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11 CHEMICAL REACTIONS

Practice Problems

In your notebook, solve the following problems. Use the 3-step problem-solving approach you learned in Chapter 1.

SECTION 11.1 DESCRIBING CHEMICAL REACTIONS

1. Write the skeleton equation for the reaction between hydrogen and oxygen that produces water.
2. Write the skeleton equation for the reaction that produces iron(II) sulfide from iron and sulfur.
3. Write the skeleton equation representing the heating of magnesium carbonate to produce solid magnesium oxide and carbon dioxide gas.
4. Write a balanced equation for the production of HCl gas from its elements.
5. Write a sentence that completely describes the chemical reaction represented by this balanced equation.

$$2HCl(aq) + CaCO_3(s) \rightarrow CO_2(g) + CaCl_2(aq) + H_2O(l)$$

6. Write the word equation for the following equation. Write a sentence fully describing the reaction. Is the equation correctly balanced? Explain.

$$2Ag(s) + S(s) \rightarrow Ag_2S(s)$$

7. Write a balanced equation representing the formation of aqueous sulfuric acid from water and sulfur trioxide gas.
8. Write a balanced equation from this word equation.

aqueous silver nitrate + copper metal → silver metal + aqueous ~~copper~~ cupric nitrate

9. Write a balanced equation for the following word equation.

phosphorus + oxygen → tetraphosphorous decoxide

SECTION 11.2 TYPES OF CHEMICAL REACTIONS

1. Write a balanced equation representing the reaction of magnesium with oxygen gas to produce magnesium oxide.
2. Write the balanced equation for the reaction that occurs between aluminum and fluorine.
3. Write the balanced equation for the production of oxygen gas and potassium chloride from the decomposition of potassium chlorate.
4. Write the balanced equation for the reaction between hydrochloric acid and calcium metal. The products are hydrogen gas and calcium chloride.
5. Write the balanced equation for the combustion of propane (C_3H_8) to produce carbon dioxide and water vapor.
6. Write the balanced equation for the reaction between iron(III) chloride and sodium hydroxide. The products are iron(III) hydroxide and sodium chloride.

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7. Classify each of the reactions in problems 1–6 as to type.
8. Use the activity series of metals (Table 11.2) and your knowledge of the relative reactivity of the halogens to predict whether the following reactions will occur. Write balanced equations for those reactions that do occur.
   a. $Br_2(l) + NaCl(aq) \rightarrow$
   b. $Ca(s) + Mg(NO_3)_2(aq) \rightarrow$
   c. $K(s) + H_2SO_4(aq) \rightarrow$
   d. $Zn(s) + NaOH(aq) \rightarrow$

SECTION 11.3 REACTIONS IN AQUEOUS SOLUTION

1. Write the net ionic equation for the reaction between aqueous barium nitrate, $Ba(NO_3)_2$, and sodium sulfate, Na_2SO_4.
2. Magnesium reacts with HCl to form hydrogen and magnesium chloride. Write the balanced net ionic equation for this reaction.

challenging problem!

3. The double-replacement reaction below results in the formation of the precipitate lead chloride. Balance the equation and write the net ionic equation.

$$Pb(NO_3)_2(aq) + NH_4Cl(aq) \rightarrow PbCl_2(s) + NH_4NO_3(aq)$$

4. Identify the precipitate formed when solutions of the following ionic compounds are mixed. If no precipitate is formed, write *no precipitate.*
   a. $Zn(NO_3)_2 + SnCl_2 \rightarrow$
   b. $KCl + AgNO_3 \rightarrow$
   c. $Cu(NO_3)_2 + Na_2S \rightarrow$
   d. $Al_2(SO_4)_3 + 3Mg(OH)_2 \rightarrow$

5. When will double replacement reactions NOT occur?

Practice Problem Solutions

Section 11.1

1. $H_2(g) + O_2(g) \rightarrow H_2O(l)$
2. $Fe(s) + S(s) \rightarrow FeS(s)$
3. $MgCO_3(s) \xrightarrow{\Delta} MgO(s) + CO_2(g)$
4. $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$
5. Hydrochloric acid and solid calcium carbonate react to produce carbon dioxide gas, aqueous calcium chloride, and liquid water.
6. silver + sulfur → silver sulfide

   Silver metal and sulfur react to produce solid silver sulfide. There are 2 silver atoms and 1 sulfur atom on each side of the equation, and the coefficients are in their lowest possible ratio. Thus, the equation is balanced correctly.
7. $H_2O(l) + SO_3(g) \rightarrow H_2SO_4(aq)$
8. $2AgNO_3(aq) + Cu(s) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$
9. $4P(s) + 5O_2(g) \rightarrow P_4O_{10}(s)$

Section 11.2

1. Magnesium is a Group 2A metal and forms cations with a 2+ charge. Oxygen is in Group 6A and forms anions with a 2− charge. They combine in a 1:1 ratio to form MgO.

   $$Mg + O_2 \rightarrow MgO$$

   The balanced chemical equation is

   $$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$$
2. $2Al(s) + 3F_2(g) \rightarrow 2AlF_3(s)$
3. First, determine the formulas for the reactant and products and write them in their proper positions to form a skeleton equation.

   $$KClO_3 \rightarrow KCl + O_2$$

   Next, balance the equation.

   $$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$
4. $Ca(s) + 2HCl(aq) \rightarrow H_2(g) + CaCl_2(aq)$
5. $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$
6. $FeCl_3(aq) + 3NaOH(aq) \rightarrow Fe(OH)_3(s) + 3NaCl(aq)$
7. combination reactions: 1 and 2
   decomposition reaction: 3
   single-replacement reaction: 4
   double-replacement reaction: 6
   combustion reactions: 1 and 5
8. **a.** no reaction

   b. $Ca(s) + Mg(NO_3)_2(aq) \rightarrow Ca(NO_3)_2(aq) + Mg(s)$

   c. $2K(s) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + H_2(g)$

   d. no reaction

   In a bromine is less reactive than chlorine so no reaction occurs. In **b** calcium replaces a less reactive magnesium and in **c** potassium replaces the less reactive hydrogen. Because zinc is less reactive than sodium, no reaction occurs in **d.**

Section 11.3

1. This reaction can be described as:

   $Ba(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaNO_3(aq)$

   The net ionic equation is:

   $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$
2. This reaction can be described as:

   $Mg(s) + 2HCl(aq) \rightarrow H_2(g) + MgCl_2(aq)$

   The net ionic equation is:

   $Mg(s) + 2H^+(aq) \rightarrow H_2(g) + Mg^{2+}(aq)$
3. $Pb(NO_3)_2(aq) + 2NH_4Cl(aq) \rightarrow PbCl_2(s) + 2NH_4NO_3(aq)$

   $Pb^{2+} + 2Cl^- \rightarrow PbCl_2(s)$
4. **a.** no precipitate
   b. $AgCl(s)$
   c. $CuS(s)$
   d. $Al(OH)_3(s)$

5. When both products are (aq).