

### 3 • Molecules & Compounds

#### Writing Formulas and Naming Compounds

##### Introduction

Writing formulas and naming compounds can be confusing because there are different types of compounds that follow different rules. Additionally, some compounds ( $\text{H}_2\text{O}$ ,  $\text{NH}_3$ ,  $\text{CH}_4$ , etc.) simply have **common names** that must be memorized.

The two types of compounds we will focus on first are **ionic compounds** (formed from positive and negative ions) and **binary nonmetal compounds** (molecular compounds). Later we will add **acids**. So... you must recognize the **type** of compound before you try to name it. [Note: + ion = "cation" and - ion = "anion".]

	Ionic	Binary Nonmetal
<b>Formula</b>	+ ion before - ion ex: NaCl (NH <sub>4</sub> )SO <sub>4</sub> Al <sub>2</sub> S <sub>3</sub>	usually the less electronegative atom is first ex: CO CO <sub>2</sub> N <sub>2</sub> O
<b>Naming</b>	Name of cation + name of anion  sodium chloride ammonium sulfate aluminum sulfide	Indicate the number (mono, di, tri, and kind of atoms. First element is simply name of element. Second element name ends with "ide"  carbon monoxide carbon dioxide dinitrogen monoxide

#### I. Writing Ionic Formulas

	Cl <sup>-</sup>	NO <sub>3</sub> <sup>-</sup>	S <sup>2-</sup>	CO <sub>3</sub> <sup>2-</sup>	N <sup>3-</sup>	PO <sub>4</sub> <sup>3-</sup>	OH <sup>-</sup>
Na <sup>+</sup>	NaCl	NaNO <sub>3</sub>	Na <sub>2</sub> S	Na <sub>2</sub> CO <sub>3</sub>	Na <sub>3</sub> N	Na <sub>3</sub> PO <sub>4</sub>	NaOH
NH <sub>4</sub> <sup>+</sup>	NH <sub>4</sub> Cl	NH <sub>4</sub> NO <sub>3</sub>	(NH <sub>4</sub> ) <sub>2</sub> S	(NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub>	(NH <sub>4</sub> ) <sub>3</sub> N	(NH <sub>4</sub> ) <sub>3</sub> PO <sub>4</sub>	NH <sub>4</sub> OH
Sn <sup>2+</sup>	SnCl <sub>2</sub>	Sn(NO <sub>3</sub> ) <sub>2</sub>	SnS	SnCO <sub>3</sub>	Sn <sub>3</sub> N <sub>2</sub>	Sn <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub>	Sn(OH) <sub>2</sub>
Hg <sub>2</sub> <sup>2+</sup>	Hg <sub>2</sub> Cl <sub>2</sub>	Hg <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	Hg <sub>2</sub> S	Hg <sub>2</sub> CO <sub>3</sub>	(Hg <sub>2</sub> ) <sub>3</sub> N <sub>2</sub>	(Hg <sub>2</sub> ) <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub>	Hg <sub>2</sub> (OH) <sub>2</sub>
Al <sup>3+</sup>	AlCl <sub>3</sub>	Al(NO <sub>3</sub> ) <sub>3</sub>	Al <sub>2</sub> S <sub>3</sub>	Al <sub>2</sub> (CO <sub>3</sub> ) <sub>3</sub>	AlN	AlPO <sub>4</sub>	Al(OH) <sub>3</sub>
Sn <sup>4+</sup>	SnCl <sub>4</sub>	Sn(NO <sub>3</sub> ) <sub>4</sub>	SnS <sub>2</sub>	Sn(CO <sub>3</sub> ) <sub>2</sub>	Sn <sub>3</sub> N <sub>4</sub>	Sn <sub>3</sub> (PO <sub>4</sub> ) <sub>4</sub>	Sn(OH) <sub>4</sub>

#### II. Naming Ionic Compounds

Cation	Anion	Formula	Name
Cu <sup>2+</sup>	OH <sup>-</sup>	Cu(OH) <sub>2</sub>	cupric hydroxide
Ba <sup>2+</sup>	SO <sub>4</sub> <sup>2-</sup>	BaSO <sub>4</sub>	barium sulfate
NH <sub>4</sub> <sup>+</sup>	Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup>	(NH <sub>4</sub> ) <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>	ammonium dichromate
Ag <sup>+</sup>	C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> <sup>-</sup>	AgC <sub>2</sub> H <sub>3</sub> O <sub>2</sub>	silver acetate
Fe <sup>3+</sup>	S <sup>2-</sup>	Fe <sub>2</sub> S <sub>3</sub>	ferric sulfide

mono	di	tri	tetra	penta	hexa	hepta	octa	nona	deca
------	----	-----	-------	-------	------	-------	------	------	------

### III. Writing Formulas of Binary Nonmetal Compounds

Name	Formula	Name	Formula
nitrogen trifluoride	$\text{NF}_3$	phosphorus trichloride	$\text{PCl}_3$
nitrogen monoxide	$\text{NO}$	phosphorus pentachloride	$\text{PCl}_5$
nitrogen dioxide	$\text{NO}_2$	sulfur hexafluoride	$\text{SF}_6$
dinitrogen tetroxide	$\text{N}_2\text{O}_4$	disulfur decafluoride	$\text{S}_2\text{F}_{10}$
dinitrogen monoxide	$\text{N}_2\text{O}$	xenon tetrafluoride	$\text{XeF}_4$

### IV. Naming Binary Nonmetal Compounds

Name	Formula	Name	Formula
carbon tetrachloride	$\text{CCl}_4$	hydrogen bromide	$\text{HBr}$
tetraphosphorus decoxide	$\text{P}_4\text{O}_{10}$	dinitrogen tetrafluoride	$\text{N}_2\text{F}_4$
chlorine trifluoride	$\text{ClF}_3$	xenon trifluoride	$\text{XeF}_3$
boron trichloride	$\text{BCl}_3$	phosphorus triiodide	$\text{PI}_3$
sulfur tetrafluoride	$\text{SF}_4$	sulfur dichloride	$\text{SCl}_2$

### V. Practice for Both Types of Compounds

Formula	Name
$\text{HCl}$	hydrogen chloride
$\text{PCl}_5$	phosphorus pentachloride
$\text{K}_2\text{S}$	potassium sulfide
$\text{NiSO}_4$	nickel sulfate
$\text{ClF}_3$	chlorine trifluoride
$\text{OF}_2$	oxygen difluoride
$\text{Al}(\text{OH})_3$	aluminum hydroxide
$\text{NCl}_3$	nitrogen trichloride
$(\text{NH}_4)_3\text{PO}_4$	ammonium phosphate
$\text{S}_2\text{Cl}_2$	disulfur dichloride

Formula	Name
$\text{CO}_2$	carbon dioxide
$(\text{NH}_4)_2\text{CO}_3$	ammonium carbonate
$\text{SCl}_2$	sulfur dichloride
$\text{CaI}_2$	calcium iodide
$\text{BF}_3$	boron trifluoride
$\text{PI}_3$	phosphorus triiodide
$\text{Mg}(\text{ClO}_4)_2$	magnesium perchlorate
$\text{KMnO}_4$	potassium permanganate
$\text{AlPO}_4$	aluminum phosphate
$\text{O}_2\text{F}_2$	dioxygen difluoride