

# Rules of Nomenclature for Binary Compounds

*There are three types of binary compounds:*

**Type I.** A metal of fixed charge and a nonmetal;

**Type II.** A metal of variable charge and a nonmetal; and

**Type III.** Two nonmetals

Metals of 'variable charge' tend to be transition elements with some exceptions; metals of fixed charge tend to be the alkali metals and the alkaline earths, along with zinc, cadmium and silver. Nonmetals are those compounds to the right of the bold zig-zag line (see Periodic Table attached)

**The rules for naming binary compounds are then as follows:**

- **Rule 1.** When writing a formula or naming a compound:
  - a). For **Type I** and **Type II** compounds, first list the metal then the nonmetal;
  - b) For **Type III** compounds always list the electropositive species first (the element furthest left in the periodic table) and then the electronegative species. **Type III** species tend to be exclusively covalently bound compounds.

<p><i>NOTE: It becomes very important that you KNOW YOUR IONS AND THEIR CHARGES (especially the anions, since any given element anion does not have varying charges)!!!</i></p>
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- **Rule 2.** All compound must be neutral *UNLESS* indicated otherwise.
- **Rule 3.** When naming binary compounds:
  - a). For compounds of **Type I** and **Type II**, always use the FULL name of the metal and add the suffix *-ide* to the root name of the nonmetal (i.e. Metal Nonmetide);
  - b). **Type II** compounds are handled the same as Type I except the charge on the metal is indicated by using a roman numeral in parentheses immediately following the metal (i.e. copper(I) chloride);
  - c). Compounds of **Type III** use a prefix to indicate the number of atoms present; **HOWEVER** the prefix *mono-* is never used to name the first element!

To illustrate 3a, take for example  $\text{Na}_2\text{Se}$ . This is a Type I compound. The metal is *Sodium* (we use its full name) and the nonmetal comes from *selenium*; the root of this is *selen-*; we add *-ide* to this and we get *selenide*, so this compound is *Sodium selenide*.

*For you own information, here is some other generally useful information:*

## Roman Numerals

**I** = 1; **II** = 2; **III** = 3; **IV** = 4; **V** = 5; **VI** = 6; **VII** = 7.

## Prefixes:

**mono** = 1; **di** = 2; **tri** = 3; **tetra** = 4; **penta** = 5; **hexa** = 6; **hepta** = 7; **octa** = 8.

## Greek letters:

$\alpha$  = alpha;  $\beta$  = beta;  $\delta$  or  $\Delta$  = delta;  $\gamma$  = gamma  $\epsilon$  = epsilon;  $\sigma$  = sigma;  $\pi$  = pi;  $\nu$  = nu

## Periodic Table of the Elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
IA												IIIA	IVA	VA	VIA	VIIA	VIIIA
1 <b>H</b> 1.008																	2 <b>He</b> 4.002
	IIA																
3 <b>Li</b> 6.941	4 <b>Be</b> 9.012											5 <b>B</b> 10.81	6 <b>C</b> 12.01	7 <b>N</b> 14.01	8 <b>O</b> 16.00	9 <b>F</b> 19.00	10 <b>Ne</b> 20.18
11 <b>Na</b> 22.99	12 <b>Mg</b> 24.30											13 <b>Al</b> 26.98	14 <b>Si</b> 28.09	15 <b>P</b> 30.97	16 <b>S</b> 32.06	17 <b>Cl</b> 35.45	18 <b>Ar</b> 39.95
		IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB						
19 <b>K</b> 39.10	20 <b>Ca</b> 40.08	21 <b>Sc</b> 44.96	22 <b>Ti</b> 47.90	23 <b>V</b> 50.94	24 <b>Cr</b> 52.00	25 <b>Mn</b> 54.94	26 <b>Fe</b> 55.85	27 <b>Co</b> 58.93	28 <b>Ni</b> 58.70	29 <b>Cu</b> 63.55	30 <b>Zn</b> 65.38	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.59	33 <b>As</b> 74.92	34 <b>Se</b> 78.96	35 <b>Br</b> 79.90	36 <b>Kr</b> 83.80
37 <b>Rb</b> 85.47	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.91	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.91	42 <b>Mo</b> 95.94	43 <b>Tc</b> (99)	44 <b>Ru</b> 101.1	45 <b>Rh</b> 102.9	46 <b>Pd</b> 106.4	47 <b>Ag</b> 107.9	48 <b>Cd</b> 112.4	49 <b>In</b> 114.8	50 <b>Sn</b> 118.7	51 <b>Sb</b> 121.8	52 <b>Te</b> 127.6	53 <b>I</b> 126.9	54 <b>Xe</b> 131.3
55 <b>Cs</b> 132.9	56 <b>Ba</b> 137.3	57 <b>La</b> 138.9	72 <b>Hf</b> 178.5	73 <b>Ta</b> 180.9	74 <b>W</b> 183.9	75 <b>Re</b> 186.2	76 <b>Os</b> 190.2	77 <b>Ir</b> 192.2	78 <b>Pt</b> 195.1	79 <b>Au</b> 197.0	80 <b>Hg</b> 200.6	81 <b>Tl</b> 204.4	82 <b>Pb</b> 207.2	83 <b>Bi</b> 209.0	84 <b>Po</b> (209)	85 <b>At</b> (210)	86 <b>Rn</b> (222)
87 <b>Fr</b> (223)	88 <b>Ra</b> 226.0	89 <b>Ac</b> 227.0	104 <b>Rf</b> (261)	105 <b>Db</b> (262)	106 <b>Sg</b> (263)	107 <b>Bh</b> (262)	108 <b>Hs</b> (265)	109 <b>Mt</b> (266)	110 <b>??</b> (269)								

