

Chapter 5: Nomenclature

These Notes are to SUPPLEMENT the Text, They do NOT Replace reading the Text Material. Additional material that is in the Text will be on your tests! To get the most information, READ THE CHAPTER prior to the Lecture, bring in these lecture notes and make comments on these notes. These notes alone are NOT enough to pass any test!

The author is providing these notes as an addition to the students reading the text book and listening to the lecture. Although the author tries to keep errors to a minimum, the student is responsible for correcting any errors in these notes.

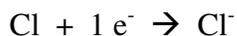
You need to know how to name a compound and go from a name to a structure.
When you're given a chemical name, you will be able to write out the reaction.

Binary Compounds:

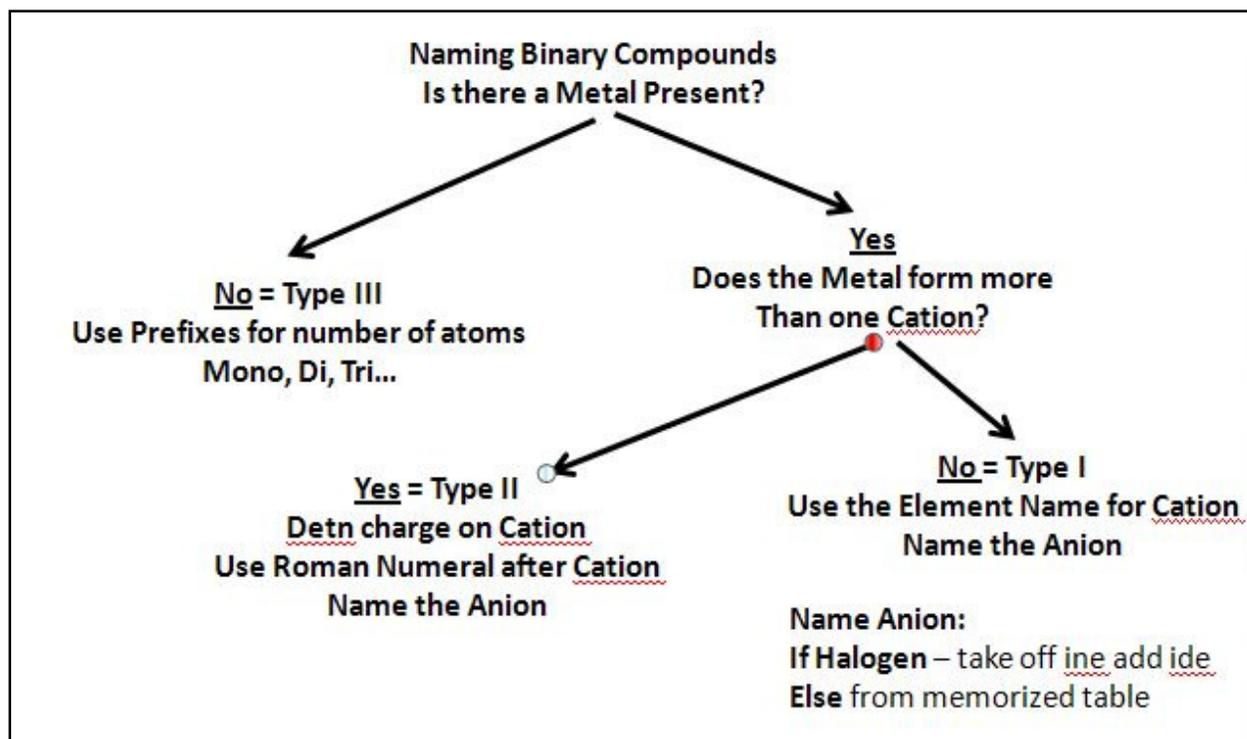
Compounds that contain a metal and a non metal or
Compounds that contain two non metals

Binary Ionic Compound

When a metal loses one electron and a non-metal gain that electron and the two combine to form a compound, it is a Binary Ionic Compound



NAMING COMPOUNDS



SIMPLIFIED RULES FOR NAMING

Rules for naming compounds: Structure → Name

1. If it begins with an H, it's an acid, except for water.
2. What is the Cation [+], what is the name of the cation element?
3. Follow the rules above for naming.

Rules for naming compounds: Name → Structure

1. Convert the Cation Name, the first name of the compound to a Chemical Symbol

Sodium → Na

2. Convert the Anion Name to a Chemical Symbol Chloride → Cl
3. If the Anion is a Polyatomic, put down the correct formulae for it Carbonate → CO₃
4. Put the charges for the Cation and Anion above the element Na⁺¹ Cl⁻¹

These charges come from various locations. Locate the Cation on the Periodic Table

- A. If the Cation is in Group I, the Alkaline Metals, its charge is +1
- B. If the Cation is in Group II, the Alkaline Earth Metals, it's charge is +2
- C. If the Cation is in the middle of the table, you must memorize the charge.
- D. If the Cation Name has a Roman Numeral after it, that is the charge Iron (III) → Fe⁺³

Locate the Anion on the Periodic Table.

