

CHAPTER 5
NOMENCLATURE

5

CHAPTER 5 NOMENCLATURE

The Nomenclature Grid – A Helpful Organizational Tool

A tool which attempts to organize the various nomenclature rules into a simplified grid (or table), based on the type of compound being named.

Four categories of compounds

- ↳ binary non-acids (Quadrant 1)
- ↳ polyatomic non-acids (Quadrant 2)
- ↳ polyatomic acids (Quadrant 3)
- ↳ binary acids (Quadrant 4)

| | BINARY | POLYATOMIC |
|----------|---|--|
| NON-ACID | <p style="text-align: center;">Type I</p> <p>M + nM M has only 1 O.N. Metal named first, anion takes "ide" ending eg: NaCl = sodium chloride</p> <p style="text-align: center;">Type II</p> <p>M + nM M has at least 2 O.N. utilizes ROMAN NUMERALS eg: FeO = iron (II) oxide Fe₂O₃ = iron (III) oxide</p> <p style="text-align: center;">Type III</p> <p>nM + nM often, element closest to F serves as anion ("ide") utilizes PREFIXES eg: CO = carbon monoxide CO₂ = carbon dioxide</p> | <p>compounds with: "ate" anions "ite" anions "ium" cations</p> <p>- Typically, named using the rules from the quadrant to the left, and an anion derived from one of the polyatomic acids from the quadrant below. (- ammonium ion is the only polyatomic CATION utilized in this course.)</p> <p>- Often, the formula of the compound's anion 'portion' can be determined if the corresponding POLYATOMIC ACID (quadrant below) is known: SO₄²⁻ = sulfate ion ← derives from sulfuric acid SO₃²⁻ = sulfite ion ← derives from sulfurous acid</p> <p>eg: Na₂SO₄ = sodium sulfate MgSO₃ = magnesium sulfite</p> |
| ACID | <p>- For our purpose, these are acids that do not contain oxygen; i.e., they are not OXYacids. • binary acid = H plus 1 other NON-metallic</p> <p>eg: HF = hydrofluoric acid HCl = hydrochloric acid H₂S = hydrosulfuric acid (aka hydrogen sulfide)</p> | <p>- Acids in which the corresponding anion is comprised of two or more elements - Some acids can be thought to exist in 'families,' in which the formula of any family member can be derived by application of a few basic rules to any single member of the family for which its formula is known. (recommend memorize the "ic" member, and derive others) - Often, they are oxyacids</p> <p>eg: H₂SO₄ = sulfuric acid H₂SO₃ = sulfurous acid</p> <p>eg: HClO₄ = perchloric acid HClO₃ = chloric acid HClO₂ = chlorous acid HClO = hypochlorous acid</p> |

H⁺

Quadrant-1

BINARY

$Na \rightarrow Na^+$
 $Cl \rightarrow Cl^-$ } NaCl

NON-ACID

Type I

- M + nM
- M has only 1 O.N.
- Metal named first, anion takes "ide" ending
- eg: NaCl = sodium chloride NaCl

Type II

- M + nM
- M has at least 2 O.N.
- utilizes ROMAN NUMERALS
- eg: FeO = iron (II) oxide
- Fe₂O₃ = iron (III) oxide

Type III

- nM + nM
- often, element closest to F serves as anion ("ide")
- utilizes PREFIXES
- eg: CO = carbon monoxide
- CO₂ = carbon dioxide

POLYATOMIC

Quadrant-2

compounds with:

- "ate" anions
- "ite" anions
- "ium" cations

- Typically, named using the rules from the quadrant to the left, and an anion derived from one of the polyatomic acids from the quadrant below.

(- ammonium ion is the only polyatomic CATION utilized in this course.)

- Often, the formula of the compound's anion 'portion' can be determined if the corresponding POLYATOMIC ACID (quadrant below) is known:

- SO₄⁻² = sulfate ion <-- derives from sulfuric acid
- SO₃⁻² = sulfite ion <-- derives from sulfurous acid

eg: Na₂SO₄ = sodium sulfate

MgSO₃ = magnesium sulfite

ACID

- For our purpose, these are acids that do not contain oxygen; i.e., they are not OXYacids.

- binary acid = H plus 1 other NON-metallic

eg:

HF = hydrofluoric acid

HCl = hydrochloric acid

H₂S = hydrosulfuric acid (aka hydrogen sulfide)

Quadrant-4

- Acids in which the corresponding anion is comprised of two or more elements

- Some acids can be thought to exist in 'families,' in which the formula of any family member can be derived by application of a few basic rules to any single member of the family for which its formula is known. (recommend memorize the "ic" member, and derive others)

- Often, they are oxyacids

eg:

H₂SO₄ = sulfuric acid

H₂SO₃ = sulfurous acid

eg:

