SECTION 3: IUPAC NOMENCLATURE

Reference: Non-metal Ions (Memorize!)

Non-metal	"-ide" Ending	Non-metal	"-ide" Ending	Non-metal	"-ide" Ending
N, nitrogen	nitride	**Cl**, chlorine	chloride	**As**, arsenic *	arsenide
O, oxygen	oxide	**Se**, selenium	selenide	**Te**, tellurium *	telluride
F, fluorine	fluoride	**Br**, bromine	bromide	**At**, astatine *	astatide
P, phosphorus	phosphide	**I**, iodine	iodide		
S, sulfur	sulfide	**H**, hydrogen	hydride		

Part 1: Naming Ionic Compounds (with Monovalent Elements)

A **monovalent element** is an element that can only make one type of ion. On the periodic table, monovalent elements have a single ion charge next to them. Examples: phosphorus (P^{3-}), beryllium (Be^{2+})

Practice: Use your periodic table to determine the ion charges of each of the following monovalent elements.

sodium	+1	magnesium	+2	aluminium	+3	phosphorus	−3	silver	+1
lithium	+1	scandium	+3	zinc	+2	chlorine	−1	iodine	−1

Naming Ionic Compounds (version 1)

1) Write the cation, first.
2) Write the anion with "-ide" ending

Examples:

NaCl	$MgBr_2$
sodium chloride	magnesium bromide

Practice: Name the following ionic compounds with monovalent elements.

a) KI potassium iodide
b) Be_3P_2 beryllium phosphide
c) ZnO zinc oxide
d) BaF_2 barium fluoride
e) $AlBr_3$ aluminium bromide

Part 2: Naming Ionic Compounds (with Multivalent Metals)

A **multivalent metal** is an element that can make multiple possible ions. Examples: manganese (Mn^{4+}, Mn^{3+} Mn^{2+}).

Practice: Which of the following elements are multivalent metals? Highlight/circle them.

calcium nickel arsenic selenium palladium manganese magnesium titanium scandium
argon sulfur germanium tin lead cesium potassium chromium gold silver cobalt

Naming Ionic Compounds (version 2)

1) Write the cation, first.
   a. For metals that can only form one ion (monovalent), do not write the ion charge.
   b. For multivalent metals, determine the ion charge through charge balancing. Then, put the ion charge in Roman numerals, in brackets.
2) Write the anion with -ide ending.

Charge Balancing (to find the charge of a multivalent metal ion)

1) Write out all the ions you have. Leave the charge blank on the multivalent metal.
2) *Rule: The total number of* positive *charges in an ionic compound must equal the total number of* negative *charges.* Determine the charge on the metal ion.
3) Write the compound name. Specify the ion charge on the multivalent metal using brackets and Roman numerals.

Examples:

Cr_2O_3 chromium (III) oxide Cr^{3+} Cr^{3+} / 6+ O^{2-} O^{2-} O^{2-} / 6-	CrO chromium (II) oxide Cr^{2+} / 2+ O^{2-} / 2-

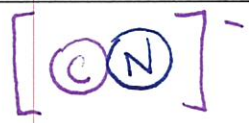
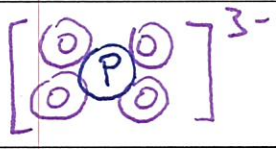
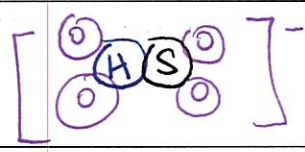
Practice: Name the following ionic compounds with multivalent elements.

a) TiO_2 titanium (IV) oxide
b) Mo_2S_3 molybdenum (III) sulfide
c) Hg_3P mercury (I) phosphide
d) $MnSe_2$ manganese (IV) selenide
e) SnI_2 tin (II) iodide

Part 3: Naming Ionic Compounds (with Polyatomic Ions)

A **polyatomic ion** is a group of covalently bonded atoms that has then gained or lost electrons to form an ion.

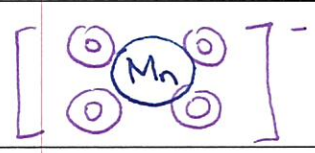
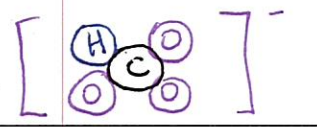
Examples:

Polyatomic Ion and Description	Drawing
• CN^- is cyanide. It contains one carbon atom and one nitrogen atom. It has a charge of 1–.	
• PO_4^{3-} is phosphate. It contains one phosphorus atom and four oxygen atoms. It has a charge of 3–.	
• HSO_4^- is hydrogen sulfate. It is also known as bisulfate. It contains one hydrogen atom, one sulfur atom, and four oxygen atoms. It has a charge of 1–.	

Practice: Write the names of each of these polyatomic ions.

ClO_3^-	chlorate	CO_3^{2-}	carbonate
NH_4^+	ammonium	ClO^-	hypochlorite
PO_4^{3-}	phosphate	SO_3^{2-}	sulfite
HS^-	hydrogen sulfide OR bisulfide	$Cr_2O_7^{2-}$	dichromate

Practice: Write the formulas and charges of each of these polyatomic ions. Then, draw them.

Polyatomic Ion Name	Formula	Ion Charge	Drawing
hydroxide	OH^-	-1	
permanganate	MnO_4^-	-1	
bicarbonate	HCO_3^-	-1	
nitrate	NO_3^-	-1	
acetate	CH_3COO^-	-1	

Naming Ionic Compounds (final version)

1) Write the cation, first.
   a) For metals that can only form one ion (monovalent), do not write the ion charge.
   b) For multivalent metals, determine the ion charge through charge balancing. Then, put the ion charge in Roman numerals, in brackets.
   c) If the cation is polyatomic, spell it the way it is written on the reference sheet.
2) Write the anion with "-ide ending" (unless it is polyatomic: spell it the way it is written on the reference sheet).

Examples:

$Mg(OH)_2$ magnesium hydroxide	$(NH_4)_2S$ ammonium sulfide
$Sc(HSO_3)_3$ scandium hydrogen sulfite OR scandium bisulfite	$Ti_2(CrO_4)_3$ titanium (III) chromate Ti^{3+} CrO_4^{2-} Ti^{3+} CrO_4^{2-} $6+$ CrO_4^{2-} $6-$

Practice: Name the following ionic compounds with polyatomic ions.

a) $Mg(HSO_4)_2$ magnesium bisulfate (or magnesium hydrogen sulfate)
b) K_2SO_4 potassium sulfate
c) $Zn_3(PO_4)_2$ zinc phosphate
d) $Ni_2(CO_3)_3$ nickel (III) carbonate
e) $Mn(Cr_2O_7)_2$ manganese (IV) dichromate

Practice: Complete workbook pg 97 #3.

Practice: Name the following ionic compounds. Monovalent, multivalent, and polyatomic ions are all included.

a) $BeCl_2$ beryllium chloride
b) TiS_2 titanium (IV) sulfide
c) Rb_3PO_4 rubidium phosphate
d) $Sc_2(SO_4)_3$ scandium sulfate
e) $FeCr_2O_7$ iron (II) dichromate
f) $Ca(HSO_4)_2$ calcium hydrogen sulfate (or calcium bisulfate)
g) $Cu(ClO_2)_2$ copper (II) chlorite
h) $Mn(CH_3COO)_3$ manganese (III) acetate
i) $Mn(CO_3)_2$ manganese (IV) carbonate