Consolidate and Extend

- To reinforce the connection between balancing equations and The Law of Conservation of Mass, have students watch the interactive resource Balancing Chemical Equations 1 available on the Nelson Science website. After viewing a brief video of the reaction of phosphorus with oxygen, students can test their understanding with the accompanying questions. The questions guide students through the process of balancing the equations for several reactions. For additional support, students can complete the questions in the interactive resource Balancing Chemical Equations 2, which walks students through the balancing process in detail.

- Have students complete the Check Your Understanding questions.

### 9.2

**CHECK YOUR UNDERSTANDING—SUGGESTED ANSWERS**

1. (a) A chemical word equation is more general than a chemical formula equation. The chemical word equation does not tell how many atoms or molecules are involved in the reaction, but the formula equation does.

   (b) Chemists use chemical formula equations because they show the formulas for the compounds in the reaction and the relative amounts of each chemical in the reaction.

2. (a) sodium carbonate + hydrochloric acid → sodium chloride + carbon dioxide + water;
   \[ \text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{CO}_2 + \text{H}_2\text{O} \]

   (b) octane + oxygen → carbon dioxide + water; 2 C₈H₁₈ + 25 O₂ → 16 CO₂ + 18 H₂O

   (c) sodium + water → sodium hydroxide + hydrogen; 2 Na + 2 H₂O → 2 NaOH + H₂

   (d) sulfuric acid + sodium hydroxide → sodium sulfate + water; H₂SO₄ + 2 NaOH → Na₂SO₄ + 2 H₂O

   (e) zinc + copper sulfate → zinc sulfate + copper; Zn + CuSO₄ → ZnSO₄ + Cu

3. (a) 3Na atoms, 3Cl atoms; (b) 2H atoms, 1S atom, 4O atoms; (c) 8H atoms, 4S atoms, 16O atoms

4. You are trying to make the number of atoms in the reactants equal the number of atoms in the products.

5. (a) C₃H₆ + O₂ → CO₂ + H₂O; C₃H₆ + 5 O₂ → 3 CO₂ + 4 H₂O

   (b) CaO + HCl → CaCl₂ + H₂O; CaO + 2 HCl → CaCl₂ + H₂O

   (c) H₃PO₄ + KOH → K₂PO₄ + H₂O; H₃PO₄ + 3 KOH → K₂PO₄ + 3 H₂O

   (d) CaCO₃ + HNO₃ → Ca(NO₃)₂ + CO₂ + H₂O; CaCO₃ + 2 HNO₃ → Ca(NO₃)₂ + CO₂ + H₂O

   (e) AgNO₃ + Cu → Cu(NO₃)₂ + Ag; 2 AgNO₃ + Cu → Cu(NO₃)₂ + 2 Ag

   (f) NaCl + H₂O → HCl + Na₂; 2 NCl₃ + 3 H₂O → 6 HCl + N₂

6. (a) 2 K + Cl₂ → 2 KCl; (b) 4 Li + O₂ → 2 Li₂O; (c) 6 K + N₂ → 2 K₃N; (d) 2 Ba + O₂ → 2 BaO

   (e) Ca + F₂ → CaF₂; (f) 3 Sr + N₂ → Sr₃N₂; (g) 2 NaNO₃ → 2 NaNO₂ + O₂

7. (a) 2 K + 2 H₂O → 2 KOH + H₂; (b) Ca + 2 H₂O → Ca(OH)₂ + H₂; (c) Mg₂N₂ + 3 H₂O → 3 MgO + 2 NH₃;

