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9 CHEMICAL NAMES AND FORMULAS

SECTION 9.1 NAMING IONS (pages 253–258)

This section explains the use of the periodic table to determine the charge of an ion. It also defines polyatomic ion *and gives the names and formulas for the most common polyatomic ions.*

▶ Monatomic Ions (pages 253–256)

1. What are monatomic ions?

_____

2. How is the ionic charge of a Group 1A, 2A, or 3A ion determined?

_____

3. How is the ionic charge of a Group 5A, 6A, or 7A ion determined?

_____

_____

4. Circle the letter of the type of element that often has more than one common ionic charge.

a. alkali metal

b. alkaline earth metal

c. transition metal

d. nonmetal

5. The _____ of naming transition metal cations uses a Roman numeral in parentheses to indicate the numeric value of the ionic charge.

6. An older naming system uses the suffix *-ous* to name the cation with the _____ charge, and the suffix *-ic* to name the cation with the _____ charge.

7. What is a major advantage of the Stock system over the old naming system?

_____

8. Use the periodic table to write the name and formula (including charge) for each ion in the table below.

Element	Name	Formula
Fluorine		
Calcium		
Oxygen		

▶ Polyatomic Ions (pages 257–258)

9. What is a polyatomic ion?

_____

_____

10. Is the following sentence true or false? The names of polyatomic anions always end in *-ide*. _____

11. What is the difference between the anions sulfite and sulfate?

_____

12. Look at Table 9.3 on page 257. Circle the letter of a polyatomic ion that is a cation.

a. ammonium

b. acetate

c. oxalate

d. phosphate

13. How many atoms make up the oxalate ion and what is its charge?

_____

_____

14. What three hydrogen-containing polyatomic anions are essential components of living systems?

a. _____

b. _____

c. _____

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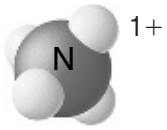
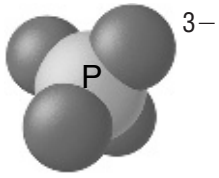
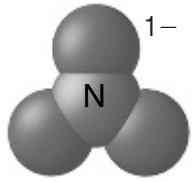
15. Look at Figure 9.5 on page 257. Identify each of the ions shown below.







a. _____ **b.** _____ **c.** _____

SECTION 9.2 NAMING AND WRITING FORMULAS FOR IONIC COMPOUNDS (pages 260–266)

This section explains the rules for naming and writing formulas for binary ionic compounds and compounds containing a polyatomic ion.

▶ Binary Ionic Compounds (pages 260–263)

1. Traditionally, common names were based on some _____ of a compound or its _____ .

2. What is the general name for compounds composed of two elements?

_____

3. When writing the formula for any ionic compound, the charges of the ions must _____ .

4. What are two methods for writing a balanced formula?

a. _____

b. _____

5. What are the formulas for the compounds formed by the following pairs of ions?

a. Fe^{2+}, Cl^{-} _____

b. Cr^{3+}, O^{2-} _____

c. Na^{+}, S^{2-} _____

6. What are the formulas for these compounds?

a. lithium bromide _____

b. cupric nitride _____

c. magnesium chloride _____

7. The name of a binary ionic compound is written with the name of the _____ first followed by the name of the _____ .

8. How can you tell that cobalt(II) iodide is a binary ionic compound formed by a transition metal with more than one ionic charge?

_____

_____

9. Write the names for these binary ionic compounds.

a. PbS _____

b. $MgCl_2$ _____

c. Al_2Se_3 _____

▶ Compounds with Polyatomic Ions (pages 264–266)

10. What is a polyatomic ion?

_____

11. How do you write the formula for a compound containing a polyatomic ion?

_____

_____

_____

12. Why are parentheses used to write the formula $Al(OH)_3$?

_____

13. Complete the table for these ionic compounds containing polyatomic ions.

Cation	Anion	Name	Formula
NH_4^+	S^{2-}		
Fe^{3+}		iron(III) carbonate	
	NO_3^-		$AgNO_3$
		potassium cyanide	KCN

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SECTION 9.3 NAMING AND WRITING FORMULAS FOR MOLECULAR COMPOUNDS (pages 268–270)

This section explains the rules for naming and writing formulas for binary molecular compounds.

▶ Naming Binary Molecular Compounds (pages 268–269)

1. Circle the letter of the type(s) of elements that form binary molecular compounds.

a. two nonmetallic elements

b. a metal and a nonmetal

c. two metals

2. Is the following sentence true or false? Two nonmetallic elements can combine in only one way. _____

3. What method is used to distinguish between different molecular compounds that contain the same elements? _____

Match the prefix with the number it indicates.

_____ **4.** *octa-* **a.** 4

_____ **5.** *tetra-* **b.** 7

_____ **6.** *hepta-* **c.** 8

_____ **7.** *nona-* **d.** 9

8. What are the names of the following compounds?

a. BF_3 _____

b. N_2O_4 _____

c. P_4S_7 _____

▶ Writing Formulas for Binary Molecular Compounds (page 270)

9. What are the formulas for the following compounds?

a. carbon tetrabromide _____

b. nitrogen triiodide _____

c. iodine monochloride _____

d. tetraiodine nonaoxide _____

Reading Skill Practice

Writing a summary can help you remember the information you have read. When you write a summary, include only the most important points. Write a summary of the information in Section 9.3 on pages 268–269. Your summary should be shorter than the text on which it is based. Do your work on a separate sheet of paper.