HClO₄ = perchloric acid

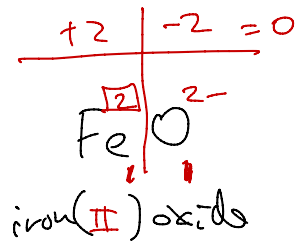
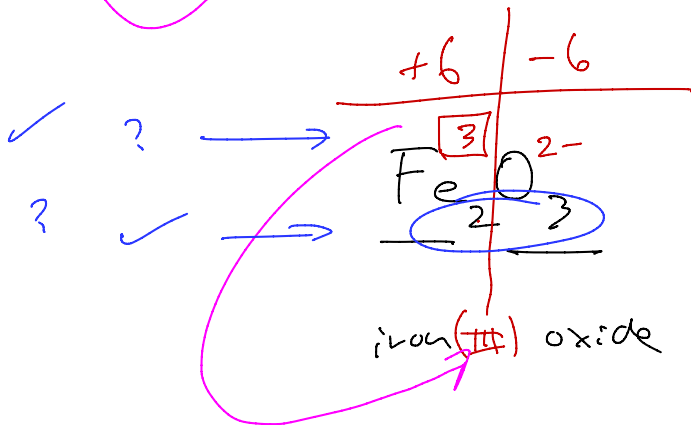
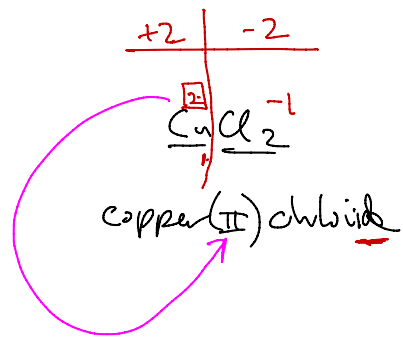
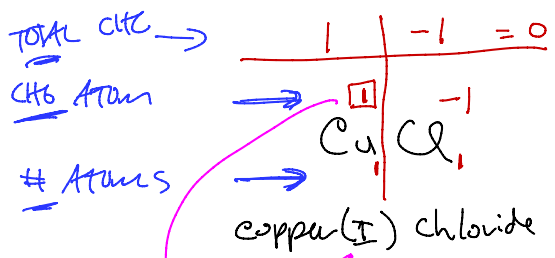
HClO₃ = chloric acid

HClO₂ = chlorous acid

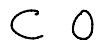
HClO = hypochlorous acid

Quadrant-3

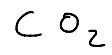
Memory



~~CaCl₂~~



carbon monooxide



carbon dioxide



nitrogen monooxide



dinitrogen pentoxide



Naming Binary Non-acids (Quadrant 1)

- Once it is determined that the compound being named is indeed a Binary Non-acid, identify the “type” of compound, from among three choices.
- There are three types of binary compounds, each of which has its own nomenclature rule.

Three TYPES of binary non-acids

- ↳ Type I — type I metal + non-metal
- ↳ Type II — type II metal + non-metal
- ↳ Type III — two non-metals

Three RULES of binary non-acids

| | |
|---|--|
| Type I | |
| M + nM | |
| M has only 1 O.N. | |
| Metal named first, anion takes "ide" ending | |
| eg: NaCl = sodium chloride | |
| Type II | |
| M + nM | |
| M has at least 2 O.N. | |
| utilizes ROMAN NUMERALS | |
| eg: FeO = iron (II) oxide | |
| Fe ₂ O ₃ = iron (III) oxide | |
| Type III | |
| nM + nM | |
| often, element closest to F serves as anion ("ide") | |
| utilizes PREFIXES | |
| eg: CO = carbon monoxide | |
| CO ₂ = carbon dioxide | |

Periodic Table of the Elements

Period

Group

18

non-metals

metals

Atomic number → 1

Symbol ← H

Atomic mass ← 1.008

Name → hydrogen

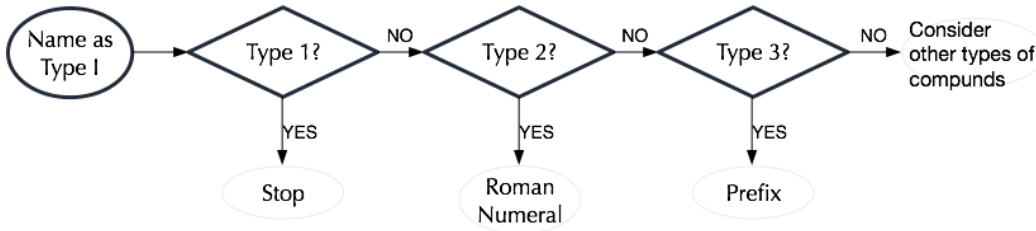
Color Code

| | | | |
|--------|-----------|-------|--------|
| Yellow | Metal | White | Solid |
| Purple | Metalloid | Blue | Liquid |
| Grey | Nonmetal | Red | Gas |

Strategy

Start by naming the compound as a Type I, and then work from there.

Strategy Map



Compounds with "ion" prefix
 Typically, named using the rules from the equivalent to the left. Some other examples from use of the parentheses:
 1) $\text{Ca}(\text{OH})_2$ = calcium hydroxide
 2) $\text{Ca}(\text{HCO}_3)_2$ = calcium bicarbonate
 3) $\text{Ca}(\text{NO}_3)_2$ = calcium nitrate

Check the formula of the compound with "ion" prefix
 Can be determined if the corresponding POLYATOMIC ION (see table) is present:
 SO_4^{2-} = sulfate ion
 SO_3^{2-} = sulfite ion
 SO_3 = sulfurous acid
 SO_2 = sulfur dioxide
 H_2SO_4 = sulfuric acid
 H_2SO_3 = sulfurous acid

For our purposes, these are acids that do not contain hydrogen in their anion (O.N. = -1)
 Binary acid + H plus 1 other NON-metallic
 HCl = hydrochloric acid
 HBr = hydrobromic acid
 HI = hydroiodic acid
 H₂S = hydrosulfuric acid
 H₂O = hydroperoxide (also hydrogen peroxide)

Acids in which the corresponding anion is composed of two or more elements
 Some acids can be thought of as "binary" in which the hydrogen and the other element can be separated from the anion to which the formula is known.
 Examples: HNO_3 = nitric acid
 HNO_2 = nitrous acid
 H_2SO_4 = sulfuric acid
 H_2SO_3 = sulfurous acid
 H_2CO_3 = carbonic acid
 $\text{H}_2\text{C}_2\text{O}_4$ = oxalic acid
 $\text{H}_2\text{C}_2\text{O}_3$ = peroxalonic acid

Type I
 - M + nM
 - M has only 1 O.N.
 - Metal named first, anion takes "ide" ending
 eg: NaCl = sodium chloride

Type II
 - M + nM
 - M has at least 2 O.N.
 - utilizes ROMAN NUMERALS
 eg: FeO = iron (II) oxide
 Fe₂O₃ = iron (III) oxide

Type III
 - nM + nM
 - often, element closest to F serves as anion ("ide")
 - utilizes PREFIXES
 eg: CO = carbon monoxide
 CO₂ = carbon dioxide

Type I Compounds (Type I metal + non-metal)

Name-to-formula

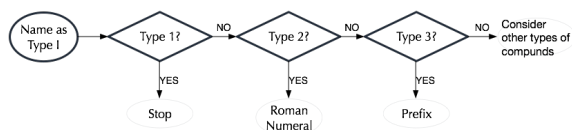
(EX) ¿Provide the correct name for the following compounds?

