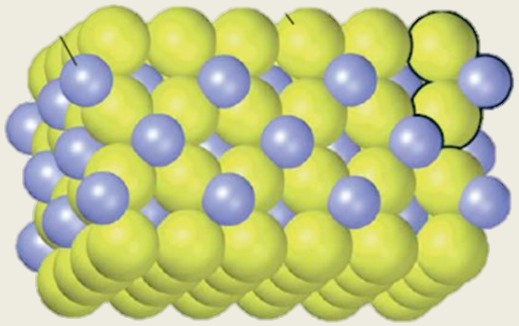
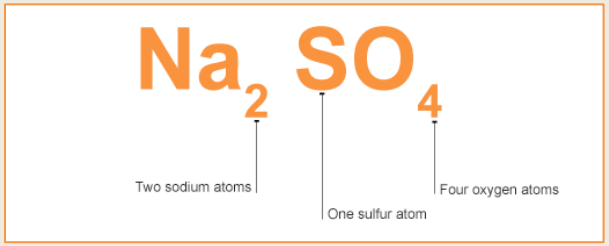
CHEMICAL NAMES & FORMULAS

SIGNIFICANCE OF A CHEMICAL FORMULA

Chemical formulas are important because they indicate the relative number of atoms of each kind of a chemical compound

- For an ionic compound: chemical formulas represents one *formula unit*
  - Formula unit: the simplest ratio of the compound's positive and negative ions
- For a molecule: the molecular formula gives the number of atoms of each element contained in a single molecule of the compound





MONATOMIC IONS

- Monatomic ion: ions formed from a single atom
  - *Ex*: Na^{+}, Mg^{2+}, S^{2-}

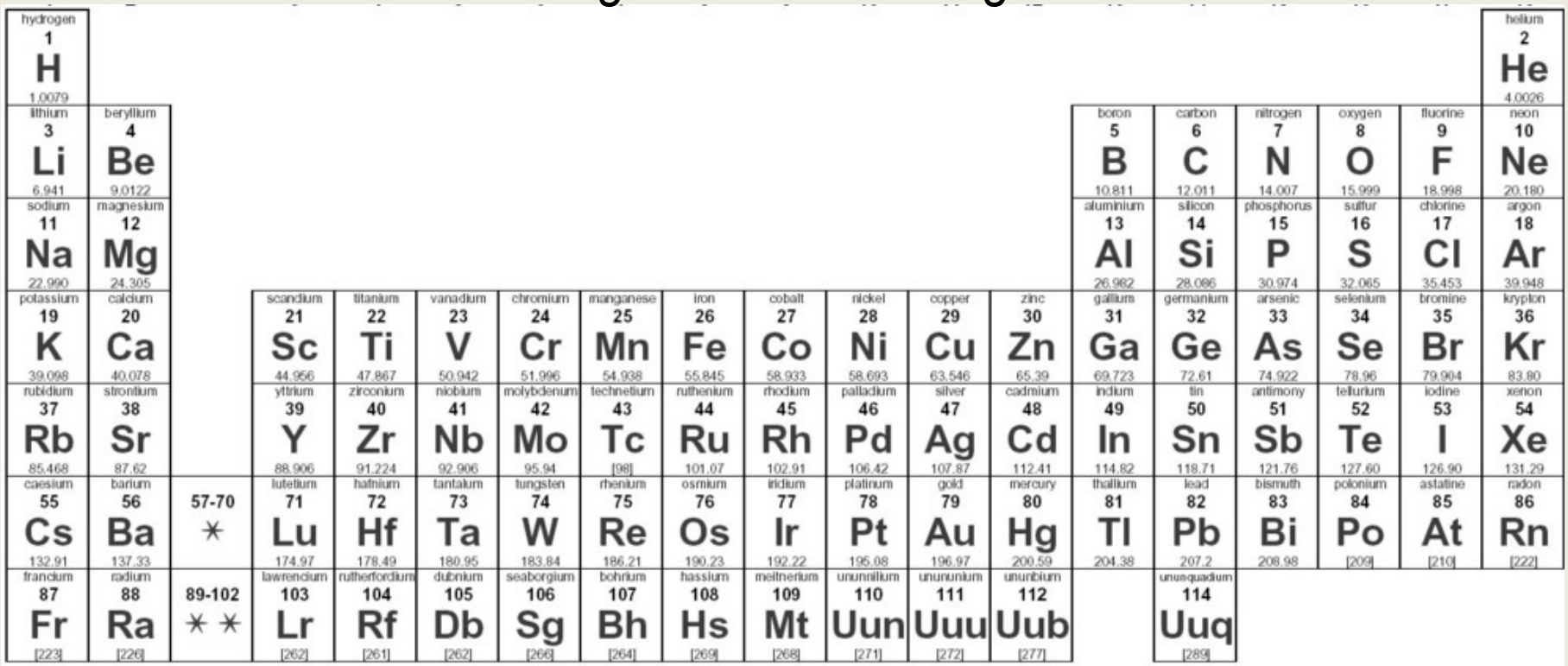
Naming monatomic ions:

