Calculate the number of moles of O₂ that are consumed.
SECTION 2

SHORT ANSWER  Answer the following questions in the space provided.

1. Match the equation type on the left to its representation on the right.

   - **c**  synthesis  
   - **d**  decomposition 
   - **b**  single-displacement  
   - **a**  double-displacement

   (a)  $AX + BY \rightarrow AY + BX$
   (b)  $A + BX \rightarrow AX + B$
   (c)  $A + B \rightarrow AX$
   (d)  $AX \rightarrow A + X$

2. **c**  In the reaction described by the equation $2Al(s) + 3Fe(NO_3)_2(aq) \rightarrow 3Fe(s) + 2Al(NO_3)_3(aq)$, iron has been replaced by

   (a)  nitrate.
   (b)  water.
   (c)  aluminum.
   (d)  nitrogen.

3. **a**  Of the following chemical equations, the only reaction that is both synthesis and combustion is

   (a)  $C(s) + O_2(g) \rightarrow CO_2(g)$.
   (b)  $2C_2H_6(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l)$.
   (c)  $6CO_2(g) + 6H_2O(g) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g)$.
   (d)  $C_6H_{12}O_6(aq) + 6O_2(g) \rightarrow 6CO_2(aq) + 6H_2O(l)$.

4. **b**  Of the following chemical equations, the only reaction that is both combustion and decomposition is

   (a)  $S(s) + O_2(g) \rightarrow SO_2(g)$.
   (b)  $2C_2H_6(l) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(l)$.
   (c)  $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$.
   (d)  $2HgO(s) \xrightarrow{\Delta} 2Hg(l) + O_2(g)$.

5. Identify the products when the following substances decompose:

   - its separate elements  
   - metal oxide + water  
   - metal oxide + carbon dioxide  
   - water + sulfur dioxide

   a. a binary compound
   b. most metal hydroxides
   c. a metal carbonate
   d. the acid $H_2SO_3$

6. The complete combustion of a hydrocarbon in excess oxygen yields the products $\text{CO}_2$ and $\text{H}_2\text{O}$. 
SECTION 2 continued

7. For the following four reactions, identify the type, predict the products (make sure formulas are correct), and balance the equations:

   a. \( \text{Cl}_2(aq) + \text{NaI}(aq) \rightarrow \)
   
   \( \text{single-displacement; } \text{Cl}_2(aq) + 2\text{NaI}(aq) \rightarrow \text{I}_2(aq) + 2\text{NaCl}(aq) \)

   b. \( \text{Mg}(s) + \text{N}_2(g) \rightarrow \)
   
   \( \text{synthesis; } 3\text{Mg}(s) + \text{N}_2(g) \rightarrow \text{Mg}_3\text{N}_2(s) \)

   c. \( \text{Co(NO}_3)_2(aq) + \text{H}_2\text{S}(aq) \rightarrow \)
   
   \( \text{double-displacement; } \text{Co(NO}_3)_2(aq) + \text{H}_2\text{S}(aq) \rightarrow \text{CoS}(s) + 2\text{HNO}_3(aq) \)

   d. \( \text{C}_2\text{H}_5\text{OH}(aq) + \text{O}_2(g) \rightarrow \)
   
   \( \text{combustion; } \text{C}_2\text{H}_5\text{OH}(aq) + 3\text{O}_2(g) \rightarrow 2\text{CO}_2(g) + 3\text{H}_2\text{O}(l) \)

8. Acetylene gas, \( \text{C}_2\text{H}_2 \), is burned to provide the high temperature needed in welding.

   a. Write the balanced chemical equation for the combustion of \( \text{C}_2\text{H}_2 \) in oxygen.
   
   \( 2\text{C}_2\text{H}_2(g) + 5\text{O}_2(g) \rightarrow 4\text{CO}_2(g) + 2\text{H}_2\text{O}(l) \)

   b. If 1.0 mol of \( \text{C}_2\text{H}_2 \) is burned, how many moles of \( \text{CO}_2 \) are formed?
   
   2.5 mol

   c. If 1.0 mol of \( \text{C}_2\text{H}_2 \) is burned how many moles of oxygen gas are consumed?

