

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.



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?



Reading Check

2. What is a multivalent metal?

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_2 |
|---|---------------------------------------|
| 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^{2+} nitride: N^{3-} |
| 2. Determine the total charges needed to balance positive and negative ions. | Zn^{2+} : $+2 +2 +2 = +6$ N^{3-} : $-3 -3 = -6$ |
| 3. Note the ratio of positive to negative. | 3 Zn^{2+} ions for every 2 N^{3-} ions. |
| 4. Use subscripts to write the formula. A “1” is not shown in the subscript. | Zn_3N_2 |

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^{3+} sulphide: S^{2-} |
| 2. Determine the total charges needed to balance positive and negative ions. | Fe^{3+} : $+3 +3 = +6$ S^{2-} : $-2 -2 -2 = -6$ |
| 3. Note the ratio of positive to negative. | 2 Fe^{3+} ions for every 3 S^{2-} ions. |
| 4. Use subscripts to write the formula. | Fe_2S_3 |

Steps for naming ionic compounds containing a multivalent metal

| Steps | Examples | |
|--|---|---|
| | Cu_3P | MnO_2 |
| 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^{2+} and Cu^+ | Mn^{2+} , Mn^{3+} , and Mn^{4+} |
| 3. Determine the ratio of the ions in the formula. | Cu_3P means 3 copper ions for every 1 phosphide ion. | MnO_2 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^{3-} is $3-$. | The charge on the oxide O^{2-} 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^{3+} hydroxide: OH^- | ammonium: NH_4^+ carbonate: CO_3^{2-} |
| 2. Determine the total charges needed to balance positive with negative. | Fe^{3+} : $3+$ OH^- : $-1 -1 -1$ | NH_4^+ : $+1 +1 +1$ CO_3^{2-} : $2-$ |
| 3. Note the ratio of positive ions to negative ions. | 1 Fe^{3+} ion for every 3 OH^- ions | 2 NH_4^+ ions for every 1 CO_3^{2-} ion |
| 4. Use subscripts and brackets to write the formula. Omit brackets if only one ion is needed. | $\text{Fe}(\text{OH})_3$ | $(\text{NH}_4)_2\text{CO}_3$ |

Use with textbook pages 84–92.

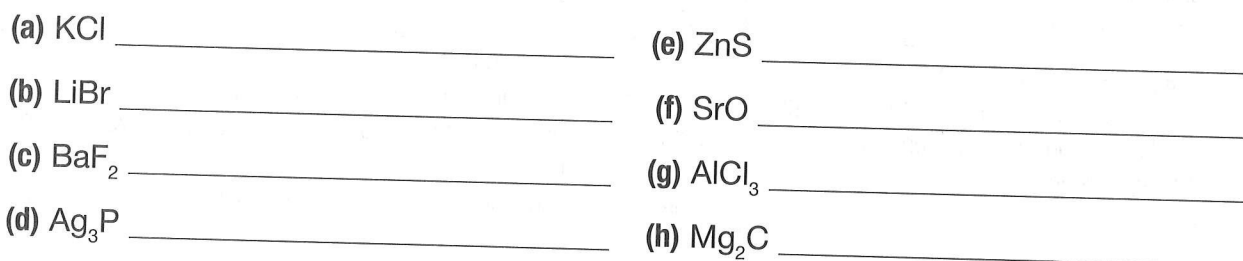
Writing names and formulas of ionic compounds

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

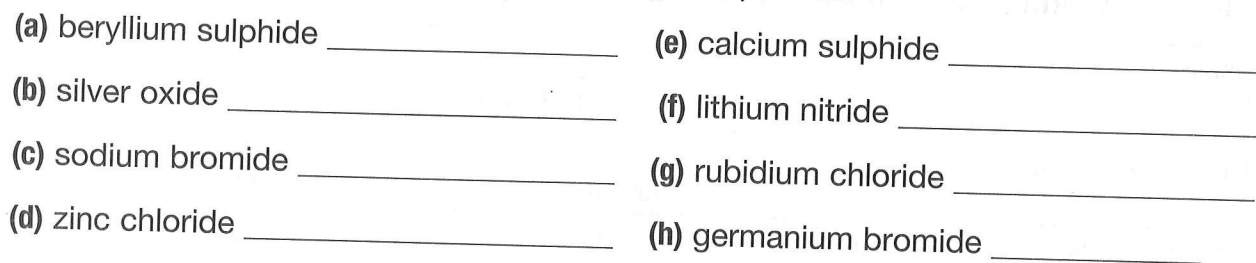
1. Complete the following table. First, identify each ion and its charge. Then, give the formula and name for each ionic compound formed. The table has been partially completed to help guide you.

| | Chloride Cl^- | Fluoride _____ | Oxygen _____ |
|-------------------------|----------------------------------|-------------------|-----------------|
| sodium Na^+ | NaCl sodium chloride | | |
| magnesium _____ | | | |
| calcium _____ | | | |

2. Write the names of the following compounds.



3. Write the chemical formulas for the following compounds.



book pages 84–92.

Ionic compounds with a multivalent metal

Answer these questions using the periodic table on page 202 to help you answer these questions.

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

| Ions | Formula | Compound name |
|--------------------------------|---------|---------------|
| $\text{Al}^{3+} \text{O}^{2-}$ | | |
| $\text{Co}^{3+} \text{Br}^{-}$ | | |
| $\text{Pt}^{2+} \text{Cl}^{-}$ | | |
| $\text{Au}^{3+} \text{S}^{2-}$ | | |
| $\text{Pb}^{4+} \text{O}^{2-}$ | | |
| $\text{Sb}^{3+} \text{S}^{2-}$ | | |
| $\text{Fe}^{2+} \text{S}^{2-}$ | | |
| $\text{Co}^{3+} \text{O}^{2-}$ | | |

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

- (a) FeF_3 _____
- (b) CuCl_2 _____
- (c) SnO_2 _____
- (d) PtS_2 _____
- (e) CoBr_2 _____
- (f) Au_2O _____
- (g) CrP _____
- (h) PbI_2 _____

Write the chemical formulas for the following compounds.

- (a) iron(III) chloride _____
- (b) copper(I) oxide _____
- (c) tin(IV) sulphide _____
- (d) bismuth(V) chloride _____
- (e) gold(I) oxide _____
- (f) chromium(II) fluoride _____
- (g) manganese(II) iodide _____
- (h) iron(III) selenide _____

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) AgNO_3 _____ (e) Ni(OH)_2 _____

(b) BaSO_4 _____ (f) CuCO_3 _____

(c) NH_4Cl _____ (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) | Ca^{2+} | CO_3^{2-} | CaCO_3 | calcium carbonate |
| (b) | K^+ | SO_3^{2-} | | |
| (c) | | | NaClO_3 | |
| (d) | | | | magnesium perchlorate |
| (e) | Cs^+ | OH^- | | |
| (f) | | | | ammonium phosphate |
| (g) | | | Ca(CN)_2 | |
| (h) | Fe^{3+} | HSO_4^- | | |