CHEMWHIZ QUICK REFERENCE

TOPIC 04

# 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 → +1 · Group 2 → +2 · Al → +3 · N, P → −3 · O, S → −2 · F, Cl, Br, I → −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 | $Cr_2O_7^{2-}$ | −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) › -ate › -ite › 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·|cation| = y·|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 (HCl(aq) → hydrochloric acid). From an -ate anion: -ic acid ($NO_3^-$ → $HNO_3$ nitric acid). From an -ite anion: -ous acid ($NO_2^-$ → $HNO_2$ nitrous acid). Extend with per-…-ic and hypo-…-ous.

## 10 Hydrates

CORE RULE

Formula: <anhydrous salt> · n $H_2O$. Name: <salt name> <Greek-prefix>hydrate, where the prefix is n ($CuSO_4 \cdot 5H_2O$ = 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.