Nomenclature- system for assigning chemical names to compounds.

Binary compounds- compounds that contain only two elements.

Ionic compounds- compounds that contain ions, cation + anion, contain a metal and a nonmetal

Covalent compound- compound that contains all non metals.

Basic Ion Formation Rules

Hydrogen can be +1 hydrogen ion or -1 hydride ion.

Silver forms a +1 cation
Zinc forms a +2 cation.

Group 1 elements form +1 cations
Group 2 elements form +2 cations
Aluminum, Gallium and Indium form +3 cations.

Group 7 elements form -1 anions
Group 6 elements (except polonium) form -2 anions
Nitrogen, Phosphorus and Arsenic form -3 anions.

Remember anions are named by using the root + ide ending.

Example:

oxygen becomes oxide
nitrogen becomes nitride

Naming Basic Ionic Compounds

The cation is named first followed by the anion.

Example:

NaCl = sodium chloride (sodium is the name of the cation, chloride is the name of the anion)
CaO = calcium oxide (calcium is the name of the cation, oxide is the name of the anion)

COMPLICATION: Metals that can form more than one cation

Some metals can form more that one cation. When naming compounds that contain these elements as the cation, we must indicate which cation is in the compound. This is accomplished using a roman numeral in parenthesis to indicate the charge on the cation.
To name compounds containing cations that can form more than one ion:

1. First you calculate the charge on the cation using the zero net charge principle
2. Then the compound is named using the name of the cation first, followed by the charge in parenthesis using roman numerals followed by the name of the anion.

Examples:

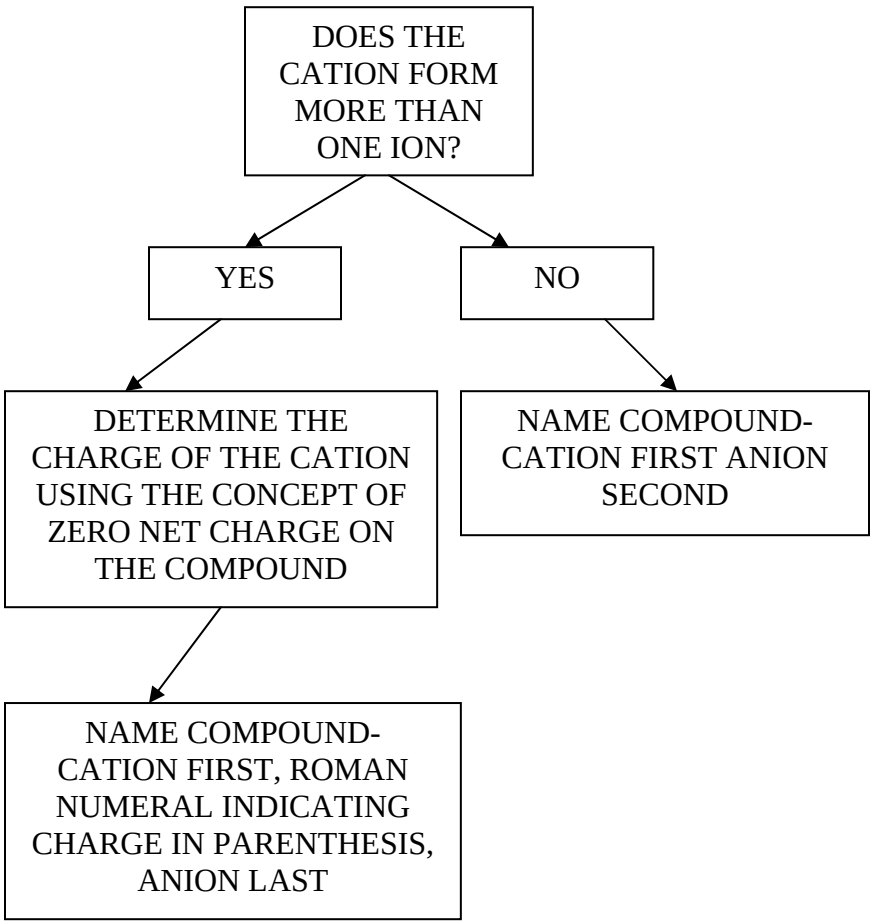
$FeCl_2$= iron (II) chloride , Fe must be a +2 charge because 2 Cl^{-1} are needed to have zero charge

$FeCl_3$= iron (III) chloride, Fe must be a +3 charge because 3 Cl^{-1} are needed to have zero charge

The most metals that form more than one cation are located in the transition metals. Of these the most common ones that will be encountered in Chemistry are iron, copper, cobalt, tin, lead, mercury, chromium, manganese and nickel.

A chart on page 128 summarizes some of their common charges.

