

# Names and Formulas of Ionic Compounds

Textbook pages 84–95

## Before You Read

How do ionic compounds form? Write your ideas on the lines below.

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### Mark the Text

#### Check for Understanding

As you read this section, be sure to reread any parts you do not understand. Highlight any sentences that help you develop your understanding.

#### Reading Check

1. What does a chemical formula include?

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#### Reading Check

2. What is a multivalent metal?

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### How are ionic compounds named and represented?

The **chemical formula** of an ionic compound includes symbols that identify each ion in the compound. The chemical formula also uses a subscript number to the right of an element symbol to show the relative numbers of ions in the compound. The **chemical names** of some ionic compounds include **Roman numerals**—for example, iron(III) sulphide. These ionic compounds include **multivalent metals**—metals that can form two or more different positive ions with different charges. ✓

#### Steps for naming ionic compounds with two elements

Steps	Example: CaF <sub>2</sub>
1. Name the metal ion.	Ca is calcium.
2. Name the non-metal ion, but change the end of its name to “ide.”	F is fluorine. Change it to fluoride.
3. Put the names together.	calcium fluoride

#### Steps for writing formulas of ionic compounds with two elements

Steps	Example: zinc nitride
1. Identify each ion and its charge.	zinc: Zn <sup>2+</sup> nitride: N <sup>3-</sup>
2. Determine the total charges needed to balance positive and negative ions.	Zn <sup>2+</sup> : +2 +2 +2 = +6 N <sup>3-</sup> : -3 -3 = -6
3. Note the ratio of positive to negative.	3 Zn <sup>2+</sup> ions for every 2 N <sup>3-</sup> ions.
4. Use subscripts to write the formula. A “1” is not shown in the subscript.	Zn <sub>3</sub> N <sub>2</sub>

### Steps for writing formulas of compounds with a multivalent metal

Steps	Example: iron(III) sulphide
1. Identify each ion and its charge.	iron(III): Fe <sup>3+</sup> sulphide: S <sup>2-</sup>
2. Determine the total charges needed to balance positive and negative ions.	Fe <sup>3+</sup> : +3 +3 = +6 S <sup>2-</sup> : -2 -2 -2 = -6
3. Note the ratio of positive to negative.	2 Fe <sup>3+</sup> ions for every 3 S <sup>2-</sup> ions.
4. Use subscripts to write the formula.	Fe <sub>2</sub> S <sub>3</sub>

### Steps for naming ionic compounds containing a multivalent metal

Steps	Examples	
	Cu <sub>3</sub> P	MnO <sub>2</sub>
1. Identify the metal.	copper (Cu)	manganese (Mn)
2. Verify that it can form more than one kind of ion by checking the periodic table.	Cu <sup>2+</sup> and Cu <sup>+</sup>	Mn <sup>2+</sup> , Mn <sup>3+</sup> , and Mn <sup>4+</sup>
3. Determine the ratio of the ions in the formula.	Cu <sub>3</sub> P means 3 copper ions for every 1 phosphide ion.	MnO <sub>2</sub> means 1 manganese ion for every 2 oxide ions.
4. Note the charge of the negative ion from the periodic table.	The charge on the phosphide P <sup>3-</sup> is 3-.	The charge on the oxide O <sup>2-</sup> is 2-.
5. The positive and negative charges must balance out. Determine what the charge needs to be on the metal ion to balance the negative ion.	Each of the 3 copper ions must have a charge of 1+ to balance the 1 phosphide ion with a charge of 3-. Therefore, the name of the copper ion is copper(I).	The 1 manganese ion must have a charge of 4+ to balance the 2 oxide ions that each have a charge of 2-. Therefore, the name of the manganese ion is manganese(IV).
6. Write the name of the compound.	copper(I) phosphide	manganese(IV) oxide

### Steps for writing the formula of a compound with polyatomic ions

Steps	Examples	
	iron(III) hydroxide	ammonium carbonate
1. Identify each ion and its charge.	iron(III): Fe <sup>3+</sup> hydroxide: OH <sup>-</sup>	ammonium: NH <sub>4</sub> <sup>+</sup> carbonate: CO <sub>3</sub> <sup>2-</sup>
2. Determine the total charges needed to balance positive with negative.	Fe <sup>3+</sup> : 3+ OH <sup>-</sup> : -1 -1 -1	NH <sub>4</sub> <sup>+</sup> : +1 +1 +1 CO <sub>3</sub> <sup>2-</sup> : 2-
3. Note the ratio of positive ions to negative ions.	1 Fe <sup>3+</sup> ion for every 3 OH <sup>-</sup> ions	2 NH <sub>4</sub> <sup>+</sup> ions for every 1 CO <sub>3</sub> <sup>2-</sup> ion
4. Use subscripts and brackets to write the formula. Omit brackets if only one ion is needed.	Fe(OH) <sub>3</sub>	(NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub>