   (d) CaCl₂ → CaCl₂ + 3 O₂; (e) (NH₄)₂SO₄ → 2 KOH + 2 NH₃ + 2 H₂O + K₂SO₄

   (f) 3 Fe + 4 H₂O → Fe₃O₄ + 4 H₂; (g) 2 AlBr₃ + 3 Cl₂ → 2 AlCl₃ + 3 Br₂

8. (a) 2 NH₄Cl + Ba(OH)₂ → 2 NH₃ + 2 H₂O + BaCl₂

   atom count: 2 N, 10 H, 2 Cl, 1 Ba, 2 O → 2 N, 10 H, 2 O, 1 Ba, 2 Cl

   (b) 2 AgNO₃ + CuCl₂ → 2 AgCl + Cu(NO₃)₂

   atom count: 2 Ag, 2 N, 6 O, 1 Cu, 2 Cl → 2 Ag, 2 Cl, 1 Cu, 2 N, 6 O

   (c) 2 RuS₂ + 7 O₂ → 2 RuO₃ + 4 SO₂

   atom count: 2 Ru, 4 S, 14 O → 2 Ru, 14 O, 4 S

   (d) SrCl₂ + (NH₄)₂CO₃ → SrCO₃ + 2 NH₄Cl

   atom count: 1 Sr, 2 Cl, 2 N, 8 H, 1 CO₃ → 1 Sr, 1 C, 3 O, 2 N, 8 H, 2 Cl

   (e) 4 SnS₂ + 11 O₂ → 2 Sn₂O₃ + 8 SO₂

   atom count: 4 Sn, 8 S, 22 O → 4 Sn, 22 O, 8 S
(f) \[ 3 \text{FeCl}_2 + 2 \text{Li}_2\text{PO}_4 \rightarrow \text{Fe}_3\text{(PO}_4)_2 + 6 \text{LiCl} \]
atom count: 3 Fe, 6 Cl, 6 Li, 2 P, 8 O \rightarrow 3 Fe, 2 P, 8 O, 6 Li, 6 Cl

(g) \[ 3 \text{CuSO}_4 + 2 \text{Mn} \rightarrow \text{Mn}_2\text{(SO}_4)_3 + 3 \text{Cu} \]
atom count: 3 Cu, 3 S, 12 O, 2 Mn \rightarrow 2 Mn, 3 S, 12 O, 3 Cu

(h) \[ 2 \text{C}_2\text{H}_4 +19 \text{O}_2 \rightarrow 12 \text{CO}_2 + 14 \text{H}_2\text{O} \]
atom count: 12 C, 28 H, 38 O \rightarrow 12 C, 38 O, 28 H

(i) \[ 2 \text{Al} + 3 \text{Pb(NO}_3)_2 \rightarrow 2 \text{Al(NO}_3)_3 + 3 \text{Pb} \]
atom count: 2 Al, 3 Pb, 6 N, 18 O \rightarrow 2 Al, 6 N, 18 O, 3 Pb

(j) \[ \text{C}_7\text{H}_6\text{O}_3 + 7 \text{O}_2 \rightarrow 7 \text{CO}_2 + 3 \text{H}_2\text{O} \]
atom count: 7 C, 6 H, 17 O \rightarrow 7 C, 17 O, 6 H

Check Understanding

- Have students read the first four paragraphs of Section 9.2. Then, have them check their understanding of the text by explaining to a partner why skeleton equations are sometimes called unbalanced equations (because there are not equal numbers of atoms of the same element on both sides of the equation). Have partners compare their explanations, noting differences in their descriptions.

Determine Meanings of Scientific and Technical Terms

- Have students read the Learning Tip on page 237 of the Student Book. Explain to students that they can use graphic clues, such as the symbols for coefficients and subscripts, to clarify the meanings of scientific terms. Have students reread the text on page 237, paying attention to the balanced equations and the chemical formulas that make up those equations.

ESL

- Although ESL learners may have limited English language skills, their math skills may be very good. Try to reduce balancing chemical equations to mathematical sentences that are easier to understand than a block of text. Suggest that they use the check atom count shown on page 237 of the Student Book each time they balance a chemical equation.

Extra Support

- Have students come up with a general list of steps to follow when balancing a chemical equation. Tell them to write these steps on a note card and refer to them when completing the exercises in this chapter and also when studying for a chapter quiz or exam.

ASSESSMENT FOR LEARNING

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