9. a. Write the balanced chemical equation for the reaction that occurs when solutions of barium chloride and sodium carbonate are mixed. Refer to Table 1 on page 437 in Chapter 13 for solubility.

   \( \text{BaCl}_2(aq) + \text{Na}_2\text{CO}_3(aq) \rightarrow \text{BaCO}_3(s) + 2\text{NaCl}(aq) \)

   b. To which of the five basic types of reactions does this reaction belong?

   \( \text{double-displacement} \)

10. For the commercial preparation of aluminum metal, the metal is extracted by electrolysis from alumina, \( \text{Al}_2\text{O}_3 \). Write the balanced chemical equation for the electrolysis of molten \( \text{Al}_2\text{O}_3 \).

   \( 2\text{Al}_2\text{O}_3(l) \rightarrow 4\text{Al}(s) + 3\text{O}_2(g) \)

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CH#8 STUDY GUIDE

CHAPTER 8 REVIEW

Chemical Equations and Reactions

SECTION 3

SHORT ANSWER  Answer the following questions in the space provided.

1. List four metals that will not replace hydrogen in an acid.
   Choose from Cu, Ag, Au, Pt, Sb, Bi, and Hg.

2. Consider the metals iron and silver, both listed in Table 3 on page 286 of the text. Which one readily forms an oxide in nature, and which one does not?
   Fe forms an oxide in nature, and Ag does not, because it is much less active.

3. In each of the following pairs, identify the more active element.
   a. F₂ and I₂
   b. Mn and K
   c. Cu and H

4. Use the information in Table 3 on page 286 of the text to predict whether each of the following reactions will occur. For each reaction that will occur, complete the chemical equation by writing in the products formed and balancing the final equation.
   a. Al(s) + CH₃COOH(aq) →
      2Al(s) + 6CH₃COOH(aq) → 2Al(C₂H₃COO)₃(aq) + 3H₂(g)
   b. Al(s) + H₂O(l) →
      no reaction
   c. Cr(s) + CdCl₂(aq) →
      2Cr(s) + 3CdCl₂(aq) → 2CrCl₃(aq) + 3Cd(s)
   d. Br₂(l) + KCl(aq) →
      no reaction
SECTION 3 continued

5. Very active metals will react with water to release hydrogen gas and form hydroxides.
   a. Complete, and then balance, the equation for the reaction of Ca(s) with water.
      \[ \text{Ca}(s) + 2\text{H}_2\text{O}(l) \rightarrow \text{Ca(OH)}_2(aq) + \text{H}_2(g) \]
   b. The reaction of rubidium, Rb, with water is faster and more violent than the reaction of Na with water. Use the atomic structure and radius of each metal to account for this difference.
      Both are alkali metals and readily form a stable $1^+$ ion by ejecting an $s^1$ electron.
      Rb has a larger radius than Na and holds its electron less tightly, making it more reactive.

6. Gold, Au, is often used in jewelry. How does the relative activity of Au relate to its use in jewelry?
   Gold has a low reactivity and therefore does not corrode over time.

7. Explain how to use an activity series to predict the outcome of a single-displacement reaction.
   In single-displacement reactions, if the activity of the free element is greater than that of the element in the compound, the reaction will take place.

8. Aluminum is above copper in the activity series. Will aluminum metal react with copper(II) nitrate, Cu(NO₃)₂, to form aluminum nitrate, Al(NO₃)₃? If so, write the balanced chemical equation for the reaction.
   Yes; because aluminum is above copper in the activity series, aluminum metal will replace copper in copper(II) nitrate.
   \[ 2\text{Al}(s) + 3\text{Cu(NO}_3\text{)}_2(aq) \rightarrow 2\text{Al(NO}_3\text{)}_3(aq) + 3\text{Cu}(s) \]
CHAPTER 8 REVIEW

Chemical Equations and Reactions

MIXED REVIEW

SHORT ANSWER  Answer the following questions in the space provided.