- Cations (+):
  - Name of element + cation
  - *Ex*: K^{+} Potassium cation
    Mg^{2+} Magnesium cation
    Al^{3+} Aluminum cation

- Anions (-):
  - Base of element + -ide
  - *Ex*: F^{-} Fluoride
    N^{3-} Nitride
    Br^{-} Bromide

PREDICTING IONIC CHARGES

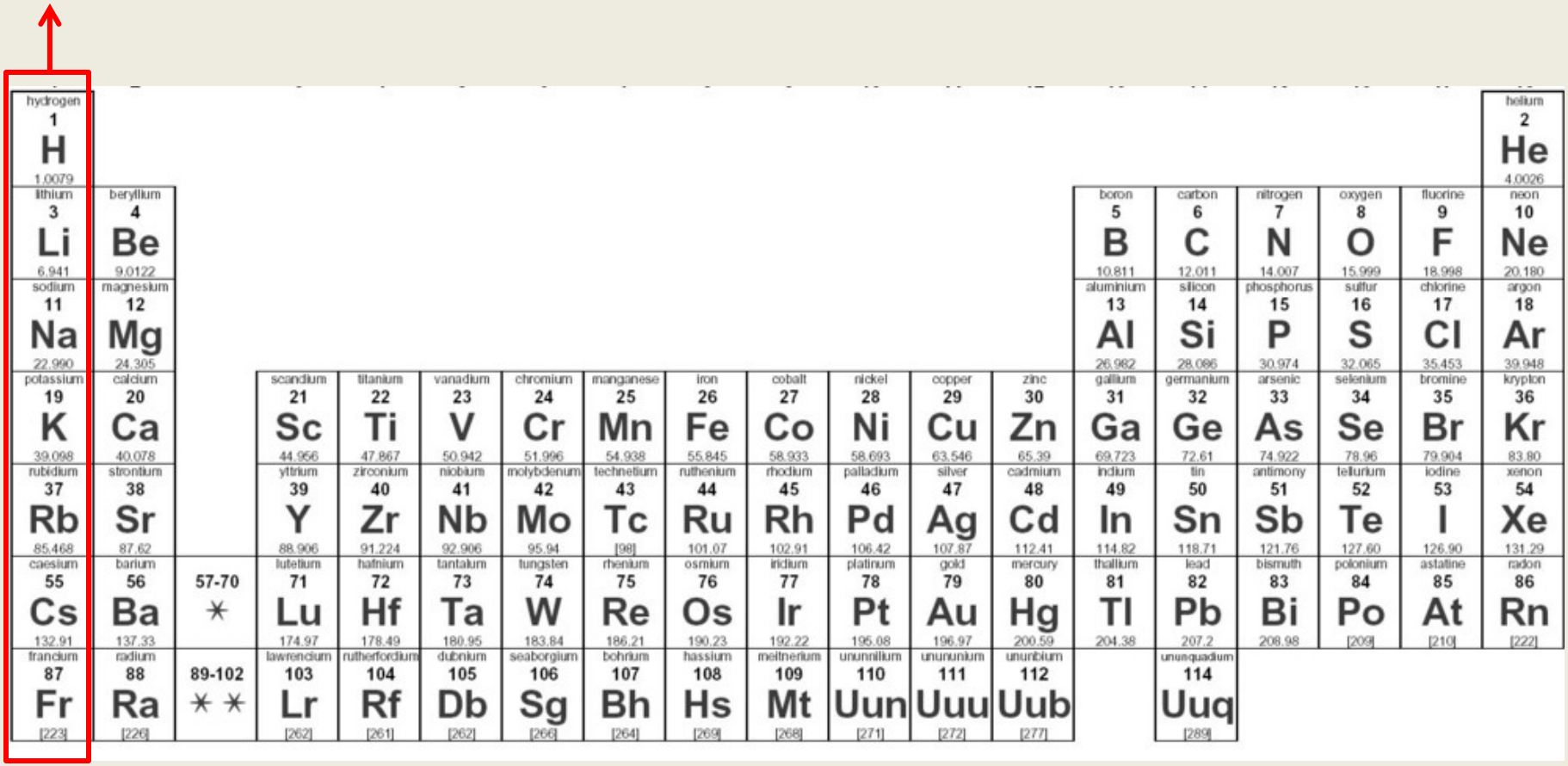
Oxidation numbers: the ions charges that atoms gain when they lose or gain their valence electrons; are the number of electrons they can lose or gain when bonding



