Chapter 19: Molecules and Compounds

Section 19.2

Chemical Formulas

Chemical Formula:

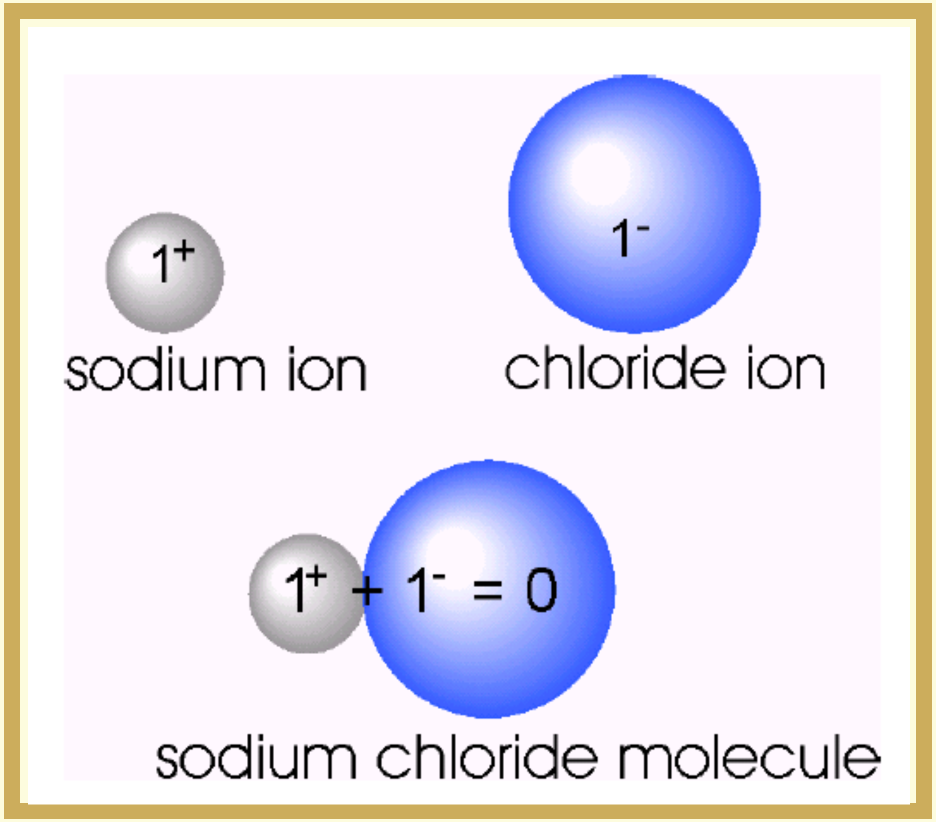
- Ratio of atoms bonded together in a compound, i.e. X:Y
- General Form: A_xB_y where x and y are called *subscripts.*

Recall NaCl (sodium chloride)…

- Formula shows that atoms combine in a 1:1 ratio.
  - Na_1Cl_1 = 1:1
- Why in that ratio?