NaCl →

MgCl₂ →

MgO →

AgBr →



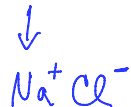
| Type I |
|---|
| - M + nM |
| - M has only 1 O.N. |
| - Metal named first, anion takes "ide" ending |
| - eg: NaCl = sodium chloride |
| Type II |
| - M + nM |
| - M has at least 2 O.N. |
| - utilizes ROMAN NUMERALS |
| - eg: FeO = iron (II) oxide |
| Fe ₂ O ₃ = iron (III) oxide |
| Type III |
| - nM + nM |
| - often, element closest to F serves as anion ("ide") |
| - utilizes PREFIXES |
| - eg: CO = carbon monoxide |
| CO ₂ = carbon dioxide |

Formula-to-name

- ↳ write the element symbol for the cation and the anion
- ↳ note the charge on each ion
- ↳ use subscripts to make the resulting formula charge-neutral

(EX) ¿Provide the correct formula for the following compounds?

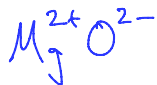
sodium chloride



magnesium chloride



magnesium oxide

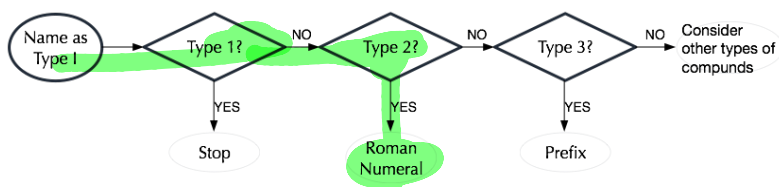
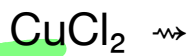


silver bromide

CAVEAT!

After you write down the elements which comprise the formula, be sure to make the formula is charge-neutral (by adding subscripts, if necessary) before naming.

Type II Compounds (type II metal + non-metal)



| |
|---|
| <p>Type I</p> <ul style="list-style-type: none">- M + nM- M has only 1 O.N.- Metal named first, anion takes "ide" ending- eg: NaCl = sodium chloride |
| <p>Type II</p> <ul style="list-style-type: none">- M + nM- M has at least 2 O.N.- utilizes ROMAN NUMERALS- eg: FeO = iron (II) oxide Fe₂O₃ = iron (III) oxide |
| <p>Type III</p> <ul style="list-style-type: none">- nM + nM- often, element closest to F serves as anion ("ide")- utilizes PREFIXES- eg: CO = carbon monoxide CO₂ = carbon dioxide |

Telling the difference between a Type II and a Type I metal

Memorize the position of all Type II metals on the periodic chart

Type I Metals
(Highlighted in green)