PREDICTING IONIC CHARGES

Group 1

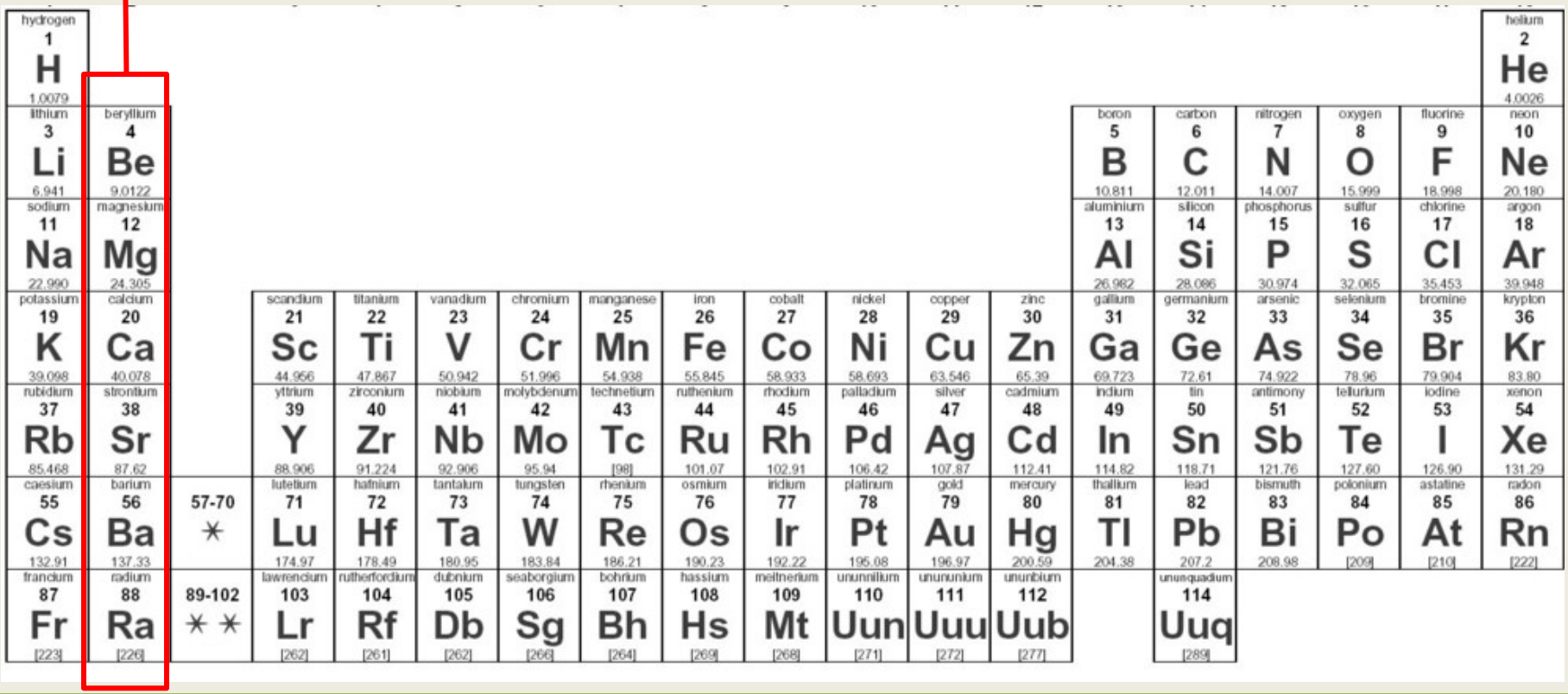
Lose 1 electron to form 1+



PREDICTING IONIC CHARGES

Group 2

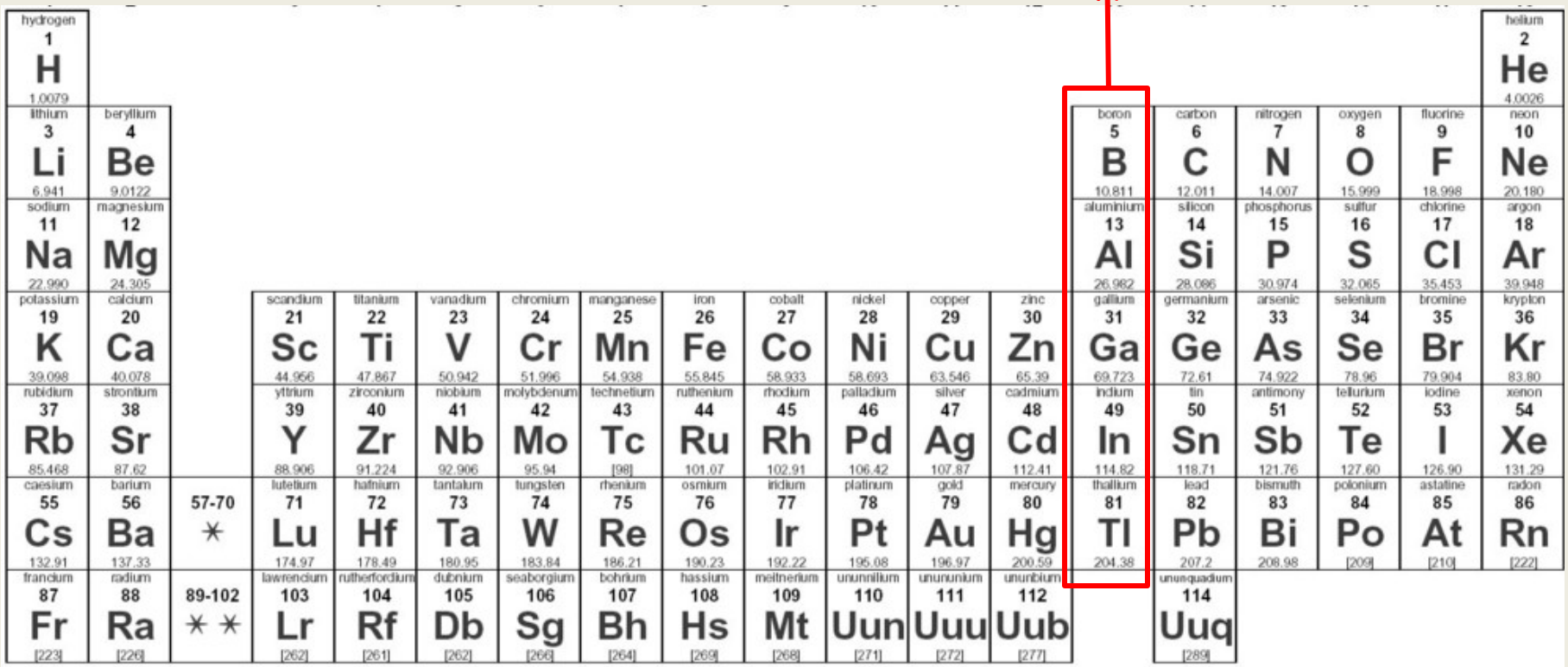
Lose 2 electrons to form 2+