1. **b** A balanced chemical equation represents all the following except
   (a) experimentally established facts.
   (b) the mechanism by which reactants combine to form products.
   (c) identities of reactants and products in a chemical reaction.
   (d) relative quantities of reactants and products in a chemical reaction.

2. **d** According to the law of conservation of mass, the total mass of the reacting substances is
   (a) always more than the total mass of the products.
   (b) always less than the total mass of the products.
   (c) sometimes more and sometimes less than the total mass of the products.
   (d) always equal to the total mass of the products.

3. Predict whether each of the following chemical reactions will occur. For each reaction that will occur, identify the reaction type and complete the chemical equation by writing in the products formed and balancing the final equation. General solubility rules are in Table 1 on page 437 of the text.

   a.  \( \text{Ba(NO}_3\text{)}_2(aq) + \text{Na}_3\text{PO}_4(aq) \rightarrow \)
      \( \text{double-displacement}; 3\text{Ba(NO}_3\text{)}_2(aq) + 2\text{Na}_3\text{PO}_4(aq) \rightarrow \)
      \( \text{Ba}_3\text{(PO}_4\text{)}_2(s) + 6\text{NaNO}_3(aq) \)

   b.  \( \text{Al}(s) + \text{O}_2(g) \rightarrow \)
      \( \text{synthesis}; 4\text{Al}(s) + 3\text{O}_2(g) \rightarrow 2\text{Al}_2\text{O}_3(s) \)

   c.  \( \text{I}_2(s) + \text{NaBr}(aq) \rightarrow \)
      \( \text{no reaction} \)

   d.  \( \text{C}_3\text{H}_4(g) + \text{O}_2(g) \rightarrow \)
      \( \text{combustion}; \text{C}_3\text{H}_4(g) + 4\text{O}_2(g) \rightarrow 3\text{CO}_2(g) + 2\text{H}_2\text{O}(g) \)
MIXED REVIEW continued

e. electrolysis of molten potassium chloride
\[ 2\text{KCl}(l) \rightarrow 2\text{K}(s) + \text{Cl}_2(g) \]

4. Some small rockets are powered by the reaction represented by the following unbalanced equation:
\[ (\text{CH}_3)_2\text{N}_2\text{H}_2(l) + \text{N}_2\text{O}_4(g) \rightarrow \text{N}_2(g) + \text{H}_2\text{O}(g) + \text{CO}_2(g) + \text{heat} \]
a. Translate this chemical equation into a sentence. (Hint: The name for \((\text{CH}_3)_2\text{N}_2\text{H}_2\) is dimethylhydrazine.)
When liquid dimethylhydrazine is mixed with dinitrogen tetroxide gas, the products are nitrogen gas, water vapor, and gaseous carbon dioxide, along with energy in the form of heat.
b. Balance the formula equation.
\[ (\text{CH}_3)_2\text{N}_2\text{H}_2(l) + 2\text{N}_2\text{O}_4(g) \rightarrow 3\text{N}_2(g) + 4\text{H}_2\text{O}(g) + 2\text{CO}_2(g) \]

5. In the laboratory, you are given two small chips of each of the unknown metals X, Y, and Z, along with dropper bottles containing solutions of XCl\(_2\)(aq) and ZCl\(_2\)(aq). Describe an experimental strategy you could use to determine the relative activities of X, Y, and Z.
Wording and strategies will vary. First, place one chip of Y into XCl\(_2\)(aq) and another into ZCl\(_2\)(aq). If Y reacts with one solution but not the other, the activity series can be established. If Y replaces X but not Z, the series is Z > Y > X. If Y replaces Z but not X, the series is X > Y > Z. If Y reacts with neither solution, Y is at the bottom of the series. Next, put one chip of X into ZCl\(_2\)(aq). If it reacts, the series is X > Z > Y. If it does not react, the series is Z > X > Y. If Y reacts with both solutions, Y is the most reactive. Last, put a chip of X into ZCl\(_2\)(aq). If it reacts, the series is Y > X > Z. If it does not react, the series is Y > Z > X.