SECTION 9.4 NAMING AND WRITING FORMULAS FOR ACIDS AND BASES (pages 271–273)

This section explains the three rules for naming acids and shows how these rules can also be used to write the formulas for acids. Names and formulas for bases are also explained.

▶ Naming Common Acids (pages 271–272)

1. Acids produce _____ ions when dissolved in water.

2. When naming acids, you can consider them to be combinations of _____ connected to as many _____ ions as are necessary to create an electrically neutral compound.

3. What is the formula for hydrobromic acid? _____

4. What are the components of phosphorous acid? What is its formula?

_____

▶Writing Formulas for Acids (page 272)

5. Use Table 9.5 on page 272 to help you complete the table about acids.

Acid Name	Formula	Anion Name
acetic acid		
carbonic acid		
hydrochloric acid		
nitric acid		
phosphoric acid		
sulfuric acid		

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▶ Names and Formulas for Bases (page 273)

6. A base is a compound that produces _____ when dissolved in water.

7. How are bases named?

_____

SECTION 9.5 THE LAWS GOVERNING FORMULAS AND NAMES (pages 274–279)

This section uses data to demonstrate that a compound obeys the law of definite proportions. It also explains how to use flow charts to write the name and formula of a compound.

▶ The Laws of Definite and Multiple Proportions (pages 274–275)

1. What is the law of definite proportions?

_____

_____

_____

2. Circle the whole-number mass ratio of Li to Cl in LiCl. The atomic mass of Li is 6.9; the atomic mass of Cl is 35.5.

a. 42 : 1

b. 5 : 1

c. 1 : 5

3. Circle the whole-number mass ratio of carbon to hydrogen in C_2H_4. The atomic mass of C is 12.0; the atomic mass of H is 1.0.

a. 1 : 6 **c.** 1 : 12

b. 6 : 1 **d.** 12 : 1

4. In the compound sulfur dioxide, a food preservative, the mass ratio of sulfur to oxygen is 1 : 1. An 80-g sample of a compound composed of sulfur and oxygen contains 48 g of oxygen. Is the sample sulfur dioxide? Explain.

_____

_____

5. What is the law of multiple proportions?

_____

_____

_____

6. Complete the table using the law of multiple proportions.

	Mass of Cu	Mass of Cl	Mass Ratio Cl : Cu	Whole-number Ratio of Cl
Compound A	8.3 g	4.6 g		
Compound B	3.3 g	3.6 g		

▶ Practicing Skills: Naming Chemical Compounds (pages 276–277)

7. How can a flowchart help you to name chemical compounds?

_____

8. Use the flowchart in Figure 9.20 on page 277 to write the names of the following compounds:

a. CsCl _____

b. $SnSe_2$ _____

c. NH_4OH _____

d. HF _____

e. Si_3N_4 _____

9. Complete the following five rules for writing a chemical formula from a chemical name.

a. In an ionic compound, the net ionic charge is _____ .

b. An *-ide* ending generally indicates a _____ compound.

c. An *-ite* or *-ate* ending means there is a _____ ion that includes oxygen in the formula.

d. _____ in a name generally indicate that the compound is molecular and show the number of each kind of atom in the molecule.

e. A _____ after the name of a cation shows the ionic charge of the cation.

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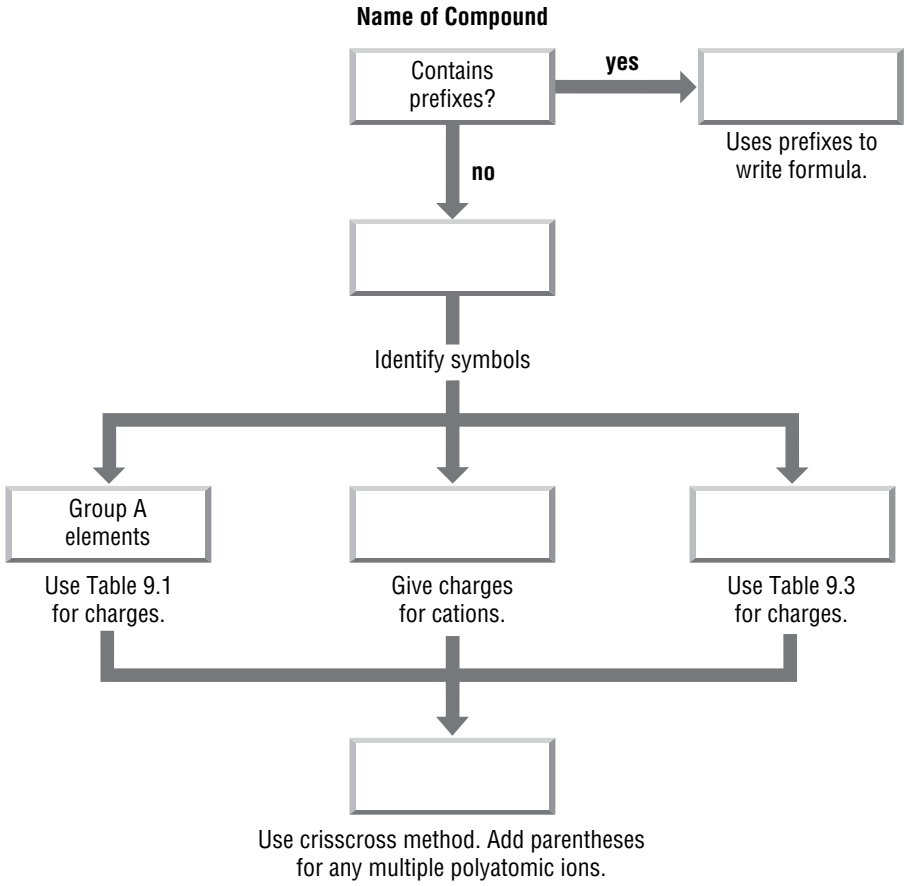
▶ Practicing Skills: Writing Chemical Formulas (page 278)

