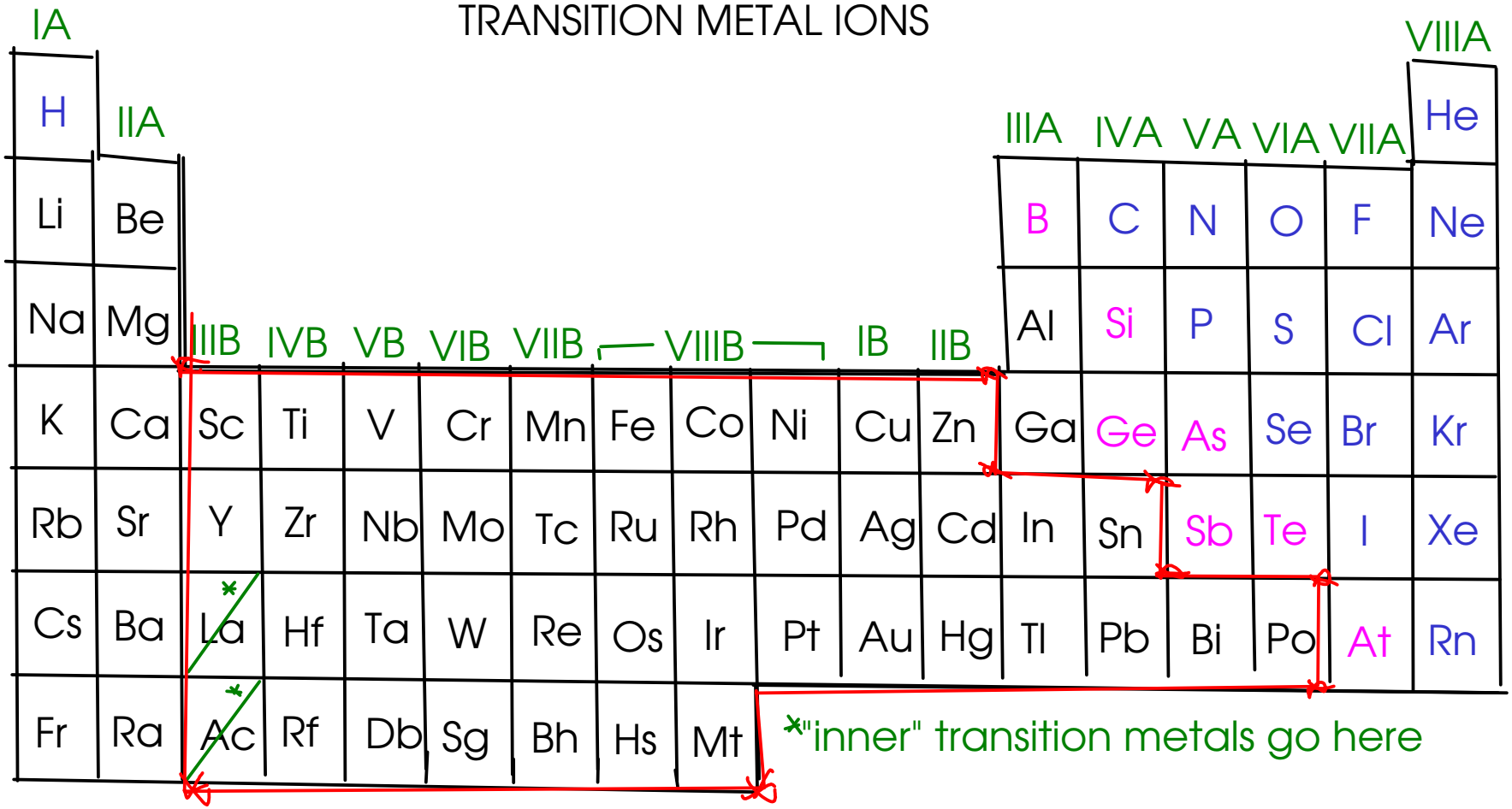
TRANSITION METAL IONS



The transition metals always form CATIONS!

However, many transition metals are capable of forming SEVERAL DIFFERENT CATIONS!

Example: Iron (Fe) forms two cations, depending on the situation: Fe^{2+} or Fe^{3+}

TRANSITION METAL CATIONS

- So how do you know which cation you're dealing with? For now, you'll have to be told

- Either the chemical formula of an ionic compound or the name of an ionic compound can tell you what charge is on the transition metal cation.

Examples:

Fe_3N_2

Fe^{2+} N^{3-}

Fe^{2+} N^{3-}

Fe^{2+}

$+6$ -6

The iron ions in this compound have a +2 charge, and are called "iron(II)" - pronoumced "iron two". This compound is called "iron(II) nitride"!

FeN

Fe^{3+} N^{3-}

$+3$ -3

The iron ion in this compound has a +3 charge, and is called "iron(III)" - pronoumced "iron three". This compound is called "iron(III) nitride"!

