

NAMING INORGANIC COMPOUNDS

Memorize:

- 1) symbols and English names of elements
(see Periodic table, groups IA - VIIIA and IIIB - IB, the most important ones are listed in the table attached)
- 2) Latin names of elements
(from the names symbols of elements are derived)
- 3) names of common cations and anions
(see attached tables)
- 4) common names of selected compounds:

Formula	Systematic Name	Common Name	Use
NH ₃	Hydrogen nitride	Ammonia	cleaner
CO ₂	Carbon dioxide	Dry Ice (solid)	freezing substance
N ₂ O	Dinitrogen oxide	Laughing gas or nitrous oxide	anesthetic
NO	Nitrogen monoxide	Nitric oxide	biological active compound
CaCO ₃	Calcium carbonate	Limestone	marble, chalk, make cement
NaCl	Sodium chloride	Table salt	seasoning
H ₂ O	Hydrogen oxide	Water	drinking, washing
H ₂ O ₂	Hydrogen peroxide	Peroxide	antiseptic, bleaching agent
HCO ₃ ⁻	hydrogen carbonate	bicarbonate	blood buffering
NaHCO ₃	Sodium hydrogen carbonate	(Baking) soda	antacid, fire extinguisher

Keep in mind the rules:

- 1) names of binary and ternary compounds are derived from the names of cations, anions and polyatomic ions
- 2) all binary compounds end in **-ide**

e.g. CaO = Calcium **oxide**, H₂O₂ = Hydrogen **peroxide**, NaCl = Sodium **chloride**,
HF (g) = Hydrogen **fluoride** (g = gas)

- 3) binary compounds composed of two nonmetals: **Greek prefixes** are used to indicate the number of atoms of each element in the compound

Greek prefixes: mono-, di-, tri-, tetra-, penta-, hexa-, hepta-, octa-, nona-, deca-
(1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

e.g. SO₂ = Sulfur **dioxide**, N₂O₅ = **Dinitrogen pentoxide**, CO = Carbon **monoxide**
(when two vowels appear next to each other, the vowel of Greek prefix is dropped;
the prefix mono- is never used for naming the first element of a compound)

- 4) binary compound composed of metal ion with fixed or variable oxidation numbers and nonmetal ion:
the metal ion is named by both the **-ous / -ic suffix system** and the **Stock system** (oxidation number written in a parenthesis, it is preferred); **no Greek prefixes are used**

e.g. CuCl₂ = Copper(II) chloride or **cupric** chloride (-ic means "a higher oxidation number")
CuCl = Copper(I) chloride or **cuprous** chloride (-ous means "a lower oxidation number")
(English name) **(derived from Latin name of the cation)**

Fe₂O₃ = Iron(III) oxide or **ferric** oxide (-ic means "a higher oxidation number")
FeO = Iron(II) oxide or **ferrous** oxide (-ous means "a lower oxidation number")

The suffixes -ous and -ic do not mean the same oxidation numbers in naming of different compounds !!! However -ic always means higher and -ous lower oxidation state of a metal.

5) ternary compounds are composed of hydrogen ion H^+ (see below) and/or metal ion with fixed (e.g. Mg) or variable (e.g. Fe) oxidation numbers, and a polyatomic ion (e.g. SO_3^{2-} or SO_4^{2-})

e.g. H_2SO_3 = Sulfurous acid / $MgSO_3$ = Magnesium sulfite (-ous / -ite) - sulfur is present as S^{4+}

H_2SO_4 = Sulfuric acid / $MgSO_4$ = Magnesium sulfate (-ic / -ate) - sulfur is present as S^{6+}

The suffix -ite is used for an anion with lower oxidation number of a central atom (see S), whereas the suffix -ate is for an anion having a higher oxidation state of the same central atom. If only one oxidation state of the central atom is possible the suffix -ate is used.

a metal forming more cations (variable oxidation numbers)

$FeSO_4$ = Iron(II) sulfate or Ferrous sulfate (iron is present as Fe^{2+})

$Fe_2(SO_4)_3$ = Iron(III) sulfate or Ferric sulfate (iron is present as Fe^{3+})

6) hydrogen compounds that yield hydrogen ions in water solution are called **acids**

binary: $HCl(l)$ = Hydrochloric acid whereas $HCl(g)$ = Hydrogen chloride !!! (l = liquid, g = gas)

exception: $HCN(l)$ = Hydrocyanic acid (prefix Hydro- although it is a ternary compound; it is an oxygen-free acid)

ternary: H_2CO_3 = Carbonic acid (its anion = carbonate, so the suffix for acid must be -ic, see point 5)

HNO_2 = Nitrous acid (its anion = nitrite, so the suffix for the acid must be -ous)

$HClO$ = Hypochlorous acid (anion = hypochlorite) Cl^{1+}

$HClO_2$ = Chlorous acid (anion = chlorite) Cl^{3+}

$HClO_3$ = Chloric acid (anion = chlorate) Cl^{5+}

$HClO_4$ = (Hy)perchloric acid (anion = perchlorate) Cl^{7+}

The prefixes hypo- (= under) and per- (or hyper- = above) are used if more than two oxidation states are formed by a central atom (e.g. all halogens).