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|-------------------------|----|--------------------------|--------|-------------------------|-----|------------------------------|-----|-------------------------|-----|---------------------------|-----|---------------------------|-----|--------------------------|-----|---------------------------|-----|-----------------------------|-----|----------------------------|-----|----------------------------|-----|---------------------------|-----|--------------------------|-----|-----------------------------|-----|----------------------------|-----|-----------------------------|-----|----------------------------|
| 1 | 2 | | | | | | | | | | | 13 | 14 | 15 | 16 | 17 | 18 | | | | | | | | | | | | | | | | | | |
| 1 | H 1.008 hydrogen | 2 | He 4.003 helium | | | | | | | | | | | 5 | B 10.81 boron | 6 | C 12.01 carbon | 7 | N 14.01 nitrogen | 8 | O 16.00 oxygen | 9 | F 19.00 fluorine | 10 | Ne 20.18 neon | | | | | | | | | | |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | | | | | | | | | | | | | | | | | | | |
| 2 | Li 6.94 lithium | 4 | Be 9.012 beryllium | | | | | | | | | | | 13 | Al 26.98 aluminum | 14 | Si 28.09 silicon | 15 | P 30.97 phosphorus | 16 | S 32.06 sulfur | 17 | Cl 35.45 chlorine | 18 | Ar 39.95 argon | | | | | | | | | | |
| 3 | 11 | 12 | | | | | | | | | | | 13 | 14 | 15 | 16 | 17 | 18 | | | | | | | | | | | | | | | | | |
| 3 | Na 22.99 sodium | 12 | Mg 24.31 magnesium | | | | | | | | | | | 13 | Al 26.98 aluminum | 14 | Si 28.09 silicon | 15 | P 30.97 phosphorus | 16 | S 32.06 sulfur | 17 | Cl 35.45 chlorine | 18 | Ar 39.95 argon | | | | | | | | | | |
| 4 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | | | | | | | | | | | | | | | | | |
| 4 | K 39.10 potassium | 20 | Ca 40.08 calcium | 21 | Sc 44.96 scandium | 22 | Ti 47.87 titanium | 23 | V 50.94 vanadium | 24 | Cr 52.00 chromium | 25 | Mn 54.94 manganese | 26 | Fe 55.85 iron | 27 | Co 58.93 cobalt | 28 | Ni 58.69 nickel | 29 | Cu 63.55 copper | 30 | Zn 65.38 zinc | 31 | Ga 69.72 gallium | 32 | Ge 72.63 germanium | 33 | As 74.92 arsenic | 34 | Se 78.97 selenium | 35 | Br 79.90 bromine | 36 | Kr 83.80 krypton |
| 5 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | | | | | | | | | | | | | | | | | |
| 5 | Rb 85.47 rubidium | 38 | Sr 87.62 strontium | 39 | Y 88.91 yttrium | 40 | Zr 91.22 zirconium | 41 | Nb 92.91 niobium | 42 | Mo 95.95 molybdenum | 43 | Tc 97.91 technetium | 44 | Ru 101.1 ruthenium | 45 | Rh 102.9 rhodium | 46 | Pd 106.4 palladium | 47 | Ag 107.9 silver | 48 | Cd 112.4 cadmium | 49 | In 114.8 indium | 50 | Sn 118.7 tin | 51 | Sb 121.8 antimony | 52 | Te 127.6 tellurium | 53 | I 126.9 iodine | 54 | Xe 131.3 xenon |
| 6 | 55 | 56 | 57-71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | | | | | | | | | | | | | | | | | |
| 6 | Cs 132.9 cesium | 56 | Ba 137.3 barium | 57-71 | La-Lu * | 72 | Hf 178.5 hafnium | 73 | Ta 180.9 tantalum | 74 | W 183.8 tungsten | 75 | Re 186.2 rhenium | 76 | Os 190.2 osmium | 77 | Ir 192.2 iridium | 78 | Pt 195.1 platinum | 79 | Au 197.0 gold | 80 | Hg 200.6 mercury | 81 | Tl 204.4 thallium | 82 | Pb 207.2 lead | 83 | Bi 209.0 bismuth | 84 | Po [209] polonium | 85 | At [210] astatine | 86 | Rn [222] radon |
| 7 | 87 | 88 | 89-103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | | | | | | | | | | | | | | | | | |
| 7 | Fr [223] francium | 88 | Ra [226] radium | 89-103 | Ac-Lr ** | 104 | Rf [261] rutherfordium | 105 | Db [262] dubnium | 106 | Sg [263] seaborgium | 107 | Bh [264] bohrium | 108 | Hs [265] hassium | 109 | Mt [266] meitnerium | 110 | Ds [267] darmstadtium | 111 | Rg [268] roentgenium | 112 | Cn [269] copernicium | 113 | Uut [270] ununtrium | 114 | F1 [271] flerovium | 115 | Uup [272] ununpentium | 116 | Lv [273] livermorium | 117 | Uus [274] ununseptium | 118 | Uuo [276] ununoctium |

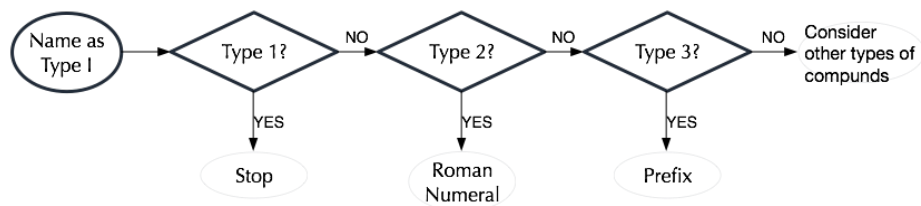
- The metals highlighted in green are Type I. Memorize their position on the periodic chart.
- Rule of Thumb for identifying metal type: if a metal is not a Type II metal, then it is assumed to be a Type I metal.

DISCLAIMER: in fact, some of the non-highlighted metals are, indeed, Type I; however, you need not memorize those anomalies. You will either not be asked to name compounds containing those anomalies, or you will not be penalized for having applied the Type II nomenclature rule.

Type I Metals (Highlighted in green)

| | | | | | | | | | | | | | | | | | | | |
|---|--------------------------|--------------------------|-----------------------------|------------------------------|---------------------------|---------------------------|--------------------------|---------------------------|---------------------------|-----------------------------|----------------------------|----------------------------|----------------------------|--------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------|
| 1 | | | | | | | | | | | | | | | | | 18 | | |
| 1 | H 1.008 hydrogen | | | | | | | | | | | | | | | | | 2 | He 4.003 helium |
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| 6 | 55 | 56 | 57-71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | |
| 6 | Cs 132.9 cesium | Ba 137.3 barium | La-Lu * | Hf 178.5 hafnium | Ta 180.9 tantalum | W 183.8 tungsten | Re 186.2 rhenium | Os 190.2 osmium | Ir 192.2 iridium | Pt 195.1 platinum | Au 197.0 gold | Hg 200.6 mercury | Tl 204.4 thallium | Pb 207.2 lead | Bi 209.0 bismuth | Po [209] polonium | At [210] astatine | Rn [222] radon | |
| 7 | 87 | 88 | 89-103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | |
| 7 | Fr [223] francium | Ra [226] radium | Ac-Lr ** | Rf [267] rutherfordium | Db [270] dubnium | Sg [271] seaborgium | Bh [270] bohrium | Hs [277] hassium | Mt [281] meitnerium | Ds [281] darmstadtium | Rg [282] roentgenium | Cn [285] copernicium | Uut [285] ununtrium | Fl [289] flerovium | Uup [288] ununpentium | Lv [293] livermorium | Uus [294] ununseptium | Uuo [294] ununoctium | |
| | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | | | | |
| | La 138.9 lanthanum | Ce 140.1 cerium | Pr 140.9 praseodymium | Nd 144.2 neodymium | Pm [145] promethium | Sm 150.4 samarium | Eu 152.0 europium | Gd 157.3 gadolinium | Tb 158.9 terbium | Dy 162.5 dysprosium | Ho 164.9 holmium | Er 167.3 erbium | Tm 168.9 thulium | Yb 173.1 ytterbium | Lu 175.0 lutetium | | | | |
| | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | | | | |
| | Ac [227] actinium | Th 232.0 thorium | Pa 231.0 protactinium | U 238.0 uranium | Np [237] neptunium | Pu [244] plutonium | Am [243] americium | Cm [247] curium | Bk [247] berkelium | Cf [251] californium | Es [252] einsteinium | Fm [257] fermium | Md [258] mendelevium | No [259] nobelium | Lr [262] lawrencium | | | | |