Lanthanide series

58 <b>Ce</b> 140.1	59 <b>Pr</b> 140.9	60 <b>Nd</b> 144.2	61 <b>Pm</b> (147)	62 <b>Sm</b> 150.4	63 <b>Eu</b> 152.0	64 <b>Gd</b> 157.3	65 <b>Tb</b> 158.9	66 <b>Dy</b> 162.5	67 <b>Ho</b> 164.9	68 <b>Er</b> 167.3	69 <b>Tm</b> 168.9	70 <b>Yb</b> 173.0	71 <b>Lu</b> 175.0
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Actinide series

90 <b>Th</b> 232.0	91 <b>Pa</b> 231.0	92 <b>U</b> 238.0	93 <b>Np</b> (237)	94 <b>Pu</b> (244)	95 <b>Am</b> (243)	96 <b>Cm</b> (247)	97 <b>Bk</b> (247)	98 <b>Cf</b> (251)	99 <b>Es</b> (252)	100 <b>Fm</b> (257)	101 <b>Md</b> (258)	102 <b>No</b> (259)	103 <b>Lr</b> (260)
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<b>TYPE I</b>	<b>TYPE II</b>	<b>TYPE III</b>
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## Common Cations<sup>c</sup>

Ionic Charge +1		Ionic Charge +2		Ionic Charge +3	
<u>Alkali Metals (Group 1A)</u>		<u>Alkaline Earths (Group 2A)</u>		<u>Group 3A</u>	
Li <sup>+</sup>	Lithium	Be <sup>+2</sup>	Beryllium	Al <sup>+3</sup>	Aluminum
Na <sup>+</sup>	Sodium	Mg <sup>+2</sup>	Magnesium	Ga <sup>+3</sup>	Gallium
K <sup>+</sup>	Potassium	Ca <sup>+2</sup>	Calcium	<u>Transition Elements</u>	
Rb <sup>+</sup>	Rubidium	Sr <sup>+2</sup>	Strontium	Cr <sup>+3</sup>	Chromium(III)
Cs <sup>+</sup>	Cesium	Ba <sup>+2</sup>	Barium	Mn <sup>+3</sup>	Manganese(III)
<u>Transition Elements</u>		<u>Transition Elements</u>		Fe <sup>+3</sup>	Iron(III)
Cu <sup>+</sup>	Copper(I)	Cr <sup>+2</sup>	Chromium(II)	Co <sup>+3</sup>	Cobalt(III)
Ag <sup>+</sup>	Silver	Mn <sup>+2</sup>	Manganese(II)		
<u>Polyatomic Ions</u>		Fe <sup>+2</sup>	Iron(II)		
NH <sub>4</sub> <sup>+</sup>	Ammonium	Co <sup>+2</sup>	Cobalt(II)		
<u>Others</u>		Ni <sup>+2</sup>	Nickel		
H <sup>+</sup>	Hydrogen	Cu <sup>+2</sup>	Copper(II)		
H <sub>3</sub> O <sup>+</sup>	Hydronium <sup>a</sup>	Zn <sup>+2</sup>	Zinc		
		Cd <sup>+2</sup>	Cadmium		
		Hg <sub>2</sub> <sup>+2</sup>	Mercury(I) <sup>b</sup>		
		Hg <sup>+2</sup>	Mercury(II)		
		<u>Others</u>			
		Sn <sup>+2</sup>	Tin(II)		
		Pb <sup>+2</sup>	Lead(II)		

a: this is the species that actually exists when H<sup>+</sup> is present in water;

b: mercury(I) ions always occur bound together to form Hg<sub>2</sub><sup>+2</sup> ions;

c: Not included in the table are two common +4 ions: Pb<sup>+4</sup> = Lead(IV) and Sn<sup>+4</sup> = Tin(IV)