PREDICTING IONIC CHARGES

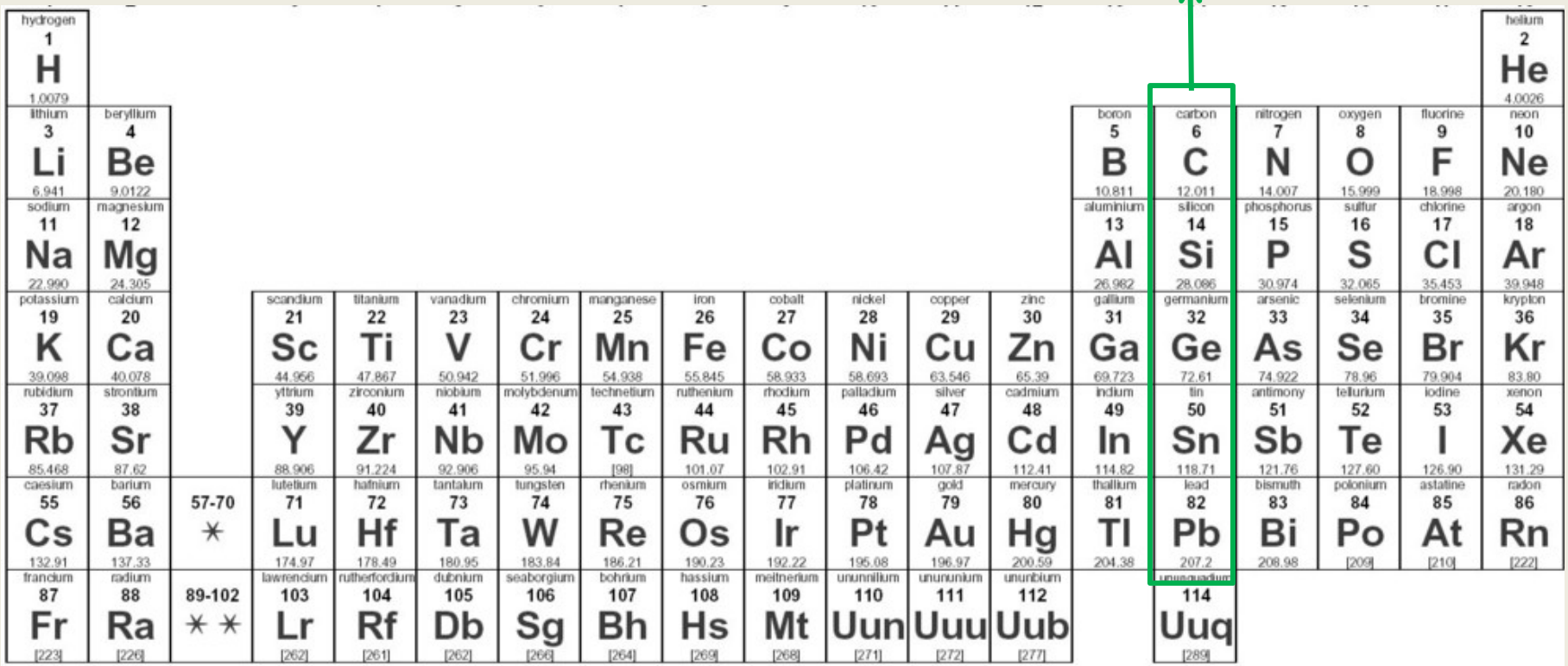
Group 13

Lose 3 electrons to form 3+



PREDICTING IONIC CHARGES

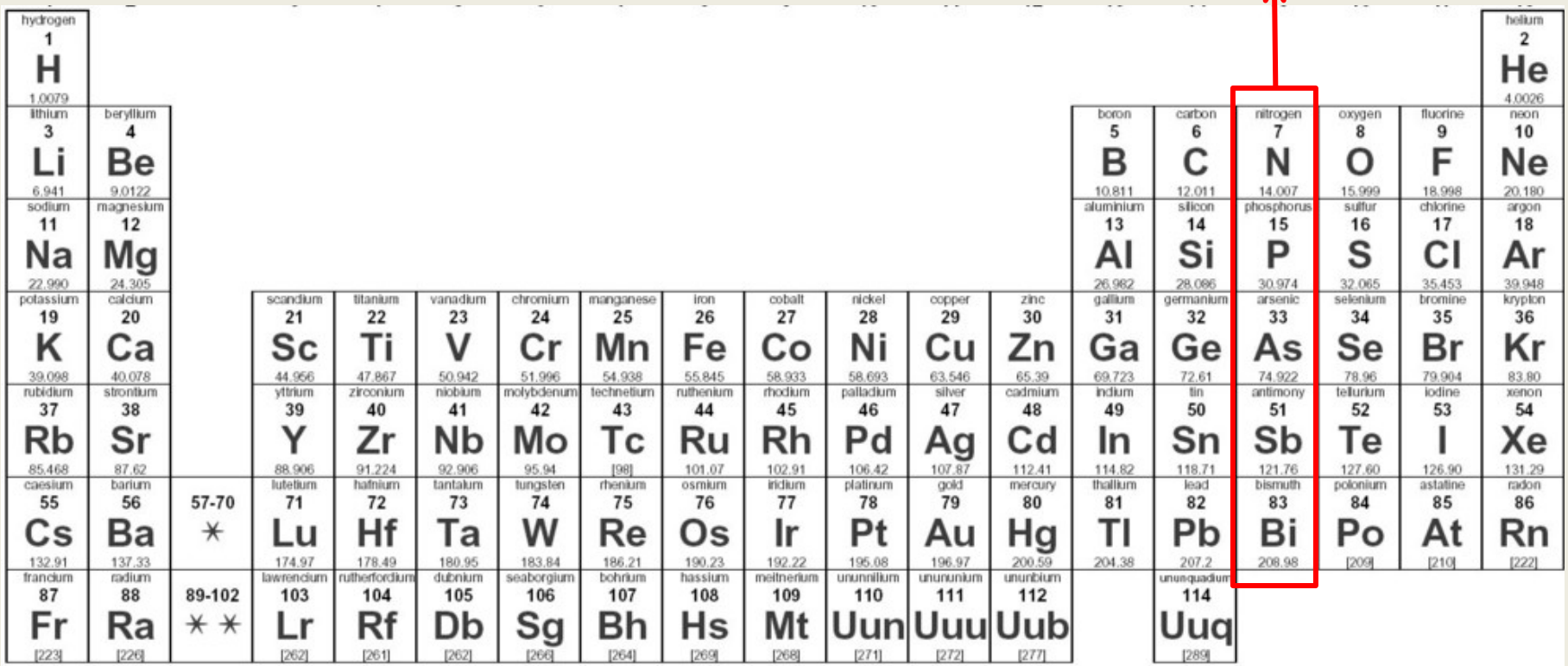
Group 14 rarely forms ions :/



PREDICTING IONIC CHARGES