POLYATOMIC IONS

- Some MOLECULES can gain or lose electrons to form CATIONS or ANIONS. These are called POLYATOMIC IONS

- Polyatomic ions form ionic compounds in the same way that single-element ions do.

Example: CO_3^{2-} : carbonate ion

Compare these formulas!

Al^{3+} O^{2-}
Al^{3+} O^{2-}
O^{2-}

Al_2O_3

Al^{3+} CO_3^{2-}
Al^{3+} CO_3^{2-}
CO_3^{2-}

$Al_2(CO_3)_3$

* Use parenthesis when an ionic compound's formula contains more than one of a polyatomic ion.

A chart of common polyatomic ions is available on the course web site!

(p130 - 7th edition)

NAMES OF IONS

- To properly discuss ions and ionic compounds, we have to know how to name them!

CATIONS

3 kinds:

1. Main group cations (metals that take only one charge when forming ions)

   - The element's name is the same as the ion's name!

   Mg^{2+}: "magnesium ion"

2. Transition metal cations (from metals that can form several cations)

   - The CHARGE of the cation must be given. Use a ROMAN NUMERAL after the element name to indicate charge!

   Fe^{2+}: "iron(II) ion"

   Cu^{+}: "copper(I) ion"

   Fe^{3+}: "Iron(III) ion"

3. Polyatomic cations

   - Memorize list.

   NH_4^+: "ammonium ion"

ANIONS

2 kinds

1. Main-group nonmetals

- Use the STEM NAME of the element, then add "-ide" suffix

N^{3-} : "nitride" ion P^{3-} : "phosphide ion" S^{2-}: sulfide ion

O^{2-} : "oxide ion" F^{-} : "fluoride ion"

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2. Polyatomic ions

- List (see web site) (also p130 in textbook 7th ed)

$C_2H_3O_2^{-}$: "acetate ion" SO_4^{2-}: "sulfate ion"

NO_3^{-} : "nitrate ion" SO_3^{2-} "sulfite ion"

NO_2^{-} : "nitrite ion"

* Polyatomic ions ending in "-ate" and "-ite" suffixes always contain oxygen! "-ate" ions have more oxygen atoms than their "-ite" counterparts.

NAMING IONIC COMPOUNDS

- The name of the compound is based on the name of the ions in the compound
- Cation first, anion second (drop the word "ion")

Examples:

$Mg(OH)_2$

magnesium hydroxide

Na_2S

sodium sulfide

$BeBr_2$

beryllium bromide

Fe_2O_3

Fe^{3+} O^{2-}

Fe^{3+} O^{2-}

O^{2-}

+6 −6

iron(III) oxide

CuO

Cu^{2+} O^{2-}

+2 −2

copper(II) oxide

Cu_2O

Cu^{+} O^{2-}

Cu^{+}

+2 −2

copper(I) oxide

Remember to include the Roman numeral for CHARGE in the name of transition metal compounds!

NAMING IONIC COMPOUNDS

$(NH_4)_2S$

ammonium sulfide

$FeCO_3$

Fe^{2+} CO_3^{2-}

+2 −2

iron(II) carbonate

TiS_2

Ti^{4+} S^{2-} S^{2-}

+4 −4

titanium(IV) sulfide

$Ba_3(PO_4)_2$

barium phosphate

SPELLING MATTERS!

$Ca(NO_3)_2$

calcium nitrate

Ba_3P_2

barium phosphide

DETERMINING THE FORMULA OF AN IONIC COMPOUND FROM THE NAME

- The name of an ionic compound is made of the names of the CATION and ANION in the compound.

- To get the FORMULA, you must figure out the SMALLEST RATIO of cation to anion that makes the charges balance out

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Examples:

iron(III) carbonate

Fe^{3+} CO_3^{2-}

Fe^{3+} CO_3^{2-}

CO_3^{2-}

$Fe_2(CO_3)_3$

potassium sulfide

K^+ S^{2-}

K^+

K_2S

calcium bromide

Ca^{2+} Br^-

Br^-

$CaBr_2$

DETERMINING IONIC FORMULAS

sodium sulfate

Na^+ SO_4^{2-}

Na^+

Na_2SO_4

tin(II) phosphate

Sn^{2+} PO_4^{3-}

Sn^{2+} PO_4^{3-}

Sn^{2+}

$Sn_3(PO_4)_2$

barium hydroxide

Ba^{2+} OH^-

OH^-

$Ba(OH)_2$

strontium oxide

Sr^{2+} O^{2-}

SrO

chromium(III) nitrate

Cr^{3+} NO_3^-

NO_3^-

NO_3^-

$Cr(NO_3)_3$

titanium(IV) chloride

chromium(III) nitride

Cr^{3+} N^{3-}

CrN

titanium(IV) oxide

~~$BaOH_2$~~

Be careful when you have a polyatomic that does not end in a subscript. You still need parenthesis to indicate more than one hydroxide (or cyanide)!