

Chemical Nomenclature

Naming ionic and molecular compounds, acids, and hydrates, plus the common polyatomic ions.

01 Ionic or molecular?

CORE RULE

Metal + nonmetal (or polyatomic ion): ionic. Only nonmetals: usually covalent, and many are molecular (SiO_2 is network-covalent).
Heuristic, not a law: NH_4Cl is ionic with no metal.

02 Common ion charges

REFERENCE

Group 1 $\rightarrow +1$ · Group 2 $\rightarrow +2$ · Al $\rightarrow +3$ · N, P $\rightarrow -3$ · O, S $\rightarrow -2$ · F, Cl, Br, I $\rightarrow -1$. Introductory patterns, not universal oxidation states.

03 Common polyatomic ions

REFERENCE

Name	Formula	Charge
ammonium	NH_4^+	+1
hydroxide	OH^-	-1
nitrate	NO_3^-	-1
nitrite	NO_2^-	-1
sulfate	SO_4^{2-}	-2
sulfite	SO_3^{2-}	-2
phosphate	PO_4^{3-}	-3
phosphite	PO_3^{3-}	-3
carbonate	CO_3^{2-}	-2
hydrogen carbonate (bicarbonate)	HCO_3^-	-1
acetate	CH_3COO^-	-1
permanganate	MnO_4^-	-1
chromate	CrO_4^{2-}	-2
dichromate	$\text{Cr}_2\text{O}_7^{2-}$	-2
cyanide	CN^-	-1
hydrogen sulfate	HSO_4^-	-1
hydrogen phosphate	HPO_4^{2-}	-2
dihydrogen phosphate	H_2PO_4^-	-1

04 Oxoanion series (most O to least O)

REFERENCE

per-...-ate (most O) $\succ$ -ate $\succ$ -ite $\succ$ hypo-...-ite (least O). Chlorine: ClO_4^- perchlorate, ClO_3^- chlorate, ClO_2^- chlorite, ClO^- hypochlorite.

05 Naming ionic compounds

METHOD

Binary (two elements): cation name (unchanged) + anion root + -ide. Never use Greek prefixes on ionic names.

With a polyatomic ion, use its name from the table unchanged (Na_2SO_4 = sodium sulfate; NH_4NO_3 = ammonium nitrate).

Balance charge: pick coprime subscripts x, y so $x \cdot |\text{cation}| = y \cdot |\text{anion}|$, then reduce to lowest terms. Wrap a polyatomic ion in parentheses when its subscript is > 1 .

Formula: cation first, then anion; integer subscripts; reduce to lowest terms (CaO , not Ca_2O_2).

06 Metals with more than one charge: Stock system

CORE RULE

Append a Roman numeral in parentheses (the charge) right after the metal name, no space: Fe^{2+} iron(II), Fe^{3+} iron(III), Cu^+ copper(I), Cu^{2+} copper(II).

07 Naming molecular (covalent) compounds

CORE RULE

Name = prefix + first element + prefix + second-element root + -ide. Drop mono- on the first element. Elide vowel clashes: monoxide, tetroxide, pentoxide.

08 Greek prefixes

REFERENCE

Greek numerical prefixes: mono- (1), di- (2), tri- (3), tetra- (4), penta- (5), hexa- (6), hepta- (7), octa- (8), nona- (9), deca- (10). Additional for hydrates: dodeca- (12).

09 Naming acids (aqueous)

CORE RULE

No oxygen (hydroacid): hydro-<root>-ic acid ($\text{HCl(aq)} \rightarrow$ hydrochloric acid). From an -ate anion: -ic acid ($\text{NO}_3^- \rightarrow \text{HNO}_3$ nitric acid). From an -ite anion: -ous acid ($\text{NO}_2^- \rightarrow \text{HNO}_2$ nitrous acid). Extend with per-...-ic and hypo-...-ous.

10 Hydrates

CORE RULE

Formula: <anhydrous salt> $\cdot n \text{ H}_2\text{O}$. Name: <salt name> <Greek-prefix>hydrate, where the prefix is n ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ = copper(II) sulfate pentahydrate).

11 Common mistakes

WATCH OUT

Charges must balance (NaCl_2 is net -1, invalid). No Greek prefixes on ionic names. Stock uses Roman numerals in parentheses, not iron 3 or iron(3). Never use hydro- on an oxyacid.