## Common Anions

Ionic Charge -1		Ionic Charge -2		Ionic Charge -3			
<b><u>Halogens (Group 7A)</u></b>		<b><u>Oxyanions</u></b>		<b><u>Group 6A</u></b>		<b><u>Group 5A</u></b>	
F <sup>-</sup>	Fluoride	ClO <sub>4</sub> <sup>-</sup>	Perchlorate	O <sup>-2</sup>	Oxide	N <sup>-3</sup>	Nitride
Cl <sup>-</sup>	Chloride	ClO <sub>3</sub> <sup>-</sup>	Chlorate	S <sup>-2</sup>	Sulfide	P <sup>-3</sup>	Phosphide
Br <sup>-</sup>	Bromide	ClO <sub>2</sub> <sup>-</sup>	Chlorite		<b><u>Oxyanions</u></b>		<b><u>Oxyanion</u></b>
I <sup>-</sup>	Iodide	ClO <sup>-</sup>	Hypochlorite				
	<b><u>Acid Anions</u></b>	BrO <sub>3</sub> <sup>-</sup>	Bromate	CO <sub>3</sub> <sup>-2</sup>	Carbonate	PO <sub>4</sub> <sup>-3</sup>	Phosphate
HCO <sub>3</sub> <sup>-</sup>	Hydrogen carbonate <sup>a</sup>	BrO <sub>2</sub> <sup>-</sup>	Bromite	SO <sub>4</sub> <sup>-2</sup>	Sulfate		
HS <sup>-</sup>	Hydrogen sulfide	BrO <sup>-</sup>	Hypobromite	SO <sub>3</sub> <sup>-2</sup>	Sulfite		
HSO <sub>4</sub> <sup>-</sup>	Hydrogen sulfate	IO <sub>4</sub> <sup>-</sup>	Periodate	C <sub>2</sub> O <sub>4</sub> <sup>-2</sup>	Oxalate		
HSO <sub>3</sub> <sup>-</sup>	Hydrogen sulfite	IO <sub>3</sub> <sup>-</sup>	Iodate	CrO <sub>4</sub> <sup>-2</sup>	Chromate		
H <sub>2</sub> PO <sub>4</sub> <sup>-</sup>	Dihydrogen phosphate	NO <sub>3</sub> <sup>-</sup>	Nitrate	Cr <sub>2</sub> O <sub>7</sub> <sup>-2</sup>	Dichromate		
	<b><u>Other Anions</u></b>	NO <sub>2</sub> <sup>-</sup>	Nitrite		<b><u>Acid Anion</u></b>		
		OH <sup>-</sup>	Hydroxide				
		C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> <sup>-</sup>	Acetate	HPO <sub>4</sub> <sup>-2</sup>	Hydrogen Phosphate		
SCN <sup>-</sup>	Thiocyanate	MnO <sub>4</sub> <sup>-</sup>	Permanganate		<b><u>Diatomic Elemental</u></b>		
CN <sup>-</sup>	Cyanide						
H <sup>-</sup>	Hydride			O <sub>2</sub> <sup>-2</sup>	Peroxide		

a: Commonly referred to as Bicarbonate

## Chemical Nomenclature Practice

A. Give the names or formulas of the following compounds:

1	NaCl	
3	BaCrO <sub>4</sub>	
5	ZnSO <sub>4</sub>	
7	Al <sub>2</sub> O <sub>3</sub>	
9	NH <sub>4</sub> NO <sub>2</sub>	
11	Zn <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub>	
13	CaS	
15	CO <sub>2</sub>	
17	H <sub>2</sub> O <sub>2</sub>	
19	Ni(MnO <sub>4</sub> ) <sub>2</sub>	
21	Co <sub>3</sub> (AsO <sub>4</sub> ) <sub>2</sub>	
23	KCN	
25	H <sub>2</sub> SO <sub>3</sub>	
27	SnS <sub>2</sub>	
29	HgC <sub>2</sub> O <sub>4</sub>	
31	Pb(HCO <sub>3</sub> ) <sub>2</sub>	

2	Lead(II) nitrate	
4	Ammonium hydroxide	
6	Cobalt(II) oxide	
8	Copper(II) sulfate	
10	Iron(III) chloride	
12	Copper(I) sulfide	
14	Cadmium hypochlorite	
16	Sodium bicarbonate	
18	Nickel(II) phosphate	
20	Sodium oxalate	
22	Zinc nitrite	
24	Potassium permanganate	
26	Sodium arsenate	
28	Acetic acid	
30	Bismuth(III) arsenate	
32	Cobalt(II) chloride	