10. Fill in the missing labels from Figure 9.22 on page 278.



11. Use the flowchart in Figure 9.22 to write the formulas of the following compounds:

a. potassium silicate _____

b. phosphorus pentachloride _____

c. manganese(II) chromate _____

d. lithium hydride _____

e. diiodine pentoxide _____

GUIDED PRACTICE PROBLEMS

GUIDED PRACTICE PROBLEM 2 (page 256)

2. How many electrons were lost or gained to form these ions?
a. Fe^{3+} **b.** O^{2-} **c.** Cu^{+}

Step 1. Determine the number of electrons based on the size of the charge.

Step 2. Determine whether the electrons were lost or gained based on the sign of the charge.

a. _____

b. _____

c. _____

GUIDED PRACTICE PROBLEMS 10B AND 10C (page 263)

10. Write formulas for compounds formed from these pairs of ions.

b. Li^{+}, O^{2-}

Analyze

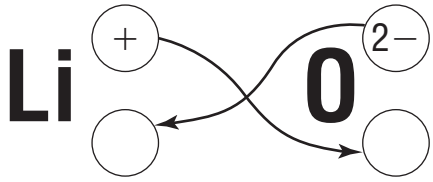
Step 1. Do the ions combine in a 1:1 ratio?

_____

Solve

Step 2. Use the crisscross method to balance the formula.

Write the formula. _____



Evaluate

Step 3. How do you know your formula is reasonable?

_____

_____

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c. Ca^{2+}, N^{3-}

Analyze

Step 1. Will the calcium (Ca^{2+}) and nitride (N^{3-}) ions combine in a 1 : 1 ratio? How do you know?

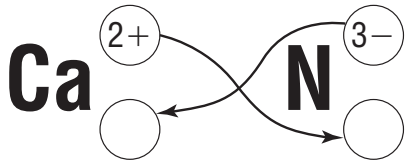
_____

_____

Solve

Step 2. Use the crisscross method to balance the formula.

Write the formula. _____



Evaluate

Step 3. How do you know this formula is reasonable?

_____

_____

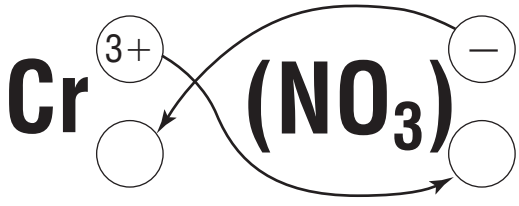
GUIDED PRACTICE PROBLEM 13B (page 265)

13b. Write the formula for chromium(III) nitrate.

- Is the compound ionic or molecular? Explain.

_____

- Use Table 9.3 on page 257 to write the formula for the nitrate ion. _____
- Use the crisscross method to balance the formula.
- Write the formula. _____



GUIDED PRACTICE PROBLEM 34 (page 275)

34. Lead forms two compounds with oxygen. One compound contains 2.98 g of lead and 0.461 g of oxygen. The other contains 9.89 g of lead and 0.763 g of oxygen. For a given mass of oxygen, what is the lowest whole-number mass ratio of lead in the two compounds?

Complete the following steps to solve the problem.

Step 1. Write the ratio of lead to oxygen for each compound.

First compound: $\frac{\square \text{ g lead}}{0.461 \text{ g oxygen}}$

Second compound: $\frac{9.89 \text{ g lead}}{\square \text{ g oxygen}}$

Step 2. Divide the numerator by the denominator in each ratio.

$\frac{6.46 \square}{\square}$ $\frac{\square \text{ g lead}}{\text{g oxygen}}$

Step 3. Write a ratio comparing the first compound to the second.

$\frac{\square \text{ ~~g lead/g oxygen~~}}{13.0 \text{ ~~g lead/g oxygen~~}}$

Step 4. Simplify. Note that this ratio has no units.

$\frac{0.497}{1} = \text{roughly } \frac{1}{\square}$

The mass ratio of lead per gram of oxygen in the two compounds is _____ .