To be stable…

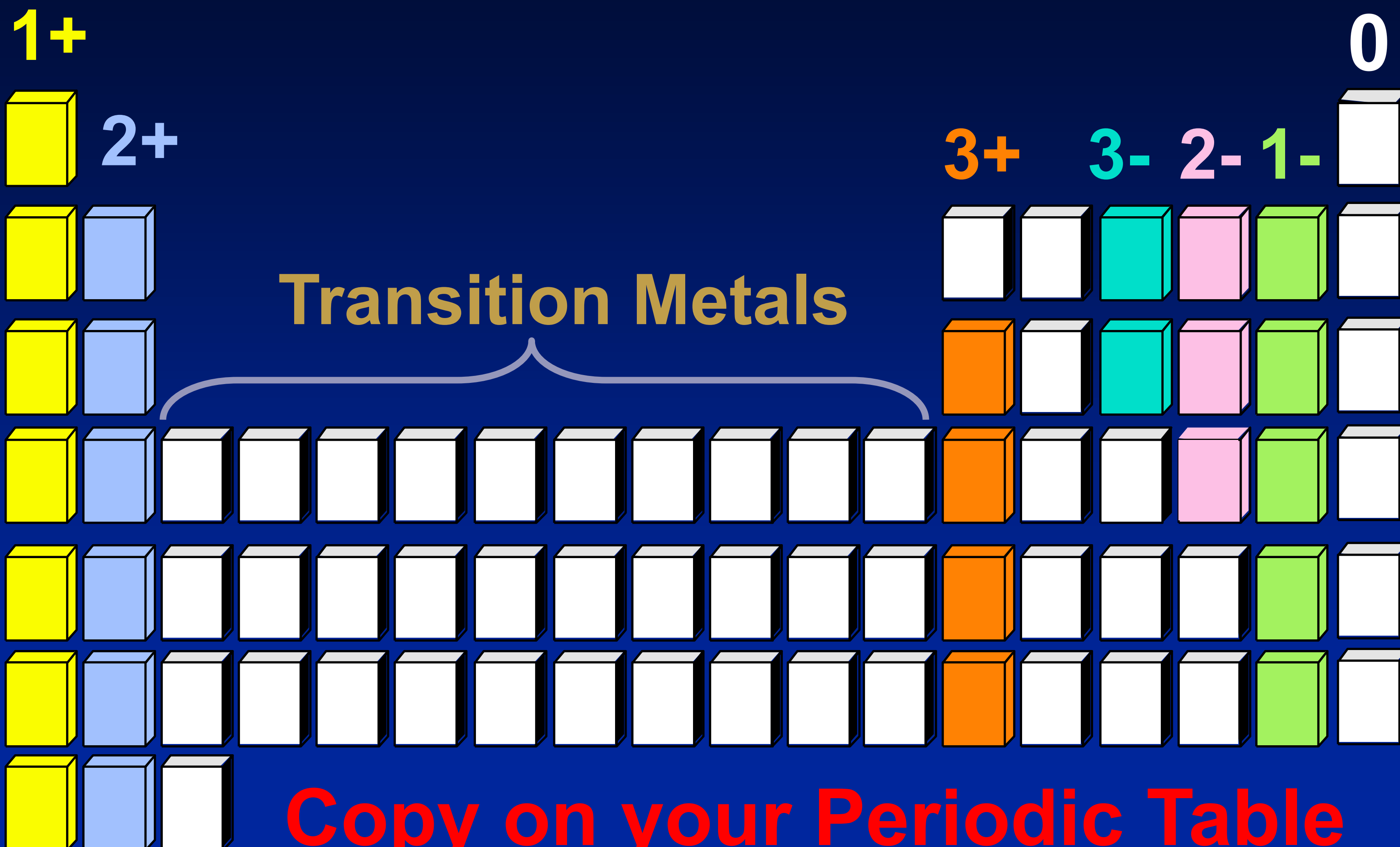
- the net electrical charge of compounds must be zero.



Oxidation Number:

- Indicates how many valence e^- are lost, gained, or shared when bonding.
- (+) or (–) symbol is written *after* the number, i.e. 1+ or 2-

Common Oxidation Numbers



Copy on your Periodic Table

Transition metals have more than one oxidation #. Roman numerals show oxidation #.

element	oxidation number
copper (I)	Cu^{+}
copper (II)	Cu^{2+}
iron (II)	Fe^{2+}
iron (III)	Fe^{3+}
chromium (II)	Cr^{2+}
chromium (III)	Cr^{3+}
lead (II)	Pb^{2+}
lead (IV)	Pb^{4+}

Writing Chemical Formulas – monatomic ions

1. Symbol of (+) ion always written 1st.
2. Symbol of (–) ion always written 2nd.
3. Add subscripts so sum of oxidation #' s is zero.