Name \_\_\_\_\_

Date \_\_\_\_\_

*Use with textbook pages 84–92.*

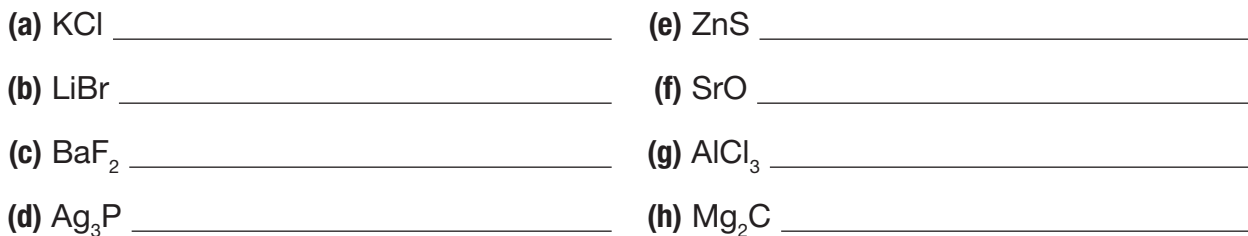
## Writing names and formulas of ionic compounds

You can use the periodic table on page 202 to help you answer these questions.

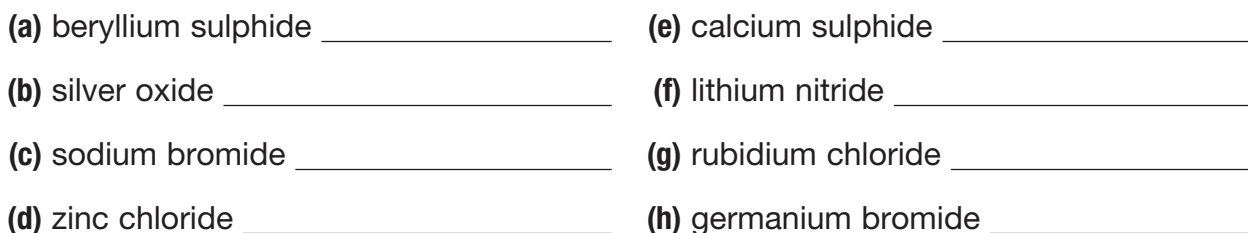
1. Complete the following table. First, identify each ion and its charge. Then, give the formula and name for each ionic compound formed. The table has been partially completed to help guide you.

	Chloride <u>Cl<sup>-</sup></u>	Fluoride _____	Oxygen _____
sodium <u>Na<sup>+</sup></u>	NaCl sodium chloride		
magnesium _____			
calcium _____			

2. Write the names of the following compounds.



3. Write the chemical formulas for the following compounds.



Use with textbook pages 84–92.

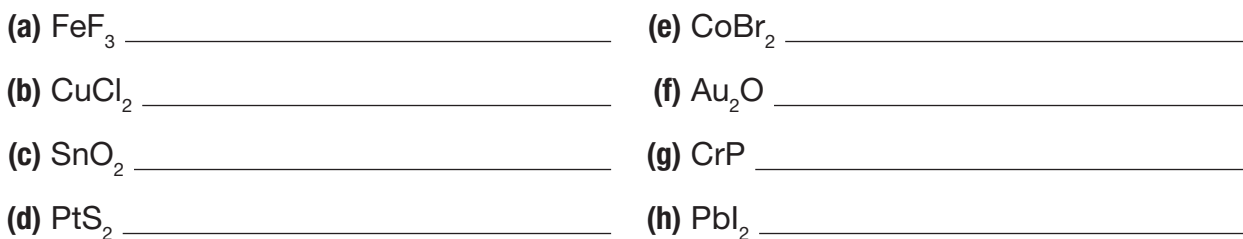
## Compounds with a multivalent metal

You can use the periodic table on page 202 to help you answer these questions.

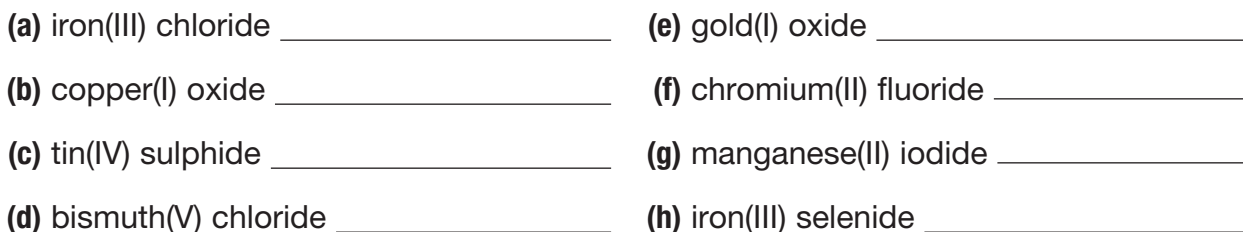
1. Write the formulas for the compounds formed from the following ions. Then name the compounds.