Type II nomenclature rule: name as a Type I, then add Roman Numeral



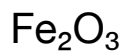
Type I Metals (Highlighted in green)

| | | | | | | | | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|----|
| 1 | H | 2 | | | | | | | | | | | 13 | 14 | 15 | 16 | 17 | 18 |
| 2 | Li | Be | | | | | | | | | | | B | C | N | O | F | Ne |
| 3 | Na | Mg | | | | | | | | | | | Al | Si | P | S | Cl | Ar |
| 4 | K | Ca | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr |
| 5 | Rb | Sr | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I | Xe |
| 6 | Cs | Ba | La | Hf | Ta | W | Re | Os | Ir | Pt | Au | Hg | Tl | Pb | Bi | Po | At | Rn |
| 7 | Fr | Ra | Ac | Rf | Db | Sg | Bh | Hs | Mt | Ds | Rg | Cn | Uut | Uuq | Uup | Uuq | Uuo | |
| | | | Lr | Ce | Pr | Nd | Pm | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu | |
| | | | Ac | Th | Pa | U | Np | Pu | Am | Cm | Bk | Cf | Es | Fm | Mn | No | Lr | |

A Roman Numeral is used to denote the charge on the metal cation

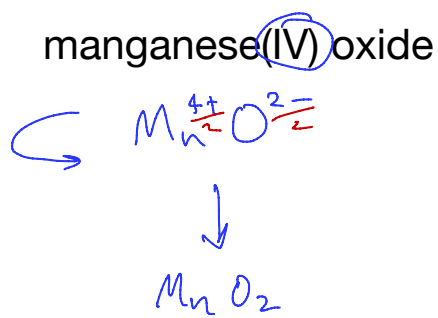
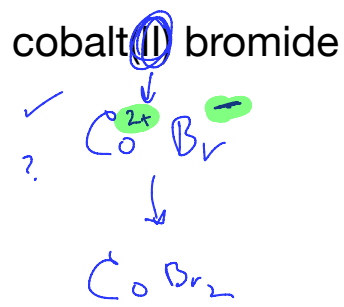
- Type I**
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 - Metal named first, anion takes "ide" ending
 - eg: NaCl = sodium chloride
- Type II**
- M + nM
 - M has at least 2 O.N.
 - utilizes ROMAN NUMERALS
 - eg: FeO = iron (II) oxide
 - Fe₂O₃ = iron (III) oxide
- Type III**
- nM + nM
 - often, element closest to F serves as anion ("ide")
 - utilizes PREFIXES
 - eg: CO = carbon monoxide
 - CO₂ = carbon dioxide

(EX) ¿Provide the correct name for the following compounds?



Type I Metals (Highlighted in green)

(EX) ¿Provide the correct formula for the following compounds?



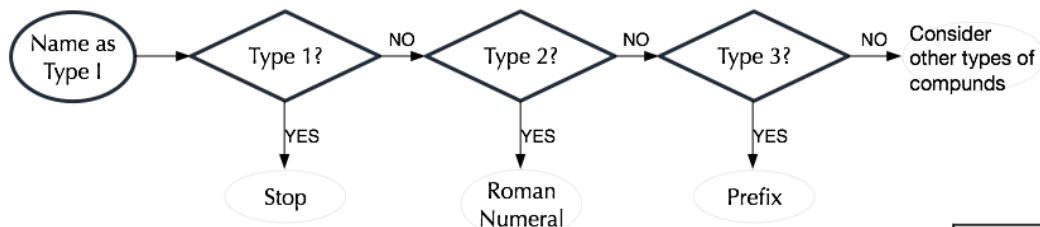
Common Type II Metals

| Ion | Systematic Name | Older Name |
|---------------------------------|-----------------|------------|
| Fe ³⁺ | iron(III) | ferric |
| Fe ²⁺ | iron(II) | ferrous |
| Cu ²⁺ | copper(II) | cupric |
| Cu ⁺ | copper(I) | cuprous |
| Co ³⁺ | cobalt(III) | cobaltic |
| Co ²⁺ | cobalt(II) | cobaltous |
| Sn ⁴⁺ | tin(IV) | stannic |
| Sn ²⁺ | tin(II) | stannous |
| Pb ⁴⁺ | lead(IV) | plumbic |
| Pb ²⁺ | lead(II) | plumbous |
| Hg ₂ ²⁺ | mercury(II) | mercuric |
| Hg ₂ ²⁺ * | mercury(I) | mercurous |

*Mercury(I) ions always occur bound together in pairs to form Hg₂²⁺.

Type III Compounds (non-metal + non-metal)

Type III nomenclature rule: name as a Type I, then add prefix(es)



| |
|---|
| <p style="text-align: center;">Type I</p> <ul style="list-style-type: none">- M + nM- M has only 1 O.N.- Metal named first, anion takes "ide" endingeg: NaCl = sodium chloride |
| <p style="text-align: center;">Type II</p> <ul style="list-style-type: none">- M + nM- M has at least 2 O.N.- utilizes ROMAN NUMERALSeg: FeO = iron (II) oxideFe₂O₃ = iron (III) oxide |
| <p style="text-align: center;">Type III</p> <ul style="list-style-type: none">- nM + nM- often, element closest to F serves as anion ("ide")- utilizes PREFIXESeg: CO = carbon monoxideCO₂ = carbon dioxide |

Type III Compounds (non-metal + non-metal)

(EX) ¿Provide the correct name for the following compounds?