Example:

- Write formula for binary (2 element) compound made of iron(III) and oxygen.

1. Find oxidation #' s of elements:

iron(III) = Fe^{3+}

oxygen = O^{2-}

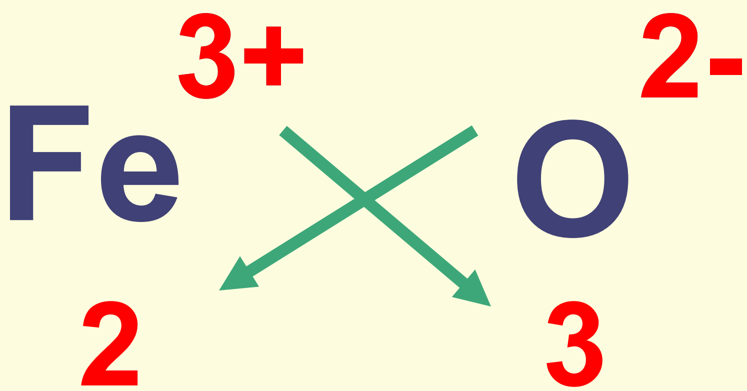
How do you make a cmpd electrically neutral?

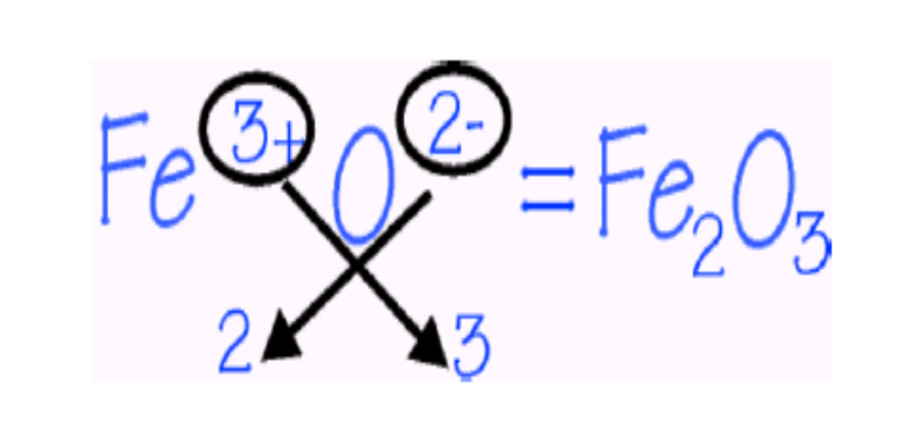
Calculate Fe^{3+} ions needed to combine with O^{2-} ions to make electrical charges equal zero.

2 (Fe^{3+}) added to 3 (O^{2-}) = 0

2 (3+) added to 3 (2-) = 0

2. To determine ratios to write chemical formulas…Use the <u>Criss-cross</u> <u>Method</u>





Writing Chemical Formulas with polyatomic ions

- "poly" means *many.*
- See page 329: Oxidation #'s for polyatomic ions.
- Each polyatomic ion is treated like a single ion.

Rules for writing formulas for cmpds with polyatomic ions:

- Symbol or formula & oxidation # of (+) ion 1st.

Use PT or Table 19.2, pg 329.

- Symbol or formula & oxidation # of (-) ion 2nd.

Again, use PT or Table 19.2.

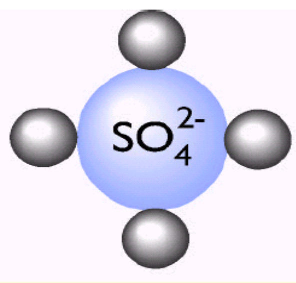
- Add oxidation #'s of (+) and (-) ions.
- = 0? If yes, then write formula: (+)ion 1st/(-) ion 2nd.
- ≠ 0? How many of each ion are needed so oxidation #'s = 0? HINT: Find LCM

Least Common Multiple

Example: Write formula for aluminum sulfate.

