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.

   \[ \begin{align*}
   d & \quad \Delta \\
   a & \quad \downarrow \\
   b & \quad \uparrow \\
   f & \quad (l) \\
   e & \quad (aq) \\
   c & \quad \rightleftharpoons \\
   \end{align*} \]

   (a) A precipitate forms.
   (b) A gas forms.
   (c) A reversible reaction occurs.
   (d) Heat is applied to the reactants.
   (e) A chemical is dissolved in water.
   (f) A chemical is in the liquid state.

2. Finish balancing the following equation:

   \[ 3\text{Fe}_2\text{O}_4 + \boxed{8} \text{Al} \rightarrow \boxed{4} \text{Al}_2\text{O}_3 + \boxed{9} \text{Fe} \]

3. In each of the following formulas, write the total number of atoms present.

   \[ \begin{align*}
   \text{12 atoms} & \quad \text{a. } 4\text{SO}_2 \\
   \text{16 atoms} & \quad \text{b. } 8\text{O}_2 \\
   \text{51 atoms} & \quad \text{c. } 3\text{AI}_2(\text{SO}_4)_3 \\
   \text{3 } \times \text{10}^{24} \text{ atoms} & \quad \text{d. } 6 \times 10^{23} \text{HNO}_3 \\
   \end{align*} \]

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

   \[ \text{NaHCO}_3(s) \xrightarrow{\Delta} \text{Na}_2\text{CO}_3(s) + \text{H}_2\text{O}(g) + \text{CO}_2(g) \]

   \[ 2\text{NaHCO}_3(s) \xrightarrow{\Delta} \text{Na}_2\text{CO}_3(s) + \text{H}_2\text{O}(g) + \text{CO}_2(g) \]
SECTION 1 continued

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, \(H_2S\), can be neutralized with a base such as sodium hydroxide, \(NaOH\). The unbalanced equation for this reaction follows:

\[ NaOH(aq) + H_2S(g) \rightarrow Na_2S(aq) + H_2O(l) \]

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

\[ Na_2OH(aq) + H_2S(g) \rightarrow Na_2S(aq) + H_3O(l) \]

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 \(H_3O\), and sodium hydroxide is not \(Na_2OH\). The correct balanced equation is \(2NaOH + H_2S \rightarrow Na_2S + 2H_2O\).

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.

\[ 30 \text{ mol} \]

a. Calculate the number of moles of \(CO_2\) that form if \(10 \text{ mol of } C_3H_4\) react according to the following balanced equation:

\[ C_3H_4 + 4O_2 \rightarrow 3CO_2 + 2H_2O \]

\[ 40 \text{ mol} \]

b. Calculate the number of moles of \(O_2\) that are consumed.
CHAPTER 8 REVIEW
Chemical Equations and Reactions

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                              (a) AX + BY → AY + BX
   d  decomposition                         (b) A + BX → AX + B
   b  single-displacement                   (c) A + B → AX
   a  double-displacement                   (d) AX → A + X

2. c  In the reaction described by the equation 2Al(s) + 3Fe(NO₃)₃(aq) → 3Fe(s) + 2Al(NO₃)₃(aq), iron has been replaced by

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

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

   (a) C(s) + O₂(g) → CO₂(g).
   (b) 2C₄H₁₀(l) + 13O₂(g) → 8CO₂(g) + 10H₂O(l).
   (c) 6CO₂(g) + 6H₂O(g) → C₆H₁₂O₆(aq) + 6O₂(g).
   (d) C₆H₁₂O₆(aq) + 6O₂(g) → 6CO₂(aq) + 6H₂O(l).

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

   (a) S(s) + O₂(g) → SO₂(g).
   (b) 2C₄H₁₀(l) + 13O₂(g) → 8CO₂(g) + 10H₂O(l).
   (c) 2H₂O₂(l) → 2H₂O(l) + O₂(g).
   (d) 2HgO(s) Δ 2Hg(l) + O₂(g).

5. Identify the products when the following substances decompose:

   its separate elements                      a. a binary compound
   metal oxide + water                       b. most metal hydroxides
   metal oxide + carbon dioxide              c. a metal carbonate
   water + sulfur dioxide                   d. the acid H₂SO₃

6. The complete combustion of a hydrocarbon in excess oxygen yields the products CO₂ and H₂O.
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. \( \text{Cl}_2(aq) + \text{NaI}(aq) \rightarrow \)
      
      single-displacement; \( \text{Cl}_2(aq) + 2\text{NaI}(aq) \rightarrow \text{I}_2(aq) + 2\text{NaCl}(aq) \)

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

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

   d. \( \text{C}_2\text{H}_5\text{OH}(aq) + \text{O}_2(g) \rightarrow \)
      
      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.
      