1. If the Anion is in Group VII, the Halides, it has a -1 charge
2. Else you must memorize the charge and structure of the Poly Atomic

Now put in the correct number for the subscripts, or multipliers for the charge, so the compound has a net zero charge: Fe⁺³ CO₃⁻² → Fe₂⁺³ (CO₃⁻²)₃

Note as a shortcut

The +3 charge for the iron now becomes the 3 subscript for the carbonate

The -2 charge for the carbonate now becomes the 2 subscript for the iron.

Group												III	IV	V	VI	VII	VIII
I	II																
1 H																	2 He
2 Li	3 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3 Na	11 Mg											+3 13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4 K	19 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	+3 31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5 Rb	37 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6 Cs	55 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7 Fr	87 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds								-1
+1		+2															
58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu				
90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr				

If the Cation is in Group I, it has a +1 Charge

If the Cation is in Group II, it has a +2 Charge

If the Anion is in Group VII, it has a -1 Charge

Naming Simple Compounds [Not a Simple Task]

Chemical Nomenclature is the systematic naming of chemical compounds

Inorganic Compounds are composed of elements other than Carbon

Need to determine the charges on the Cation and Anion

Cation	Group 1A	Alkali Metals	+1	Li, Na, K, Rb, Cs
	Group IIA	Alkaline Earth Metals	+2	Be, Mg, Ca, Sr, Ba
	Group IIIA	Some Transition Metals	+3	Al, Ga, In, Tl
Anion	Group 8A	Noble Gases do not form ionic compounds		
	Group 7A	Halogens	-1	F, Cl, Br, I

Type I Group 1 and 2 Metals

1. Cation named first, then the Anion 2nd
2. Simple Cation [single atom] takes the name from the element Na⁺ = Sodium
3. Simple Anion named taking the 1st part of the element name and add **-ide if it's a halogen**
e.g. NaCl = Sodium Chloride

Type II Transitions Metals

1. Cation is always named 1st, then the Anion
2. Cation can assume more than one charge – specify the charge with Roman Numerals
Cu⁺¹ and Cu⁺² = Copper (I) and Copper (II)
FeCl₃ = Iron (III) Chloride FeCl₂ = Iron (II) Chloride

Type III Binary Compounds containing NonMetals [No Metals]

1. The 1st element is named first and the full name is used
2. The 2nd element is named as if it were an ANION [ide]
3. Prefixes donate the number of atoms present
4. Prefix MONO is NEVER used for the 1st element [See Table 2.7 p 68]

- | | | | |
|---------|----------|----------|----------|
| 1. Mono | 3. Tri | 5. Penta | 7. Hepta |
| 2. Di | 4. Tetra | 6. Hexa | 8. Octa |

Polyatomics: These are charged entities containing several elements bonded together and are treated as one.

Check out this video on YouTube “How to Remember Your PolyAtomics”:

<http://www.youtube.com/watch?v=jcKR9U4IxIk>

Oxyanions Note the increasing in number of oxygen atoms

ClO ⁻	Hypochlorite
ClO ₂ ⁻	Chlorite
ClO ₃ ⁻	Chlorate
ClO ₄ ⁻	Perchlorate

Addition of acid or H⁺: The following are the base with the addition of one H⁺

PO ₄ ³⁻	Phosphate	CO ₃ ²⁻	Carbonate
HPO ₄ ²⁻	Hydrogen Phosphate	HCO ₃ ⁻	Hydrogen BiCarbonate
H ₂ PO ₄ ⁻	Dihydrogen Phosphate		

Simple Cations [Table 5.1]

Cation	Name	Cation	Name	Cation	Name
H ⁺	Hydrogen	Be ²⁺	Beryllium	Al ³⁺	Aluminum
Li ⁺	Lithium	Mg ²⁺	Magnesium		
Na ⁺	Sodium	Ca ²⁺	Calcium		
K ⁺	Potassium	Ba ²⁺	Barium		
Cs ⁺	Cesium				
Ag ⁺	Silver	Zn ²⁺	Zinc		

Common Type II Cations [Table 5.2]

Copper	Copper (I)	Cu ⁺	Copper (II)	Cu ²⁺		
Mercury	Mercury (I)	Hg ₂ ²⁺	Mercury (II)	Hg ²⁺		
Iron			Iron (II)	Fe ²⁺	Iron (III)	Fe ³⁺
Cobalt			Cobalt (II)	Co ²⁺	Cobalt (III)	Co ³⁺
Tin			Tin (II)	Sn ²⁺	Tin (IV)	Sn ⁴⁺
Lead			Lead (II)	Pb ²⁺	Lead (IV)	Pb ⁴⁺