	Ions	Formula	Compound name
(a)	$\text{Mn}^{3+}$ $\text{O}^{2-}$		
(b)	$\text{Pb}^{3+}$ $\text{Br}^-$		
(c)	$\text{Pt}^{2+}$ $\text{Cl}^-$		
(d)	$\text{Au}^{3+}$ $\text{S}^{2-}$		
(e)	$\text{Pb}^{4+}$ $\text{O}^{2-}$		
(f)	$\text{Sb}^{3+}$ $\text{S}^{2-}$		
(g)	$\text{Fe}^{2+}$ $\text{S}^{2-}$		
(h)	$\text{Co}^{3+}$ $\text{O}^{2-}$		

2. Write the names of the following ionic compounds using Roman numerals.



3. Write the chemical formulas for the following compounds.



Use with textbook pages 84–92.

## Compounds with polyatomic ions

You can use the periodic table on page 202 to help you answer these questions.

1. Write the names of the following ionic compounds.

- (a)  $\text{AgNO}_3$  \_\_\_\_\_ (e)  $\text{Ni(OH)}_2$  \_\_\_\_\_  
 (b)  $\text{BaSO}_4$  \_\_\_\_\_ (f)  $\text{CuCO}_3$  \_\_\_\_\_  
 (c)  $\text{NH}_4\text{Cl}$  \_\_\_\_\_ (g)  $\text{Sr(NO}_3)_2$  \_\_\_\_\_  
 (d)  $\text{Ca}_3(\text{PO}_4)_2$  \_\_\_\_\_ (h)  $\text{Cr}_2(\text{SO}_4)_3$  \_\_\_\_\_

2. Write the chemical formulas for the following compounds.

- (a) calcium hydroxide \_\_\_\_\_ (e) potassium dichromate \_\_\_\_\_  
 (b) ammonium chloride \_\_\_\_\_ (f) tin(II) hydroxide \_\_\_\_\_  
 (c) sodium nitrite \_\_\_\_\_ (g) ammonium phosphate \_\_\_\_\_  
 (d) lithium hydrogen carbonate \_\_\_\_\_ (h) iron(III) nitrate \_\_\_\_\_

3. Write the formulas and names of the compounds with the following combination of ions. The table has been partially completed to help guide you.

	Positive ion	Negative ion	Formula	Compound name
(a)	$\text{Ca}^{2+}$	$\text{CO}_3^{2-}$	$\text{CaCO}_3$	calcium carbonate
(b)	$\text{K}^+$	$\text{SO}_3^{2-}$		
(c)			$\text{NaClO}_3$	
(d)				magnesium perchlorate
(e)	$\text{Cs}^+$	$\text{OH}^-$		
(f)				ammonium phosphate
(g)			$\text{Ca(CN)}_2$	
(h)	$\text{Fe}^{3+}$	$\text{HSO}_4^-$		

Name \_\_\_\_\_

Date \_\_\_\_\_

Use with textbook pages 84–92.

## Names and formulas of ionic compounds

Match each Compound Name on the left with the correct Chemical Formula on the right. Each Chemical Formula may be used only once.

Compound Name	Chemical Formula
1. _____ aluminum sulphide	<b>A.</b> $\text{Al}_2\text{S}_3$
2. _____ aluminum sulphate	<b>B.</b> $\text{AlSO}_4$
3. _____ ammonium sulphite	<b>C.</b> $\text{Al}_2(\text{SO}_3)_3$
	<b>D.</b> $\text{Al}_2(\text{SO}_4)_3$
	<b>E.</b> $\text{NH}_4\text{SO}_3$
	<b>F.</b> $\text{NH}_4\text{SO}_4$
	<b>G.</b> $(\text{NH}_4)_2\text{SO}_3$
	<b>H.</b> $(\text{NH}_4)_2\text{SO}_4$

Circle the letter of the best answer.

4. How many chlorine atoms are in the compound calcium chlorate,  $\text{Ca}(\text{ClO}_3)_2$ ?
- A.** 1  
**B.** 2  
**C.** 3  
**D.** 6
5. What is the ending of an ionic compound consisting of two elements (a metal and a non-metal)?
- A.** ate  
**B.** ide  
**C.** ine  
**D.** ite

6. In a chemical formula, what part shows the relative numbers of ions in the compound?
- A.** the coefficient in front of the element symbol  
**B.** the subscript to the right of the element symbol  
**C.** the superscript to the right of the element symbol  
**D.** the positive or negative number to the right of the element symbol

Use the following diagrams to answer question 7.

26	3+	25	2+
<b>Fe</b>	2+	<b>Mn</b>	3+
Iron		Manganese	4+
55.8		54.9	

7. What do iron and manganese have in common?

I.	they are multivalent metals
II.	they have more than one ion charge
III.	their most common ion charge is 2+

- A.** I and II only  
**B.** I and III only  
**C.** II and III only  
**D.** I, II, and III
8. In the name “cobalt(II) phosphate,” what does the Roman numeral reveal about cobalt?
- A.** it has gained two electrons  
**B.** it has an ion charge of 2–  
**C.** it has an ion charge of 2+  
**D.** it can form two positive ions
9. What is the name for the compound  $\text{CaCl}_2$ ?
- A.** calcium chlorate  
**B.** calcium chloride  
**C.** calcium chlorine  
**D.** calcium(II) chloride