NO

N₂O

CO

CO₂

Common Type III Prefixes

| Prefix | Number Indicated |
|---------------|------------------|
| <i>mono-</i> | 1 |
| <i>di-</i> | 2 |
| <i>tri-</i> | 3 |
| <i>tetra-</i> | 4 |
| <i>penta-</i> | 5 |
| <i>hexa-</i> | 6 |
| <i>hepta-</i> | 7 |
| <i>octa-</i> | 8 |

(EX) ¿Provide the correct formula for the following compounds?

boron trifluoride → BF₃

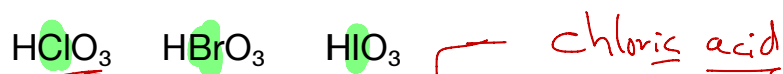
dinitrogen pentoxide → N₂O₅

carbon monoxide

Naming Polyatomic Acids (Quadrant 3)

Memory Acids

Memorize the "ic" version of common polyatomic acids



• sulfuric acid

Mon Sept 27

2019_FA_CHEM_1305_001_Intro Chem I

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★ START HERE ★

SCHEDULE

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SYLLABUS

My Grades

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MODULES

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MODULE 1

MODULE 2

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MODULE 5

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Discussions

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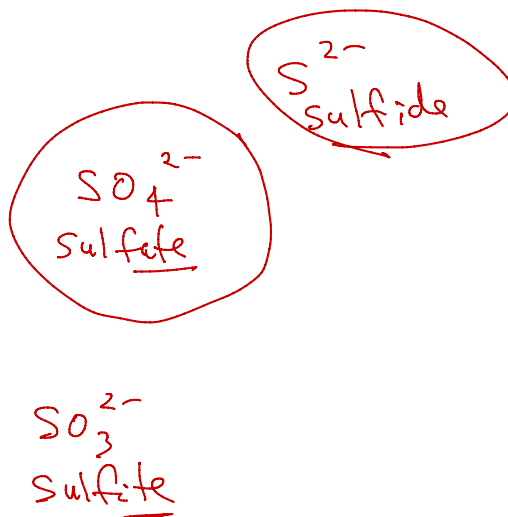
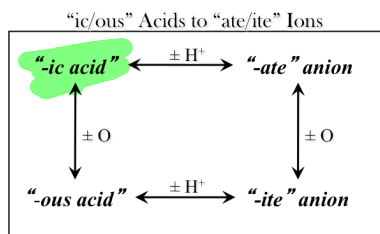
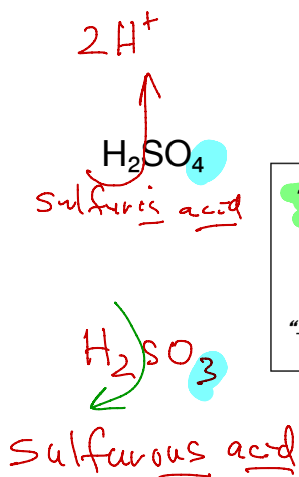
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 - CH05 | Overview Notes
 - CH05 | Powerpoint Slide
 - VIDEO | Nomenclature (
 - VIDEO | Nomenclature (
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 - Practice Problems-N
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 - List of Acids & Polyat
 - Type I Metals Periodic C
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 - VIDEO | BCE 02 | Balanc
- BALANCING CHEMICAL

Practice Problems–Nomenclature

This Learning Module item should open in a new

[Click to Launch](#)

Derivatives of 'ic' Acids: 'ous' Acids, 'ate' Anions, 'ite' Anions

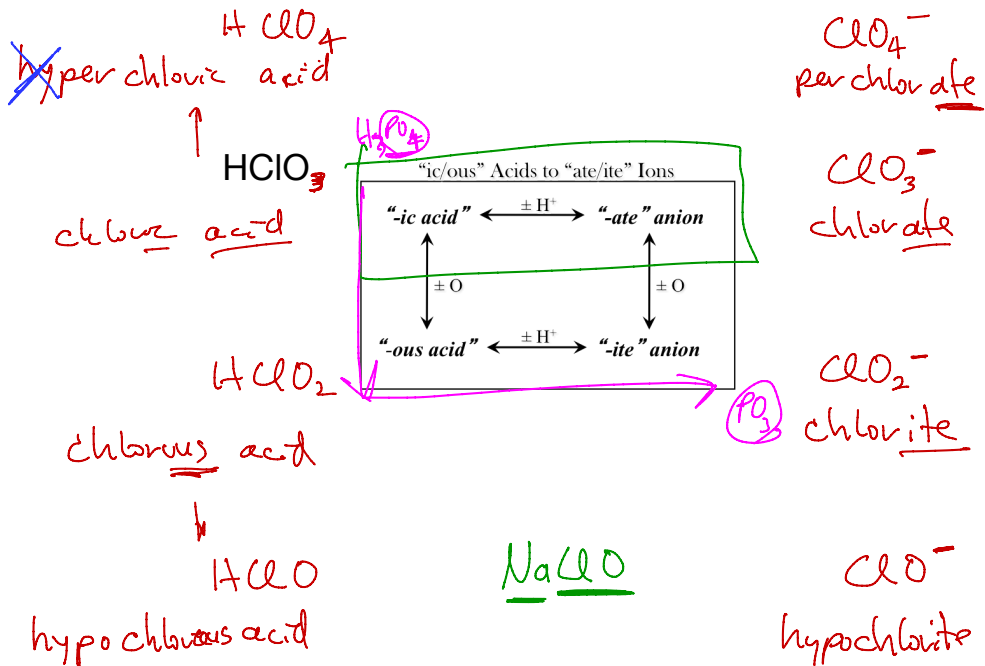


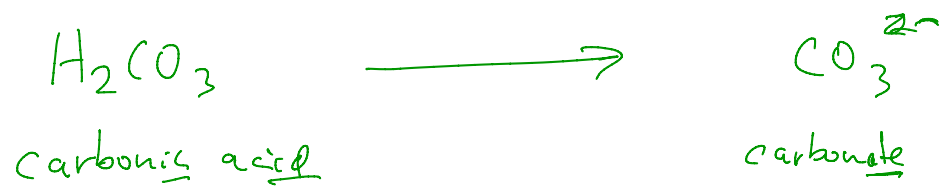
element \rightarrow ide
ic \rightarrow ate
ous \rightarrow ite