Type III Prefexes

Mono	1	Tetra	4	Hepta	7
Di	2	Penta	5	Hexa	8
Tri	3	Hexa	6		

Names of the Common Polyatomic Ions

NH ₄ ⁺	Ammonium	S ⁻²	Sulfide
NO ₂ ⁻	Nitrite	SO ₃ ²⁻	Sulfite
NO ₃ ⁻	Nitrate	SO ₄ ²⁻	Sulfate
		HSO ₄ ⁻	Bisulfate or Hydrogen Sulfate
OH ⁻	Hydroxide	CO ₃ ²⁻	Carbonate
CN ⁻	Cyanide	HCO ₃ ⁻	Hydrogen Carbonate or BiCarbonate
PO ₄ ³⁻	Phosphate	C ₂ H ₃ O ₂ ⁻	Acetate
HPO ₄ ²⁻	Hydrogen Phosphate	O ₂ ²⁻	Peroxide
H ₂ PO ₄ ⁻	Dihydrogen Phosphate		
ClO ⁻	Hypochlorite	MnO ₄ ⁻	Permanganate
ClO ₂ ⁻	Chlorite		
ClO ₃ ⁻	Chlorate	Cr ₂ O ₇ ²⁻	Dichromate
ClO ₄ ⁻	Perchlorate	CrO ₄ ²⁻	Chromate

Acids

Acids with Oxygen

H ₂ SO ₄	Sulfuric Acid *
H ₂ SO ₃	Sulfurous
H ₃ PO ₄	Phosphoric Acid
HNO ₃	Nitric Acid *
HNO ₂	Nitrous
HC ₂ H ₄ O ₂	Acetic Acid

Acids without Oxygen

HF	Hydrofluoric Acid
HCl	Hydrochloric Acid *
HBr	Hydrobromic Acid
HI	Hydroiodic Acid
HCN	Hydrocyanic Acid
H ₂ S	Hydrosulfuric Acid

ClO ⁻	Hypochlorite	HClO	Hypochlorous Acid [also called common bleach]
ClO ₂ ⁻	Chlorite	HClO ₂	Chlorous Acid
ClO ₃ ⁻	Chlorate	HClO ₃	Chloric Acid
ClO ₄ ⁻	Perchlorate	HClO ₄	Perchloric Acid

* Common Lab Acids

EXAMPLE PROBLEMS:

Write the balanced equation and name the products.

Magnesium Hydroxide and Hydrochloric Acid

Silver Nitrate and Copper (II) Chloride

Iron (II) Phosphate and Aluminum Hydroxide

Cobalt (III) Sulfate and Potassium Chloride

Ammonium Perchlorate and Sodium Hydroxide

Calcium Hydroxide and Hydrochloric Acid

Sulfuric Acid and Iron (III) Hydroxide

Copper (II) Carbonate and Phosphoric Acid

Potassium Dichromate and Lithium Chloride

Ca (NO₃)₂

Ba CO₃

Mg₃ (PO₄)₂

Co CrO₄

Fe₂ (CrO₄)₃

Fe (MnO₄)₃

Fe (CN)₃

Na	+1	Alkali Metal	He		Noble Gas
K	+1	Alkali Metal	Ne		Noble Gas
Rb	+1	Alkali Metal	Ar		Noble Gas
Cs	+1	Alkali Metal	Kr		Noble Gas
Fr	+1	Alkali Metal	Xe		Noble Gas
Be	+2	Alkaline Earth Metal	Rn		Noble Gas
Mg	+2	Alkaline Earth Metal	F		Halogen
Ca	+2	Alkaline Earth Metal	Cl		Halogen
Sr	+2	Alkaline Earth Metal	Br		Halogen
Ba	+2	Alkaline Earth Metal	I		Halogen
Ra	+2	Alkaline Earth Metal	At		Halogen
			O		
Fe	+2	Iron II / Ferrous	S		
	+3	Iron III / Ferric	NH ₄	+1	Ammonium
Cu	+1	Copper I / Cuprous	NO ₂	1-	NITRITE
	+2	Copper II / Cupric	NO ₃	1-	NITRATE
Sn	+2	Tin II / Stannous	SO ₃	2-	SULFITE
	+4	Tin IV / Stannic	SO ₄	2-	SULFATE
Pb	+2	Lead II / Plumbous	HSO ₄	1-	BISULFATE
	+4	Lead IV / Plumbic	OH	1-	Hydroxide
Hg	+2	Mercury II / Mercuric	CN	1-	Cyanide
Hg ₂	+2	Mercury I / Mercuric	PO ₄	3-	PHOSPHATE
			HPO ₄	2-	HYDROGEN PHOSPHATE
H ₂ SO ₄		Sulfuric Acid	H ₂ PO ₄	1-	DIHYDROGEN PHOSPHATE
H ₂ SO ₃		Sulfurous Acid	CO ₃	2-	CARBONATE
HNO ₃		Nitric Acid	HCO ₃	1-	BICARBONATE
HNO ₂		Nitrous Acid	ClO	1-	HYPO CHLORITE
H ₂ PO ₄		Phosphoric Acid	ClO ₂	1-	CHLORITE
HC ₂ H ₃ O ₂		Acetic Acid	ClO ₃	1-	PERCHLORATE
HF		Hydrofluoric	C ₂ H ₃ O ₂	1-	Acetate
HCl		Hydrochloric	MnO ₄	1-	Permanganate
HBr		HydroBromic	Cr ₂ O ₇	2-	DICHROMATE
HI		HydroIodic	CrO ₄	2-	CHROMATE
HCN		HydroCyanic	O ₂	2-	Peroxide
H ₂ S		HydroSulfuric			