7) **bases** are substances that contain a metal ion and a hydroxide anion; the suffix: **-ide**

e.g. $NaOH$ = Sodium hydroxide, $Fe(OH)_3$ = Ferric hydroxide

8) **salts** are formed when one or more of the hydrogen ions of an acid is replaced by a cation

e.g. NaH_2PO_4 = Sodium dihydrogen phosphate

Na_3PO_4 = Trisodium phosphate

9) **acid salts** are salts that contain one or more hydrogen atoms bonded to the anion

e.g. NaH_2PO_4 = Sodium dihydrogen phosphate

10) **hydroxy salts** are salts that contain one or more hydroxide ions together with their own anion

e.g. $Ca(OH)Cl$ = Calcium hydroxychloride

11) **double salts** are salts containing two different cations or anions

e.g. $KLiSO_4$ = Potassium lithium sulfate

$Cu_3(CO_3)_2F_2$ = Copper(II) carbonate fluoride

12) **hydrates** are salts containing one or more molecules of water bonded to their molecule

e.g. $CoCl_2 \cdot 6H_2O$ = Cobalt(II) chloride hexahydrate

13) **thioacids or thiosalts** are compounds in which one oxygen was replaced by sulfur atom

e.g. $H_2S_2O_3$ = Thiosulfuric acid

$Na_2S_2O_3$ = Sodium thiosulfate

Names of elements

Symbol	Latin	English
H	Hydrogenium	Hydrogen
Li	Lithium	Lithium
Na	Natrium	Sodium
K	Kalium	Potassium
Be	Beryllium	Beryllium
Mg	Magnesium	Magnesium
Ca	Calcium	Calcium
Sr	Strontium	Strontium
Ba	Baryum	Barium
B	Borum	Boron
Al	Aluminium	Aluminium
C	Carboneum	Carbon
Si	Silicium	Silicon
Sn	Stannum	Tin
Pb	Plumbum	Lead
N	Nitrogenium	Nitrogen
P	Phosphorus	Phosphorus
As	Arsenicum	Arsenic
Sb	Stibium	Antimony
Bi	Bismuthum	Bismuth
O	Oxygenium	Oxygen
S	Sulfur	Sulfur
Se	Selenium	Selenium
F	Fluorum	Fluorine
Cl	Chlorum	Chlorine
Br	Bromum	Bromine
I	Iodium	Iodine
He	Helium	Helium
Ne	Neon	Neon
Ar	Argon	Argon
Kr	Krypton	Krypton
Xe	Xenon	Xenon
Rn	Radon	Radon
Cr	Chromium	Chromium
Mo	Molybdaenum	Molybdenum
W	Wolframium	Tungsten
Mn	Manganum	Manganese
Fe	Ferrum	Iron
Co	Cobaltum	Cobalt
Ni	Niccolum	Nickel
Pt	Platinum	Platinum
Cu	Cuprum	Copper
Ag	Argentum	Silver
Au	Aurum	Gold
Zn	Zincum	Zinc
Cd	Cadmium	Cadmium
Hg	Hydrargyrum	Mercury

Common metals and their cations

Metal	Group	Common Cations	Cation Name
Lithium	IA	1+	Lithium
Sodium	IA	1+	Sodium
Potassium	IA	1+	Potassium
Beryllium	IIA	2+	Beryllium
Magnesium	IIA	2+	Magnesium
Calcium	IIA	2+	Calcium
Strontium	IIA	2+	Strontium
Barium	IIA	2+	Barium
Aluminium	IIIA	3+	Aluminium
Tin	IVA	2+	Tin(II) or stannous
		4+	Tin(IV) or stannic
Lead	IVA	2+	Lead(II) or plumbous
		4+	Lead(IV) or plumbic
Bismuth	VA	3+	Bismuth
Iron	VIIIB	2+	Iron(II) or ferrous
		3+	Iron(III) or ferric
Cobalt	VIIIB	2+	Cobalt(II) or cobaltous
		3+	Cobalt(III) or cobaltic
Copper	IB	1+	Copper(I) or cuprous
		2+	Copper(II) or cupric
Silver	IB	1+	Silver
Gold	IB	3+	Gold(III)
Zinc	IIB	2+	Zinc
Cadmium	IIB	2+	Cadmium
Mercury	IIB	1+	Mercury(I) or Hydrargyrous
		2+	Mercury(II) or Hydrargyric

Common nonmetals and their anions (suffix -ide)

Nonmetal	Group	Anion	Anion Name
Fluorine	VIIA	1-	Fluoride
Chlorine	VIIA	1-	Chloride
Bromine	VIIA	1-	Bromide
Iodine	VIIA	1-	Iodide
Hydrogen	IA	1-	Hydride
Nitrogen	VA	3-	Nitride
Phosphorus	VA	3-	Phosphide
Oxygen	VIA	2-	Oxide
Sulfur	VIA	2-	Sulfide

Common polyatomic cations

<i>Formula</i>	<i>Cation Name</i>
NH ₄ ⁺	Ammonium
H ₃ O ⁺	Hydronium

Common polyatomic anions

<i>Formula</i>	<i>Anion Name</i>
OH ⁻	Hydroxide
CN ⁻	Cyanide
CO ₃ ²⁻	Carbonate
NO ₂ ⁻	Nitrite
NO ₃ ⁻	Nitrate
PO ₄ ³⁻	Phosphate
SO ₃ ²⁻	Sulfite
SO ₄ ²⁻	Sulfate
CrO ₄ ²⁻	Chromate
MnO ₄ ⁻	Permanganate
ClO ⁻	Hypochlorite
ClO ₂ ⁻	Chlorite
ClO ₃ ⁻	Chlorate
ClO ₄ ⁻	Perchlorate

Suffixes in English and the related ones in Latin

	lower cation	higher cation	lower anion	higher anion
English	ous	ic	ite	ate
Latin	osi	i	is	as

	lower anion	related lower acid	higher anion	related higher acid
English	ite	ous	ate	ic
Latin	is	osum	as	icum

	binary compounds, hydroxides and CN ⁻
English	ide
Latin	idum