A SUMMARY OF NAMING BASIC IONIC COMPOUNDS



Naming Covalent Compounds

When the compound contains only nonmetals the following rules are followed:

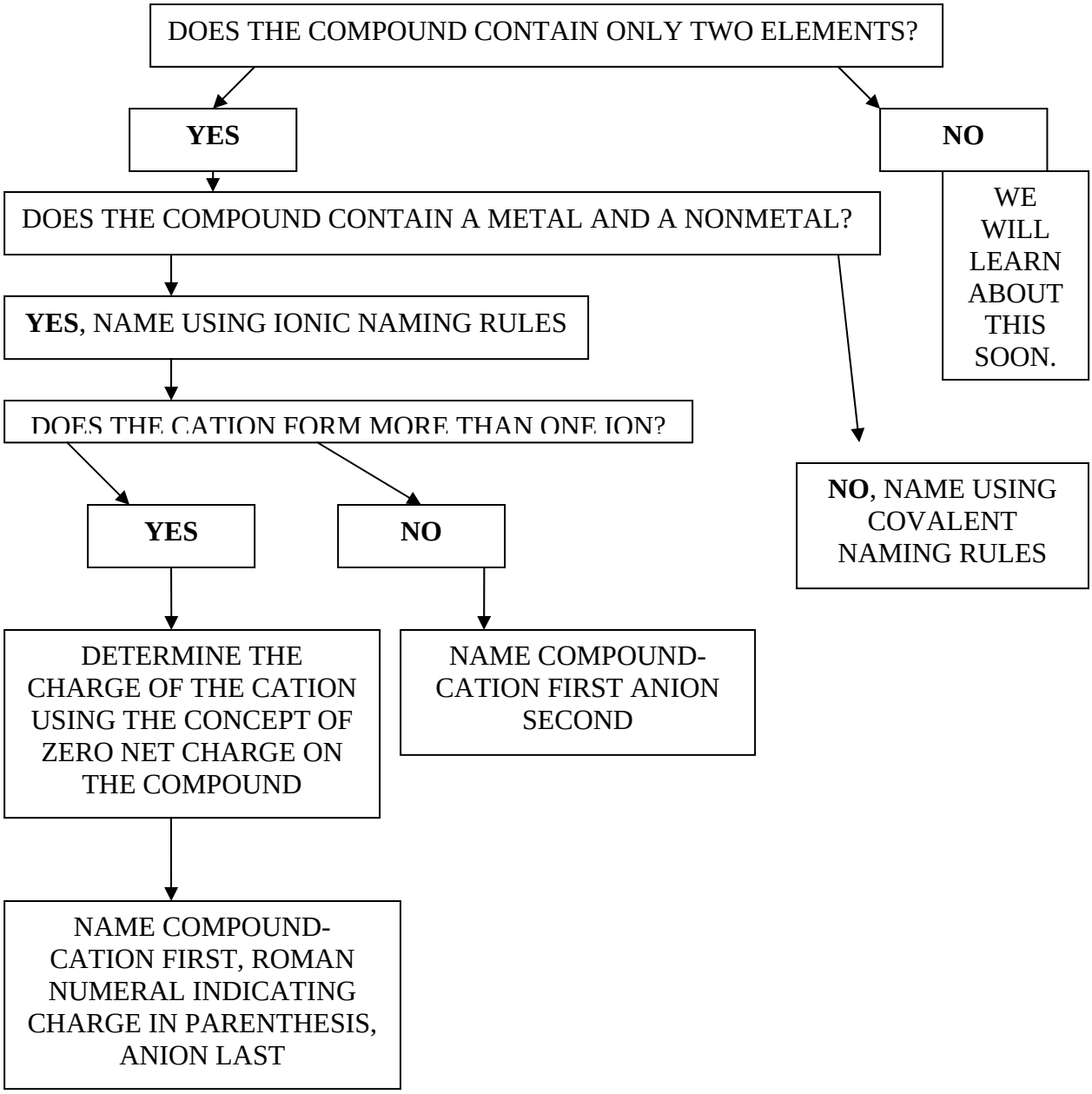
1. The element listed first in the formula is named first using the complete element name.
2. The second element listed in the formula is named next as if it were an anion (root + ide)
3. Prefixes are used to indicate the number of atoms of each element.
   1= mono, 2= di, 3= tri, 4= tetra, 5= penta, 6= hexa, 7 = hepta, 8 = octa 9= nona, 10= deca
4. The prefix mono is NEVER used on the first element.
5. If the name of the element begins with a vowel, the last vowel of the prefix may be omitted to make the pronunciation easier. Example: monooxide = monoxide

Examples:

BF_3= boron trifluoride
NO= nitrogen monoxide
N_2O_5= dinitrogen pentoxide

Two Exceptions:

Water (H_2O) and Ammonia (NH_3) are always refered to by their common names not their systematic names.