Group 15

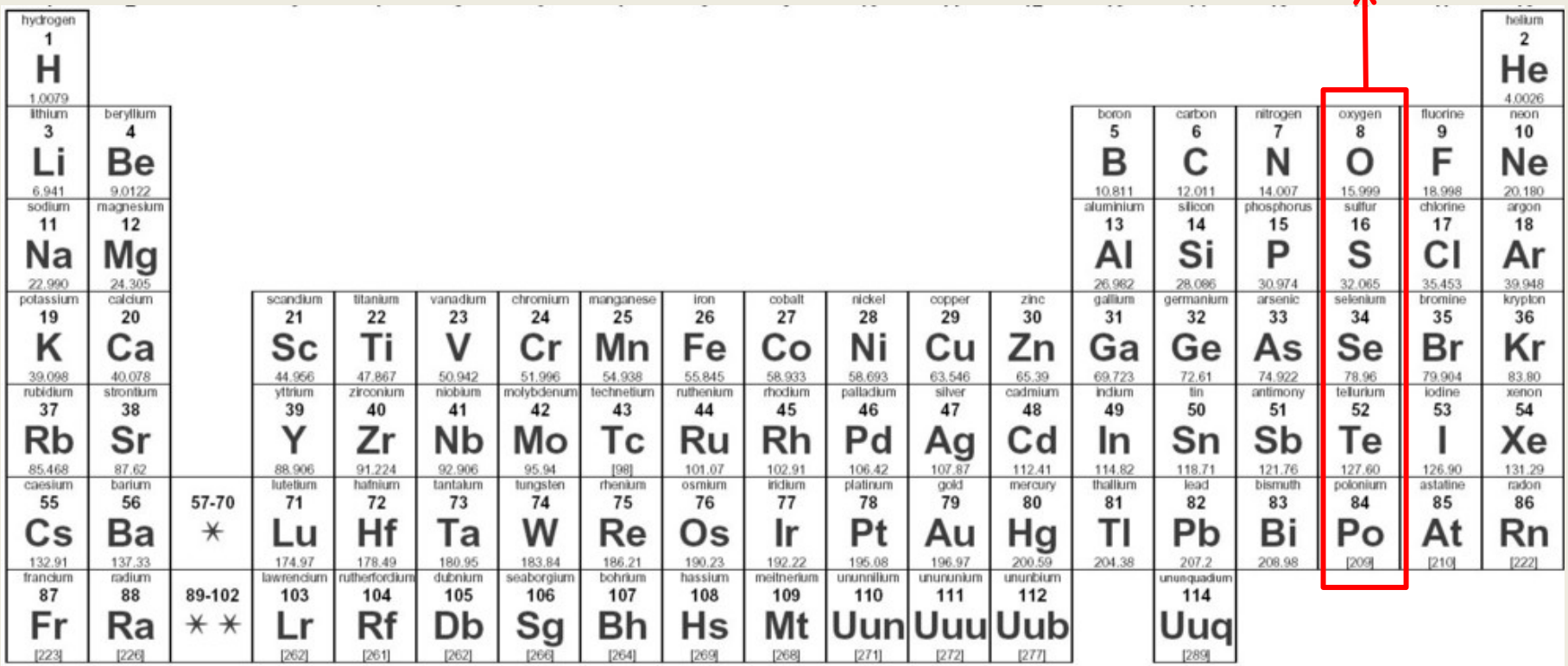
Gain 3 electrons to form 3-



PREDICTING IONIC CHARGES

Group 16

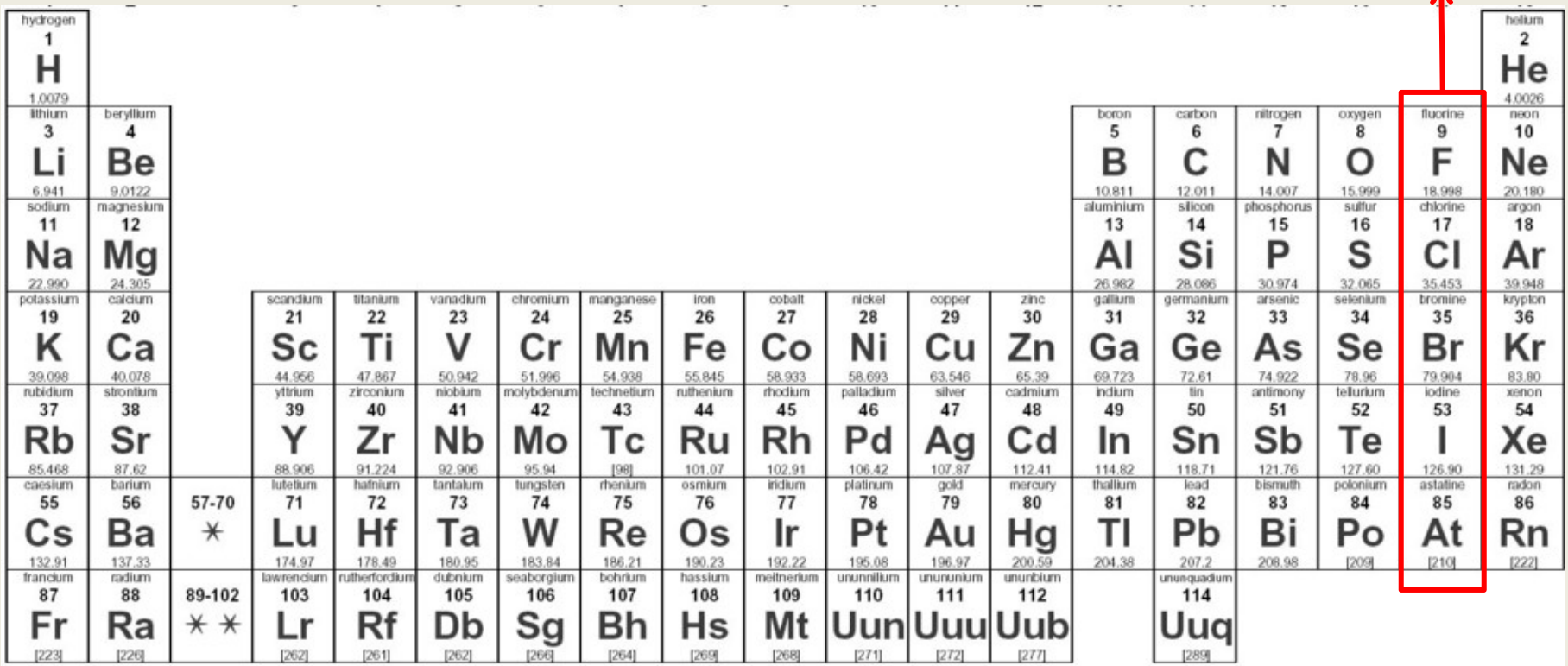
Gain 2 electrons to form 2-



PREDICTING IONIC CHARGES