The "Extended Family"

Three common extended families, the halogen-centered polyatomic acids:

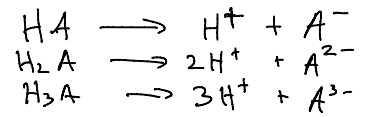
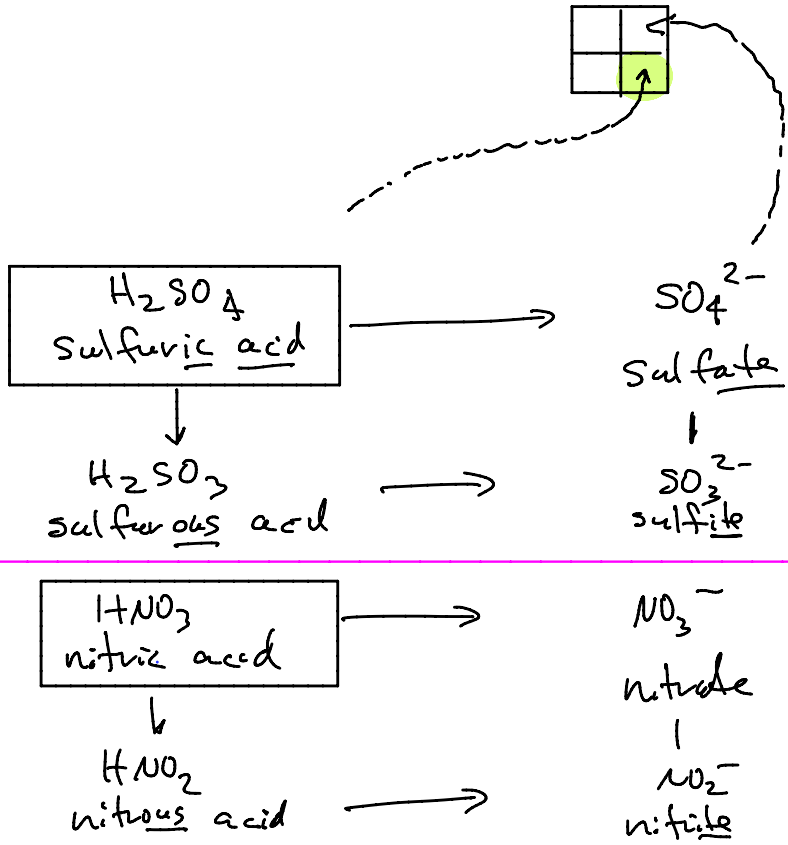
- HClO₃
- HBrO₃
- HIO₃





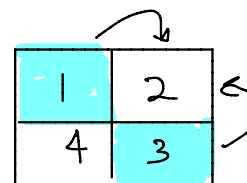
Polyatomic Acid Families

ate, ous anions → Quadrant 2
 ic, ous acids → Quadrant 3



Naming Polyatomic Non-acids (Quadrant 2)

Guidance

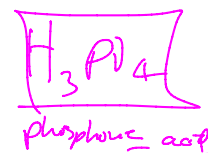
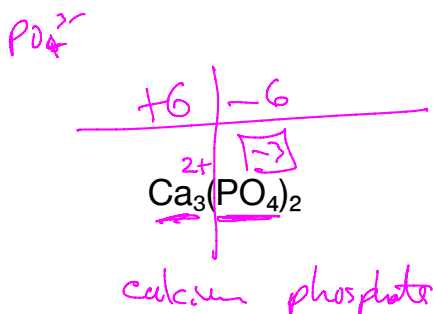
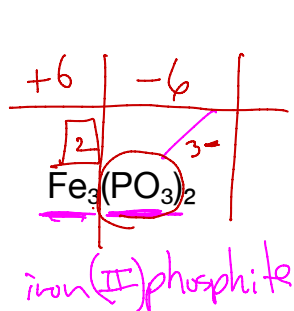


↳ often: Q1 metal cation + Q3 polyatomic anion = Quadrant 2 name

↳ treat polyatomic ions as a single unit; e.g, treat PO_4^{3-} as one unit with a -3 charge

↳ essentially, apply the Type I and Type II rules to polyatomic species

↳ whereas Type I and Type II rules applied to binary non-acids (Q1) often end in "ide", the same rules applied to POLYATOMIC non-acids (Q2) often end in "ate" or "ite"