      \( 2\text{C}_2\text{H}_2(g) + 5\text{O}_2(g) \rightarrow 4\text{CO}_2(g) + 2\text{H}_2\text{O}(l) \)

      \[ 2.0 \text{ mol} \quad \text{b. If 1.0 mol of } \text{C}_2\text{H}_2 \text{ is burned, how many moles of } \text{CO}_2 \text{ are formed?} \]

      \[ 2.5 \text{ mol} \quad \text{c. If 1.0 mol of } \text{C}_2\text{H}_2 \text{ is burned how many moles of oxygen gas are consumed?} \]

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?
      
      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 \( \text{Al}_2\text{O}_3. \)
      
      \( 2\text{Al}_2\text{O}_3(l) \rightarrow 4\text{Al}(s) + 3\text{O}_2(g) \)
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 (F₂ and I₂)
   b. K (Mn and K)
   c. H (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(CH₃COO)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(NO\(_3\))\(_2\), to form aluminum nitrate, Al(NO\(_3\))\(_3\)? 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. Ba(NO₃)₂(aq) + Na₃PO₄(aq) →
      double-displacement; 3Ba(NO₃)₂(aq) + 2Na₃PO₄(aq) →
      Ba₃(PO₄)₂(s) + 6NaNO₃(aq)

   b. Al(s) + O₂(g) →
      synthesis; 4Al(s) + 3O₂(g) → 2Al₂O₃(s)

   c. I₂(s) + NaBr(aq) →
      no reaction

   d. C₃H₄(g) + O₂(g) →
      combustion; C₃H₄(g) + 4O₂(g) → 3CO₂(g) + 2H₂O(g)
MIXED REVIEW continued

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

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 \(\text{XCl}_2(aq)\) and \(\text{ZCl}_2(aq)\). 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 \(\text{XCl}_2(aq)\) and another
   into \(\text{ZCl}_2(aq)\). 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 \(\text{ZCl}_2(aq)\). 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 \(\text{ZCl}_2(aq)\). 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 9 REVIEW

Stoichiometry

SECTION 1

SHORT ANSWER  Answer the following questions in the space provided.

1.  b  The coefficients in a chemical equation represent the
   (a) masses in grams of all reactants and products.
   (b) relative number of moles of reactants and products.
   (c) number of atoms of each element in each compound in a reaction.
   (d) number of valence electrons involved in a reaction.

2.  d  Which of the following would not be studied within the topic of stoichiometry?
   (a) the mole ratio of Al to Cl in the compound aluminum chloride
   (b) the mass of carbon produced when a known mass of sucrose decomposes
   (c) the number of moles of hydrogen that will react with a known quantity of oxygen
   (d) the amount of energy required to break the ionic bonds in CaF₂

3.  a  A balanced chemical equation allows you to determine the
   (a) mole ratio of any two substances in the reaction.
   (b) energy released in the reaction.
   (c) electron configuration of all elements in the reaction.
   (d) reaction mechanism involved in the reaction.

4.  c  The relative number of moles of hydrogen to moles of oxygen that react to form water
   represents a(n)
   (a) reaction sequence.
   (b) bond energy.
   (c) mole ratio.
   (d) element proportion.

5.  Given the reaction represented by the following unbalanced equation: N₂O(g) + O₂(g) → NO₂(g)
   a. Balance the equation.
      \[ 2N₂O(g) + 3O₂(g) \rightarrow 4NO₂(g) \]
   b. What is the mole ratio of NO₂ to O₂?
   c. If 20.0 mol of NO₂ form, how many moles of O₂ must have been consumed?
   d. Twice as many moles of NO₂ form as moles of N₂O are consumed, True or False?
   e. Twice as many grams of NO₂ form as grams of N₂O are consumed, True or False?
SECTION 1 continued

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

6. Given the following equation: \( \text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g) \)
   
   - **28.0 g/mol N\(_2\)**
   - **2.0 g/mol H\(_2\)**
   - **17.0 g/mol NH\(_3\)**
   
   a. Determine to one decimal place the molar mass of each substance and express each mass in grams per mole.

   - **3 mol H\(_2\):1 mol N\(_2\)**
   - **2 mol NH\(_3\):1 mol N\(_2\)**
   - **2 mol NH\(_3\):3 mol H\(_2\)** or their reciprocals

   b. There are six different mole ratios in this system. Write out each one.