Group 17

Gain 1 electrons to form 1-



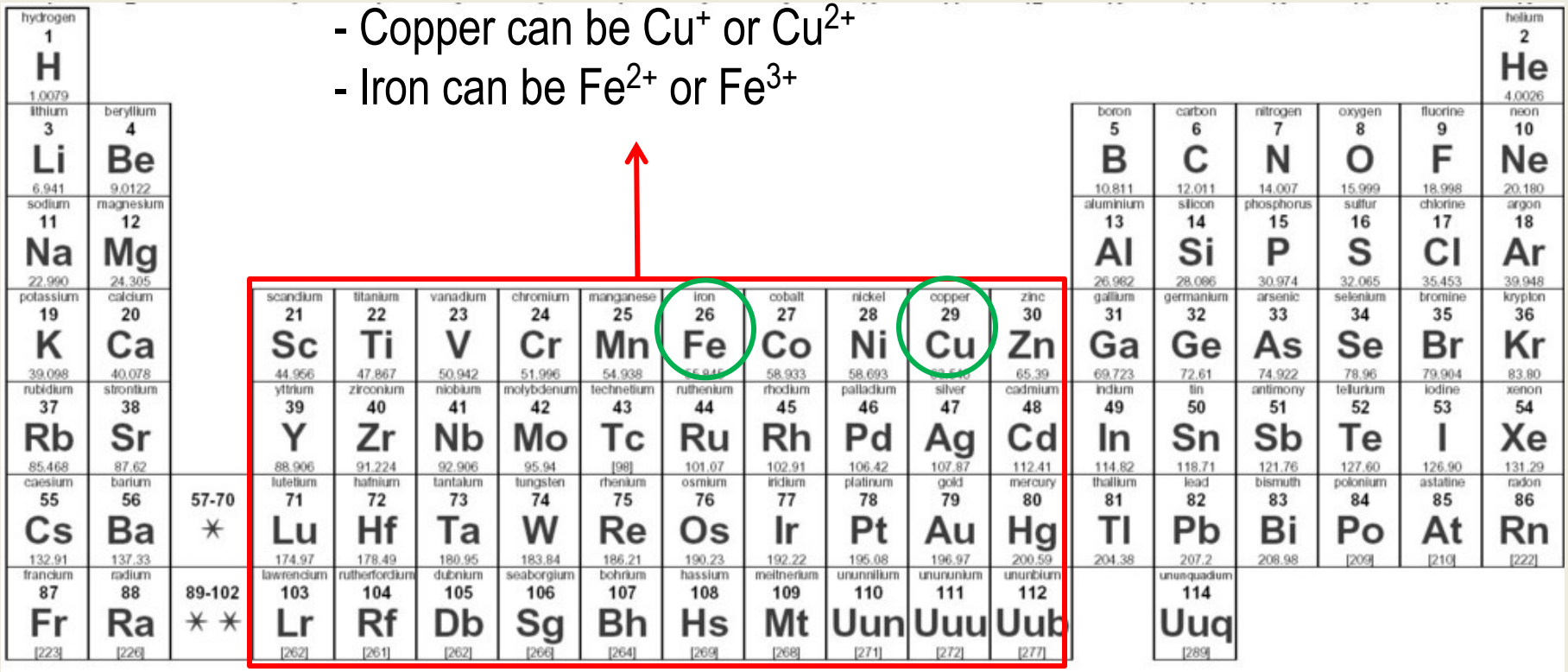
PREDICTING IONIC CHARGES

Groups 3-12 (Transition Metals)

d-block elements form variable charges

Ex:

- Copper can be Cu^{+} or Cu^{2+}
- Iron can be Fe^{2+} or Fe^{3+}



BINARY IONIC COMPOUNDS

- Binary compounds: compounds composed of two different elements

- For ionic compounds…
  - The total # of positive charges and negative charges must be equal