DOES THE COMPOUND CONTAIN ONLY TWO ELEMENTS?
YES
NO
WE WILL LEARN ABOUT THIS SOON.
DOES THE COMPOUND CONTAIN A METAL AND A NONMETAL?
YES, NAME USING IONIC NAMING RULES
DOES THE CATION FORM MORE THAN ONE ION?
NO, NAME USING COVALENT NAMING RULES
YES
NO
DETERMINE THE CHARGE OF THE CATION USING THE CONCEPT OF ZERO NET CHARGE ON THE COMPOUND
NAME COMPOUND-CATION FIRST ANION SECOND
NAME COMPOUND-CATION FIRST, ROMAN NUMERAL INDICATING CHARGE IN PARENTHESIS, ANION LAST

Compounds that are not Binary Compounds.

Compounds that contain more than two elements are not Binary Compounds.

These compounds usually contain polyatomic ions.

POLYATOMIC IONS : charged entities that contain several atoms bound together.

These ion names and their charges must be learned!!

See page 137 in the textbook.

When naming a compound that contains a polyatomic ion, the name of the polyatomic ion is used for the cation or anion represented by the polyatomic ion.

Note: the only polyatomic ion that can be a cation is NH_4^{+1}, all others are anions.

Examples:

NH_4Cl = ammonium chloride
NaCN = sodium cyanide
$Fe(NO_3)_3$ = iron (III) nitrate

Note: if a subscript is used to modify a polyatomic ion, the polyatomic ion must be placed in parenthesis so that the subscript modifies the entire ion.

Polyatomic ions can be used to calculate the charge on a cation that forms more than one ion. This is why it is important to know the charges of the polyatomic ions as well as their names and formulas.

If the compound is not binary, there must be a polyatomic ion in order for it to be named during the scope of this course.

Hydrates Note Sheet

Definitions:

- **hydrate**
  An ionic molecule which has water molecules trapped in the crystal structure. The water molecules can be removed by heating. Hydrates usually involve ionic compounds with transition metal cations. The substances do not feel wet.

- **anhydrate**
  A molecule which has no water molecules attached to it. This term is usually only used when describing chemicals which have specifically had their water molecules removed during heating – in these cases, the word "anhydrate" is added to the name.

- **dehydration**
  The process of removing water from a hydrate, usually through applied heat.

Rules for Naming Hydrates

1. Name regular compound first.
2. Use prefixes to indicate number of water molecules attached to the regular molecule.

Rules for Writing Formulas of Hydrates

1. Write formula of regular compound first.
2. A dot separates regular compound from water.
3. Number followed by H_2O follows the dot to indicate water molecules attached to regular molecule.

Examples

Naming Example- Formula to Name

$FeCl_3 \cdot 6\ H_2O$ **iron (III) chloride hexahydrate**

$CuSO_4 \cdot 5\ H_2O$ **copper (II) sulfate pentahydrate**

Naming Examples- Name to Formula

barium chloride dihydrate **$BaCl_2 \cdot 2\ H_2O$**

magnesium sulfate heptahydrate **$MgSO_4 \cdot 7\ H_2O$**

Prefixes

Prefix	Number of Atoms	Prefix	Number of Atoms
mono-	1	hexa-	6
di-	2	hepta-	7
tri-	3	octa-	8
tetra-	4	nona-	9
penta-	5	deca-	10

Naming Acids

Before we can name acids, we must know how to identify a compound as an acid.

An **ACID** is a compound that when dissolved in water will produce or give off H^{+1} ions (hydrogen ions)

To designate that something is dissolved in water we use (aq) following the formula.

(aq) = aqueous = dissolved in water

Example:

HCl is not an acid because it is not dissolved in water (no aq. designation) It would be named hydrogen chloride.

HCl (aq) is an ACID because it contains hydrogen and it is dissolved in water (the aq designation)

Once we have identified our substance as an acid, we must decide to which of two categories it belongs.

Acids that contain an anion that does not contain oxygen

When we name this type of acid we use the prefix **hydro** on the root of the anion followed by the suffix **ic**.

Example:

HCl (aq)= **HYDRO**CHLOR**IC** ACID

Note: you must include "acid" as part of the name

Acids that contain an anion that contains oxygen (oxyanion)

When we name this type of acid we attach a suffix to either the root of the anion or the main element of the anion.

The suffix added depends on the anion name:

If the anion ends in **–ate** then the suffix **–ic** is used
If the anion ends in **–ite** then the suffix **–ous** is used

Example:

$HClO_2$ = chlorous acid, uses the root of the anion plus –ous
$HClO_2$ = chloric acid, uses the root of the anion plus –ic
H_2SO_4 = sulfuric acid, uses the main element of the anion plus –ic