7. Given the following equation: \(4\text{NH}_3(g) + 6\text{NO}(g) \rightarrow 5\text{N}_2(g) + 6\text{H}_2\text{O}(g)\)
   
   - **1 mol NO:1 mol H\(_2\)O**
   - **3 mol NO:2 mol NH\(_3\)**
   - **0.360 mol**
   
   a. What is the mole ratio of NO to H\(_2\)O?

   b. What is the mole ratio of NO to NH\(_3\)?

   c. If 0.240 mol of NH\(_3\) react according to the above equation, how many moles of NO will be consumed?

8. Propyne gas can be used as a fuel. The combustion reaction of propyne can be represented by the following equation:

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

   a. Write all the possible mole ratios in this system.

   - **4 mol O\(_2\):1 mol C\(_3\)H\(_4\)**
   - **3 mol CO\(_2\):1 mol C\(_3\)H\(_4\)**
   - **2 mol H\(_2\)O:1 mol C\(_3\)H\(_4\)**

   or their reciprocals

   b. Suppose that \(x\) moles of water form in the above reaction. The other three mole quantities (not in order) are \(2x\), \(1.5x\), and \(0.5x\). Match these quantities to their respective components in the equation above.

   - C\(_3\)H\(_4\) is \(0.5x\); O\(_2\) is \(2x\); and CO\(_2\) is \(1.5x\)
MIXED REVIEW continued

c. If 0.1 mol of N₂ combine with H₂, what must be true about the quantity of H₂ for N₂ to be the limiting reactant?

At least 0.3 mol of H₂ must be provided.

4. 75% If a reaction’s theoretical yield is 8.0 g and the actual yield is 6.0 g, what is the percentage yield?

5. Joseph Priestley generated oxygen gas by strongly heating mercury(II) oxide according to the following equation:

\[
2\text{HgO(s)} \rightarrow 2\text{Hg(l)} + \text{O}_2(\text{g})
\]

0.0693 mol

a. If 15.0 g HgO decompose, how many moles of HgO does this represent?

0.0346 mol

b. How many moles of O₂ are theoretically produced?

1.11 g

c. How many grams of O₂ is this?

0.786 L

d. If the density of O₂ gas is 1.41 g/L, how many liters of O₂ are produced?

1.05 g

e. If the percentage yield is 95.0%, how many grams of O₂ are actually collected?
CHAPTER 9 REVIEW

Stoichiometry

SECTION 2

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

1.  4.5 mol  The following equation represents a laboratory preparation for oxygen gas:
     2KClO₃(s) → 2KCl(s) + 3O₂(g)
     How many moles of O₂ form if 3.0 mol of KClO₃ are totally consumed?

2.  200 g  Given the following equation: H₂(g) + F₂(g) → 2HF(g)
     How many grams of HF gas are produced as 5 mol of fluorine react?

3.  0.53 g  Water can be made to decompose into its elements by using electricity according to the following equation:
     2H₂O(l) → 2H₂(g) + O₂(g)
     How many grams of O₂ are produced when 0.033 mol of water decompose?

4.  34.8 g  Sodium metal reacts with water to produce NaOH according to the following equation:
     2Na(s) + 2H₂O(l) → 2NaOH(aq) + H₂(g)
     How many grams of NaOH are produced if 20.0 g of sodium metal react with excess oxygen?
SECTION 2 continued

5. **60.2 g**
   a. What mass of oxygen gas is produced if 100. g of lithium perchlorate are heated and allowed to decompose according to the following equation?
   \[ \text{LiClO}_4(s) \rightarrow \text{LiCl(s)} + 2\text{O}_2(g) \]

   **42.1 L**
   b. The oxygen gas produced in part a has a density of 1.43 g/L. Calculate the volume of this gas.

6. A car air bag requires 70. L of nitrogen gas to inflate properly. The following equation represents the production of nitrogen gas:
   \[ 2\text{NaN}_3(s) \rightarrow 2\text{Na}(s) + 3\text{N}_2(g) \]

   **81 g**
   a. The density of nitrogen gas is typically 1.16 g/L at room temperature. Calculate the number of grams of \( \text{N}_2 \) that are needed to inflate the air bag.

   **2.9 mol**
   b. Calculate the number of moles of \( \text{N}_2 \) that are needed.

   **1.3 \times 10^2 g**
   c. Calculate the number of grams of \( \text{NaN}_3 \) that must be used to generate the amount of \( \text{N}_2 \) necessary to properly inflate the air bag.
SECTION 3

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

1. \(88\%\) The actual yield of a reaction is 22 g and the theoretical yield is 25 g. Calculate the percentage yield.

