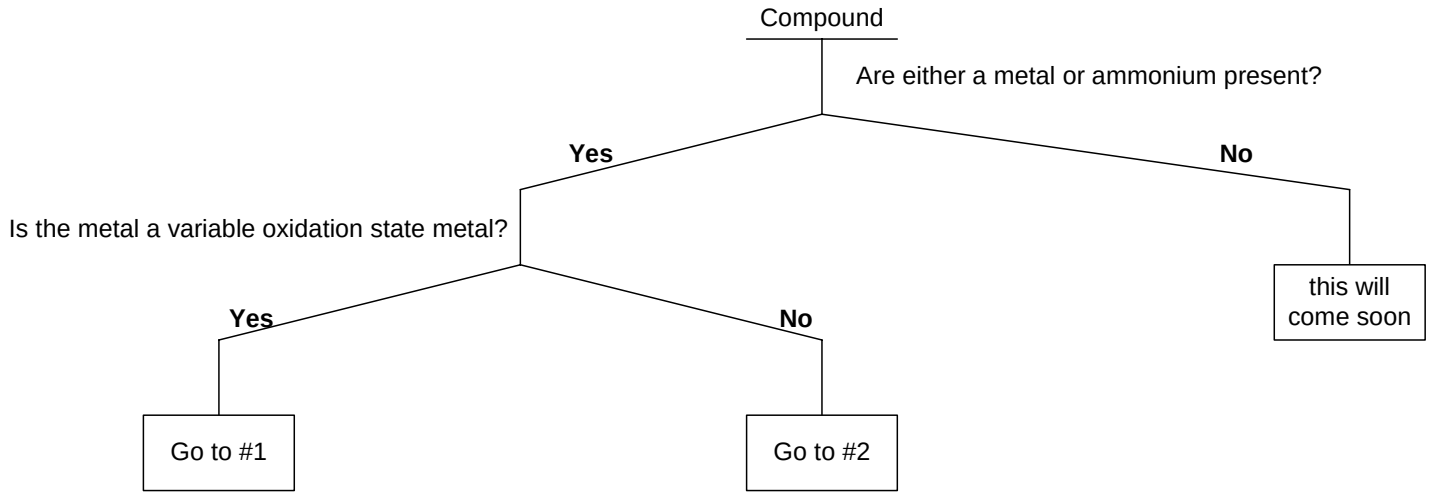
Nomenclature – Naming Ionic Compounds and Writing Ionic Formulae

Remember: In order for a compound to be ionic, there MUST be a metal present. ***MAJOR EXCEPTION!!!!*** If the cation ammonium is present, it is also an ionic compound, for example, NH_4NO_3 is an ionic compound despite the lack of a metal.

Remember: The metal (or ammonium) is ALWAYS written first.

Remember: Variable oxidation state metals are those metals that can have more than one charge when it is an ion. For example, iron is a variable oxidation state metal because it can be either Fe^{+2} or Fe^{+3}. Here are ALL of the variable oxidation state metals you are responsible for: Ti, Cr, Mn, Fe, Co, Ni, Cu, As, Sn, Sb, Au, Hg, Pb, and Bi. If one of these is present, you MUST use roman numerals in the name of the compound. If one of these is not present you must NOT use roman numerals in the name.

FORMULA TO NAME



#1 – There is a variable oxidation state metal present

Step 1: Find the charge on the metal.

$$(\#\text{ of cations}) \bullet (\text{charge of cation}) = (\#\text{ of anions}) \bullet (\text{charge of anion})$$

The charge of the cation will always be unknown, so will always be X

Step 2: Write the name of the metal and the roman numeral for the charge of the metal

Step 3: Add the name of the anion.

Example: $Au(C_2H_3O_2)_3$

Step 1: $(1) \bullet (X) = (3) \bullet (1)$

X = charge of cation = 3, so this is Au^{+3}

Step 2: gold (III)

Step 3: gold (III) acetate

Example: $PbSe_2$

Step 1: $(1) \bullet (X) = (2) \bullet (2)$

X = charge of cation = 4, so this is Pb^{+4}

Step 2: lead (IV)

Step 3: lead (IV) selenide

#2 – The metal can have only have one charge when it is an ion

Step 1: Name the cation

Step 2: Add the name of the anion

Example: $Ca(OH)_2$

Step 1: calcium

Step 2: calcium hydroxide

NAME TO FORMULA

Step 1: Write the symbol for the cation, including the charge and the symbol for the anion, including charge.

Step 2: Find the LCM of the two charges and use it to determine how many cations and how many anions you need in the formula.

$$\frac{\text{LCM}}{\text{charge of cation}} = \text{\# of cations} \qquad \frac{\text{LCM}}{\text{charge of anion}} = \text{\# of anions}$$

Step 3: Write the formula for the compound: $\{\text{symbol of cation}\}_{\{\text{\# of cations}\}}\{\text{symbol of anion}\}_{\{\text{\# of anions}\}}$ no charges in the formula
Remember, if, and only if, there are more than one of a polyatomic ion present, you MUST surround it with parentheses. Parentheses are NOT used for monatomic ions or for single polyatomic ion.

Example: ammonium carbonate

Step 1: ammonium = NH_4^+ carbonate = CO_3^{2-}

Step 2: LCM of 1 and 2 is 2. $\frac{2}{1} = 2$ cations $\frac{2}{2} = 1$ anion

Step 3: $(NH_4)_2CO_3$

Note: There are two ammonium ions needed, so the NH_4 MUST be in parentheses with the number of cations on the outside of the parentheses. There is only a single carbonate needed, so there must NOT be parentheses.

Example: calcium phosphide

Step 1: calcium = Ca^{+2} phosphide = P^{3-}

Step 2: LCM of 2 and 3 is 6. $\frac{6}{2} = 3$ cations $\frac{6}{3} = 2$ anions

Step 3: Ca_3P_2

Note: There are no polyatomic ions here, so there will not be any parentheses in the formula. There will NEVER be parentheses unless there is a poly atomic ion present.

Example: arsenic (V) arsenate

Step 1: arsenic (V) = As^{5+} arsenate = AsO_4^{3-}

Step 2: LCM of 5 and 3 is 15. $\frac{15}{5} = 3$ cations $\frac{15}{3} = 5$ anions

Step 3: $As_3(AsO_4)_5$

Example: tin (IV) chromate

Step 1: tin (IV) = Sn^{4+} chromate = CrO_4^{-2}

Step 2: LCM of 4 and 2 is 4. $\frac{4}{4} = 1$ cations $\frac{4}{2} = 2$ anions

Step 3: $Sn(CrO_4)_2$

Example: mercury (I) phosphate

Step 1: mercury (I) = Hg_2^{2+} phosphate = PO_4^{-3}

Step 2: LCM of 2 and 3 is 6. $\frac{6}{2} = 3$ cations $\frac{6}{2} = 3$ anions

Step 3: $(Hg_2)_3(PO_4)_2$

Note: mercury (I) is a polyatomic ion and is ALWAYS Hg_2^{+2}, make sure to commit that to memory. In this compound there are 2 more than one of each of the polyatomic ions, so everything needs parentheses.