Polyatomic Acids And Ions

Common Polyatomic Ions

| Name | Formula | Related Acid | Formula |
|----------------------|---------------------------|------------------|--------------------------|
| ammonium | NH_4^+ | | |
| hydronium | H_3O^+ | | |
| oxide | O^{2-} | | |
| peroxide | O_2^{2-} | | |
| hydroxide | OH^- | | |
| acetate | CH_3COO^- | acetic acid | CH_3COOH |
| cyanide | CN^- | hydrocyanic acid | HCN |
| azide | N_3^- | hydrazoic acid | HN_3 |
| carbonate | CO_3^{2-} | carbonic acid | H_2CO_3 |
| bicarbonate | HCO_3^- | | |
| nitrate | NO_3^- | nitric acid | HNO_3 |
| nitrite | NO_2^- | nitrous acid | HNO_2 |
| sulfate | SO_4^{2-} | sulfuric acid | H_2SO_4 |
| hydrogen sulfate | HSO_4^- | | |
| sulfite | SO_3^{2-} | sulfurous acid | H_2SO_3 |
| hydrogen sulfite | HSO_3^- | | |
| phosphate | PO_4^{3-} | phosphoric acid | H_3PO_4 |
| hydrogen phosphate | HPO_4^{2-} | | |
| dihydrogen phosphate | H_2PO_4^- | | |
| perchlorate | ClO_4^- | perchloric acid | HClO_4 |

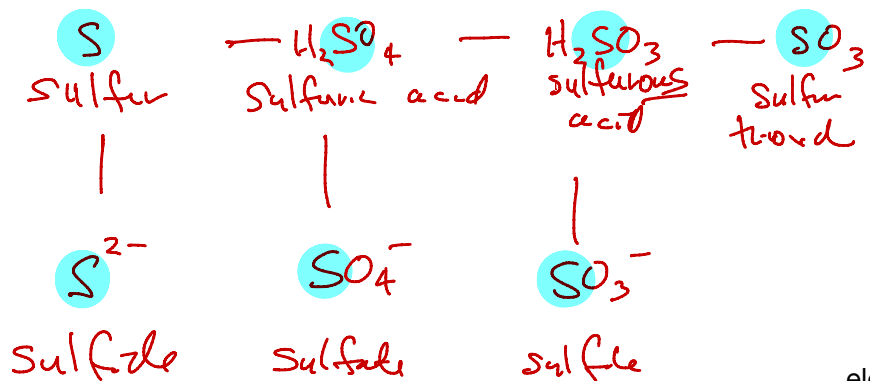
element → ide

ic → ate

ous → ite

The 7 memory
"ic acids"
highlighted in
blue

Atoms, Molecules, And Their Ions
— Don't get them confused



element → ide
ic → ate
ous → ite

Binary Acids (Quadrant 4 Names)

Names of Some Simple Acids

| Name of Gas | Name of Acid |
|---------------------------------------|--|
| HF(g), hydrogen fluoride | HF(aq), hydrofluoric acid |
| HCl(g), hydrogen chloride | HCl(aq), hydrochloric acid |
| HBr(g), hydrogen bromide | HBr(aq), hydrobromic acid |
| HI(g), hydrogen iodide | HI(aq), hydroiodic acid |
| H ₂ S(g), hydrogen sulfide | H ₂ S(aq), hydrosulfuric acid |

Table 2.12



Acids vs. Pure Substance counterparts

| this... | is a(n).... | so it uses this... |
|----------|-------------|---------------------------|
| HCl (aq) | acid/water | binary acid (Q4) name |
| HCl (s) | pure | binary non-acid (Q1) name |
| HCl (l) | pure | binary non-acid (Q1) name |
| HCl (g) | pure | binary non-acid (Q1) name |

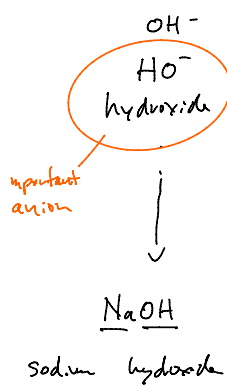
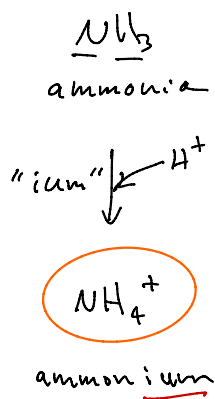
Wed, Sept 25

Common Names

H_2O = water (not dihydrogen monoxide)

NH_3 = ammonia (not nitrogen trihydride)

Polyatomic Ions Not Derived From Polyatomic Acids



—PRACTICE PROBLEMS: ANSWERS NEXT PAGE—

(EX) Nomenclature: Name → Formula

chromium(III) phosphide

magnesium(II) phosphate

calcium chloride

ammonium sulfate

calcium oxide

nitric acid

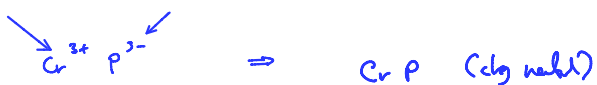
nitrate ion

phosphite ion

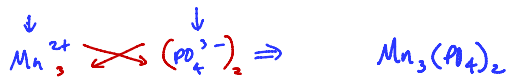


(EX) Nomenclature: Name → Formula

chromium(III) phosphide



magnesium(II) phosphate



calcium chloride



ammonium sulfate



calcium oxide



nitric acid



nitrate ion



phosphite ion



— PRACTICE PROBLEMS: ANSWERS NEXT PAGE —

(EX) Nomenclature: Formula → Name

(a) KNO_3

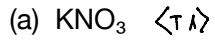
(b) NO

(c) Al_2O_3

(d) $\text{Ni}_2(\text{SO}_4)_3$



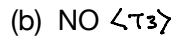
(EX) Nomenclature: Formula → Name



Type I name

potassium nitrate

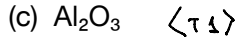
↑ ↓
no II, no III
(stop)



Type I name

nitrogen monoxide

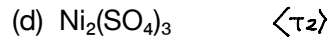
↓
no II, yes III --> prefixes
nitrogen monoxide



Type I name

aluminum oxide

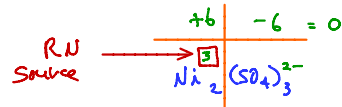
↓
no II, no III
(stop)



Type I name

nickel sulfate

↓
yes II --> RN
(around the bend)



nickel (II) sulfate