6. List the observations that would indicate that a reaction had occurred.
Signs of a reaction include generation of energy as heat or light, formation of a precipitate, formation of a gas, and change in color.
CHAPTER
Chemical Equations

7-1 Concept Review

Building Relationships
1. Answer the following questions in the space provided.
   a. Use the law of conservation of energy to explain how endothermic and exothermic reactions can be the reverse of one another.

   ENERGY MUST BE CONSERVED

   Handout #2

   b. Many common reactions are viewed as producing one product when in fact there may be more than one product. For example, NaCl can be produced by mixing HCl with NaOH. Use the law of conservation of mass to explain why it is wrong to write the equation for this reaction as HCl + NaOH → NaCl.

   O + H ARE NOT ON THE PRODUCT SIDE

   CANS CAN RUST + LEAK

Distilling Information
2. Identify the following events as examples of physical or chemical changes. For those describing chemical changes, identify the reactants and the products.
   a. Silver nitrate solution is added to another solution, producing a white solid.

      chemical change

   b. Gasoline gives off fumes.

      physical change

   c. Sea water evaporates, leaving salt deposits.

      physical change

   d. A marshmallow is toasted over a campfire.

      chemical change

3. Granules of zinc oxide, ZnO, will react with hydrochloric acid, HCl, to form zinc chloride, ZnCl₂, and water. Write the balanced chemical equation for this reaction. (Hint: see Sample Problem 7A.)

   \[ \text{ZnO(s) + 2HCl(aq) \rightarrow ZnCl}_2 + \text{H}_2\text{O(l)} \]

   Answer

4. A reaction between copper and nitric acid, HNO₃, produces copper nitrate, Cu(NO₃)₂, nitrogen monoxide, NO, and water. Write the balanced chemical equation for this reaction. (Hint: see Sample Problem 7A.)

   \[ \text{HNO}_3 + \text{Cu(s)} \rightarrow \text{Cu(NO}_3)_2 + \text{NO} + \text{H}_2\text{O} \]

   Answer

5. Ethane, C₂H₆, reacts with molecular oxygen to produce carbon dioxide and water. Write the balanced chemical equation for this reaction. (Hint: see Sample Problem 7A.)

   \[ 2\text{C}_2\text{H}_6 + \frac{7}{2}\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O} \]

   Answer
7-4 Practice

Equations of Basic Reaction Types

1. Classify the reaction type for each of the following reactions. Briefly explain the reason for your selection.
   a. \(2Cr(s) + SnCl_2(aq) \rightarrow Sn(s) + 2CrCl_2(aq)\)

   **Element + Compound \rightarrow New Element + New Compound**
   Answer: Single Displacement

   \[\text{Element + Compound} \rightarrow \text{New Element + New Compound}\]

   **SINGLE DISPLACEMENT**

   \[2Cr(s) + SnCl_2(aq) \rightarrow Sn(s) + 2CrCl_2(aq)\]

   **List what you know**
   - List all data given in the problem and determine the reaction type.
   **Set up the problem**
   - Write chemical formulas for all of the reactants and products specified for the reaction.
   - Check your formulas using Table A-12 of the Appendix.
   - Assign a physical state to each reactant and product.
   **Balance and verify**
   - Count the number of atoms for each element.
   - Continue to insert coefficients until the law of conservation of mass is satisfied.
   - Check your work.

   **Answer**

   \[2Cr(s) + SnCl_2(aq) \rightarrow Sn(s) + 2CrCl_2(aq)\]

   \[\text{CO}_2 + \text{H}_2\text{O}\]

   \[\text{Combustion}\]

   \[\text{Synthesis}\]

   \[\text{Double Displacement}\]

   \[\text{Decomposition}\]

2. Write a balanced chemical equation for the synthesis of potassium bromide, \(KBr\). Be sure to include states of matter in your equation. (Hint: see Sample Problem 7B.)

   \[2K(s) + Br_2(l) \rightarrow 2KBBr(s)\]

3. Write a balanced chemical equation for the decomposition of hydrogen peroxide. One of the products of this reaction is oxygen gas. Be sure to include states of matter. (Hint: see Sample Problem 7B.)

   \[2H_2O_2(s) \rightarrow O_2(g) + 2H_2O(l)\]