- 1^{st} ion is always (+). Use PT to find oxidation #.
  - Aluminum = Al^{3+}

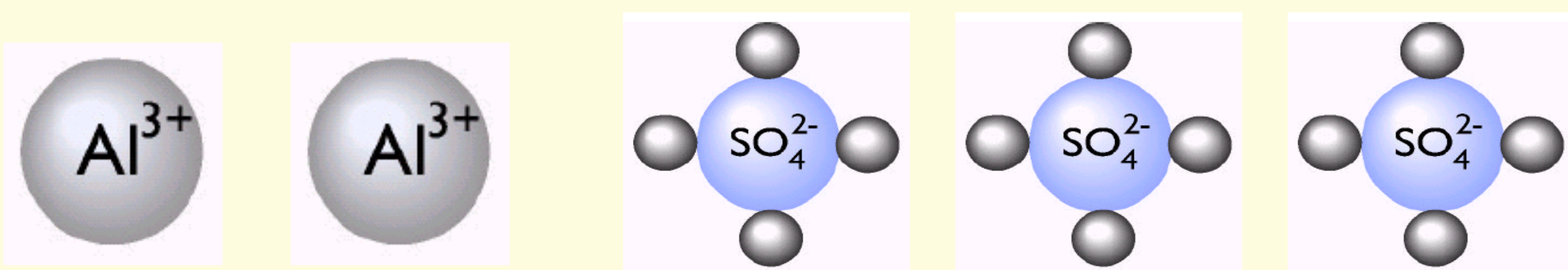
- 2^{nd} ion is always (-). Use Table 19.2.
  - Sulfate = SO_4^{2-}



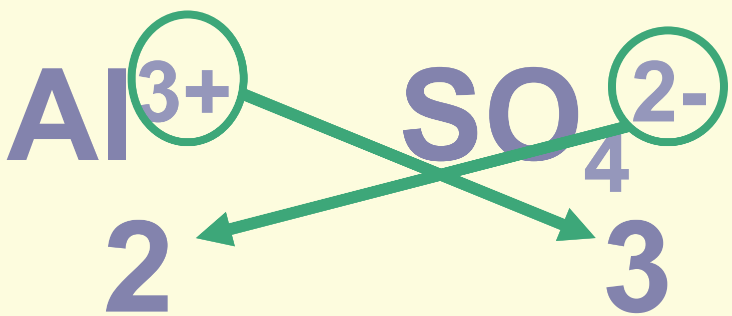
- LCM of 2 and 3? **6**
- How many of each ion are needed?

- $(Al^{3+}) \times 2 = 6+$
- $(SO_4^{2-}) \times 3 = 6-$

$\}$ 0



- Write chemical formula
  - $Al_2(SO_4)_3$
  - Don't change subscripts in polyatomic ion!! Use ( )
- Criss-cross method



Naming binary ionic compounds

- Write name of 1st element or polyatomic ion.
- Write root name of 2nd element and add -ide.
  - Exs: *chlor*-ine = *chlor*-ide

phosph-orus = *phosph*-ide

Naming ionic cmpds with polyatomic ions

- **Write name of (+) ion 1st.**
  Use PT or Table 19.2
- **Write name of (-) ion 2nd.**
  Use PT or Table 19.2

Naming binary covalent compounds

- Specify number of each element by using prefixes (Figure 19.25, pg 332).
- If only one atom of 1st element, don’t use mono-

Examples:

- CO carbon monoxide
- CO_2 carbon dioxide
- PCl_5 phosphorus pentachloride
- N_2S_6 dinitrogen hexasulfide

Empirical vs Molecular formulas

- Empirical formula – simplest whole number ratio of elements in cmpd.
- Molecular formula – actual # of atoms of each element in a compound.

Example:

- Molecular formula -sugar

$C_6H_{12}O_6$

- Empirical formula -sugar

CH_2O