2. 6.0 mol of \(\text{N}_2\) are mixed with 12.0 mol of \(\text{H}_2\) according to the following equation:
\[
\text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3(g)
\]
________ N\(_2\); 2.0 mol a. Which chemical is in excess? What is the excess in moles?

________ 8.0 mol b. Theoretically, how many moles of \(\text{NH}_3\) will be produced?

________ 6.4 mol c. If the percentage yield of \(\text{NH}_3\) is 80\%, how many moles of \(\text{NH}_3\) are actually produced?

3. 0.050 mol of \(\text{Ca(OH)}_2\) are combined with 0.080 mol of \(\text{HCl}\) according to the following equation:
\[
\text{Ca(OH)}_2(aq) + 2\text{HCl}(aq) \rightarrow \text{CaCl}_2(aq) + 2\text{H}_2\text{O}(l)
\]
________ 0.10 mol a. How many moles of \(\text{HCl}\) are required to neutralize all 0.050 mol of \(\text{Ca(OH)}_2\)?
SECTION 3 continued

_____ HCl  b. What is the limiting reactant in this neutralization reaction?

____ 1.4 g  c. How many grams of water will form in this reaction?

4. Acid rain can form in a two-step process, producing HNO₃(aq).

\[
\begin{align*}
\text{N}_2(g) + 2\text{O}_2(g) & \rightarrow 2\text{NO}_2(g) \\
3\text{NO}_2(g) + \text{H}_2\text{O}(g) & \rightarrow 2\text{HNO}_3(aq) + \text{NO}(g)
\end{align*}
\]

_____ 1.26 \times 10^3 g  a. A car burns 420. g of N₂ according to the above equations. How many grams of HNO₃ will be produced?

____ 960. g  b. For the above reactions to occur, O₂ must be in excess in the first step. What is the minimum amount of O₂ needed in grams?

_____ 6.9 \times 10^2 L  c. What volume does the amount of O₂ in part b occupy if its density is 1.4 g/L?
CHAPTER 9 REVIEW

Stoichiometry

MIXED REVIEW

SHORT ANSWER  Answer the following questions in the space provided.

1. Given the following equation: $\text{C}_3\text{H}_4(g) + x\text{O}_2(g) \rightarrow 3\text{CO}_2(g) + 2\text{H}_2\text{O}(g)$

   __________ a. What is the value of the coefficient $x$ in this equation?

   $\frac{4}{40.07 \text{ g/mol}}$ b. What is the molar mass of $\text{C}_3\text{H}_4$?

   $2 \text{ mol O}_2 : 1 \text{ mol H}_2\text{O}$ c. What is the mole ratio of $\text{O}_2$ to $\text{H}_2\text{O}$ in the above equation?

   __________ d. How many moles are in an 8.0 g sample of $\text{C}_3\text{H}_4$?

   __________ e. If $z$ mol of $\text{C}_3\text{H}_4$ react, how many moles of $\text{CO}_2$ are produced, in terms of $z$?

2. a. What is meant by ideal conditions relative to stoichiometric calculations?

   The limiting reactant is completely converted to product with no losses, as

   dictated by the ratio of coefficients.

   b. What function do ideal stoichiometric calculations serve?

   They determine the theoretical yield of the products of the reaction.

   c. Are actual yields typically larger or smaller than theoretical yields?

   smaller

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

3. Assume the reaction represented by the following equation goes all the way to completion:

   $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$

   __________ a. If 6 mol of $\text{H}_2$ are consumed, how many moles of $\text{NH}_3$ are produced?

   __________ b. How many grams are in a sample of $\text{NH}_3$ that contains $3.0 \times 10^{23}$ molecules?

8.5 g
## 5 The Periodic Law

**Section: History of the Periodic Table**

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**Section: Electron Configuration and the Periodic Table**

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## 6 Chemical Bonding

**Section: Introduction to Chemical Bonding**

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**Section: Covalent Bonding and Molecular Compounds**

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**Section: Ionic Bonding and Ionic Compounds**

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## 7 Chemical Formulas and Chemical Compounds

**Section: Chemical Names and Formulas**

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**Section: Oxidation Numbers**

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**Section: Using Chemical Formulas**

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**Section: Determining Chemical Formulas**

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## 8 Chemical Equations and Reactions

**Section: Describing Chemical Reactions**

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Answer Key