

Nomenclature for ionic compounds

Worksheet-Answer Key

Name _____ Date _____

Nomenclature is a system of naming. This worksheet presents a widely used system of nomenclature for ionic compounds.

The big picture: How this worksheet is organized:

There are two types of metal cations with different naming conventions discussed separately.

Use a Roman numeral

- **Part A:** Fixed charge (single charge) cations → Never
- **Part B:** Variable charge (multiple charge) cations → Always

Cations with a single, fixed charge

Cations have a positive charge. They are formed from metals, which lie on the left side of the periodic table. The main group (Groups 1-8) metals form cations with a single, fixed charge. The charge is the same as the Group (column) number on the periodic table. The cation name is formed by adding the word “ion” after the element name. For example, the element sodium (Na) is found in Group 1. It ionizes to form the “sodium ion” represented as Na^+ . The charge is +1 because it is in Group 1.

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Anions have a negative charge. They are formed from nonmetals, which lie on the right side of the periodic table. The negative charge is found using the **Octet Rule** as eight (8) minus the Group number. Anions always have a single, fixed charge. The anion name is formed by changing the element name suffix to “-ide” and adding the word “ion” after the element name. For example, the element chlorine (Cl) is found in Group 7. It ionizes to form the “chloride ion” represented as Cl^- . The charge is -1 because it is in Group 7, and $8 - 7 = 1$.

Ionic compounds are formed by cation-anion pairs in electrically neutral ratios. They are named using the cation name first, followed by the anion name, excluding the word “ion.” For example, sodium ion (Na^+) and chloride ion (Cl^-) form the compound sodium chloride. Its formula is NaCl , which is electrically neutral because sodium ion is +1 and chloride ion is -1. As a second example, magnesium chloride has the formula MgCl_2 . The subscript indicates 2 chloride ions (Cl^-) per 1 magnesium ion (Mg^{2+}). The subscript “1” is always implied and never written.

Note: *There is never any charge indicated in the name of a compound having a cation with a single, fixed charge. The single, fixed charge is obvious to a chemist.*

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Exercise 1. Provide the name or formula for each ion:

<u>Cl⁻</u>	<u>chloride ion</u>	<u>Li⁺</u>	<u>lithium ion</u>
<u>Br⁻</u>	<u>bromide ion</u>	<u>Na⁺</u>	<u>sodium ion</u>
<u>F⁻</u>	<u>fluoride ion</u>	<u>K⁺</u>	<u>potassium ion</u>
<u>S²⁻</u>	<u>sulfide ion</u>	<u>Mg²⁺</u>	<u>magnesium ion</u>
<u>O²⁻</u>	<u>oxide ion</u>	<u>Ca²⁺</u>	<u>calcium ion</u>
<u>N³⁻</u>	<u>nitride ion</u>	<u>Al³⁺</u>	<u>aluminum ion</u>
<u>P³⁻</u>	<u>phosphide ion</u>	<u>Ba²⁺</u>	<u>barium ion</u>
<u>I⁻</u>	<u>iodide ion</u>	<u>B³⁺</u>	<u>boron ion</u>

Exercise 2. Complete the table of neutral ionic compounds with the formulas and names for each cation-anion pair.

	Cl⁻	I⁻	S²⁻	O²⁻	Br⁻	N³⁻
Na⁺	NaCl sodium chloride	NaI sodium iodide	Na ₂ S sodium sulfide	Na ₂ O sodium oxide	NaBr sodium bromide	Na ₃ N sodium nitride
K⁺	KCl potassium chloride	KI potassium iodide	K ₂ S potassium sulfide	K ₂ O potassium oxide	KBr potassium bromide	K ₃ N potassium nitride
Mg²⁺	MgCl ₂ magnesium chloride	MgI ₂ magnesium iodide	MgS magnesium sulfide	MgO magnesium oxide	MgBr ₂ magnesium bromide	Mg ₃ N ₂ magnesium nitride
Al³⁺	AlCl ₃ aluminum chloride	AlI ₃ aluminum iodide	Al ₂ S ₃ aluminum sulfide	Al ₂ O ₃ aluminum oxide	AlBr ₃ aluminum bromide	AlN aluminum nitride

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Cations with a variable/multiple charges

Some transition metals have multiple possible cation charges. A roman numeral (I, II, III, IV, V, ...) must be used in the cation and ionic compound naming system to distinguish between the charges. For example, iron (Fe) can form the iron (II) ion and also the iron (III) ion, denoted Fe^{2+} and Fe^{3+} , respectively. Iron (II) oxide and iron (III) oxide are distinct compounds, with electrically neutral formulas FeO and Fe_2O_3 , respectively.

Exercise 3. Provide the formula for each compound.

iron (II) oxide FeO

iron (III) oxide Fe₂O₃

lead (II) chloride PbCl₂

lead (IV) iodide PbI₄

cobalt (II) chloride CoCl₂

cobalt (III) chloride CoCl₃

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Mixed cation types

The first step in naming an ionic compound is to determine whether or not the cation can exhibit multiple charges. This requires memorization. Learn the following procedure.

1. The main group (Groups 1-8) elements always have a single charge, determined by the column on the periodic table.
2. Silver and zinc are the only transition metals with a single charge. Memorize the ionic charges for Ag^+ and Zn^{2+} .
3. All other transition metals have multiple charges. Use a roman numeral to indicate the cation charge, which can be figured out from the given information.

Exercise 4. Provide the name for each compound.

FeO	<u>iron (II) oxide</u>	CaS	<u>calcium sulfide</u>
NaCl	<u>sodium chloride</u>	Ag ₂ S	<u>silver sulfide</u>
CuBr ₂	<u>copper (II) bromide</u>	CoI ₃	<u>cobalt (III) iodide</u>
ZnO	<u>zinc oxide</u>	Be ₃ N ₂	<u>beryllium nitride</u>
K ₃ P	<u>potassium phosphide</u>	NaCl	<u>sodium chloride</u>