WRITING IONIC COMPOUND FORMULAS

Rules for writing formulas for ionic compounds:

① Write the symbols & charges for the ions (cations first)

② Cross over the charges as subscripts

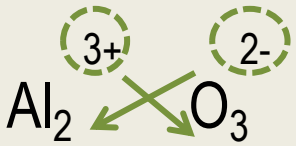
③ Check to make sure the charges are equal

Ex: Aluminum Oxide

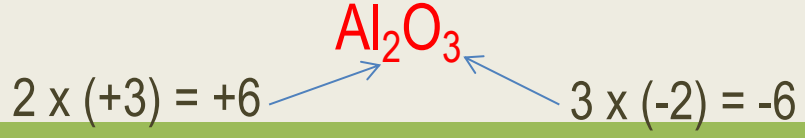
1. Write the symbols for the ions (cations first)

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

2. Cross over the charges as subscripts



3. Check to make sure the charges are equal



YOU TRY!

- **Write the formulas for the binary ionic compounds formed between the following elements:**
  - Potassium and iodine
    - KI
  - Magnesium and chlorine
    - $MgCl_2$
  - Sodium and sulfur
    - Na_2S

NAMING BINARY IONIC COMPOUNDS

- Involves combining the names of cations and anions
- Rules for naming ionic compounds:
  1. Name the cation first: full name of cation
  2. Name anion last: base of anion + -ide

  - *Ex*: Al_2O_3
    - Al = aluminum
    - O = oxygen → oxide
    - Aluminum oxide

YOU TRY!

- Name the binary ionic compounds indicated by the following formulas:
  - AgCl
    - Silver chloride
  - ZnO
    - Zinc oxide
  - $CaBr_2$
    - Calcium bromide

- Some elements (transition metals) form two or more cations with different charges
- Use the Stock System of nomenclature for compounds with transitional metals
  - Roman numerals represents charges in parentheses

    Fe^{2+} Fe^{3+}

    Iron(II) Iron(III)

- *Ex*: $CuCl_2$ *Hint: undo the crisscross to determine cation charge!*

  Copper(II) chloride

YOU TRY!

- Give the names for the following ionic compounds:
  - $CuBr_2$
    - Copper(II) bromide
  - $PbCl_2$
    - Lead(II) chloride
  - Fe_2O_3
    - Iron(III) oxide

COMPOUNDS CONTAINING POLYATOMIC IONS

- Polyatomic ions are mostly anions (except NH_4^+)
  - Most are oxyanions
    - Oxyanion: polyatomic ions that contain oxygen
  - Most common anions have –ate endings
    (Ex: ClO_3^- chlorate)

- Treat polyatomic ions as one unit!
  - Use parentheses if more than one polyatomic ion is present
    - *Ex*: $Al_2(SO_4)_3$
- Rules for naming compounds with polyatomic ions:
  - Same as naming for regular ionic compounds except:
    - Name polyatomic ion as one unit
      - *Ex*: $AgNO_3$ = silver nitrate

YOU TRY!

- Name the following binary compounds:
  - Na_2CO_3
    - Sodium carbonate
  - Ag_3PO_4
    - Silver phosphate
  - $Fe(NO_3)_3$
    - Iron(III) nitrate

- Sample for writing formulas for compounds with polyatomic ions:
  - Ex: Aluminum hydroxide

    $Al^{3+} + (OH)^-$ *Use crisscross method!*

    $Al(OH)_3$

You Try!

- Give the formula for the following ionic compounds:
  - Barium hydroxide
    - $Ba(OH)_2$
  - Copper(II) nitrate
    - $Cu(NO_3)_2$

BINARY MOLECULAR COMPOUNDS

- Prefixes used to note how many atoms in a compound

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

- Rules for naming molecular compounds:
  1. Less-electronegative element is given first
  2. First element only gets a prefix if it has more than one
  3. Second element is named by combining…
     - A prefix indicating the number of atoms
     - The root name of the second element
     - The ending -ide
  4. The o or a at the end of a prefix is usually dropped when the word following the prefix begins with another vowel

The Molecular Compounds of Nitrogen and Oxygen	
Formula	**Prefix-System Name**
N_2O	Dinitrogen monoxide
NO	Nitrogen monoxide
NO_2	Nitrogen dioxide
N_2O_3	Dinitrogen trioxide
N_2O_4	Dinitrogen tetroxide
N_2O_5	Dinitrogen pentoxide

YOU TRY!

Name the following molecular compounds:

- SO_3
  - Sulfur trioxide
- ICl_3
  - Iodine trichloride
- PBr_5
  - Phosphorus pentabromide

Write the formulas for the following molecular compounds

- Carbon tetraiodide
  - CI_4
- Phosphorus trichloride
  - PCl_3
- Oxygen difluoride
  - OF_2