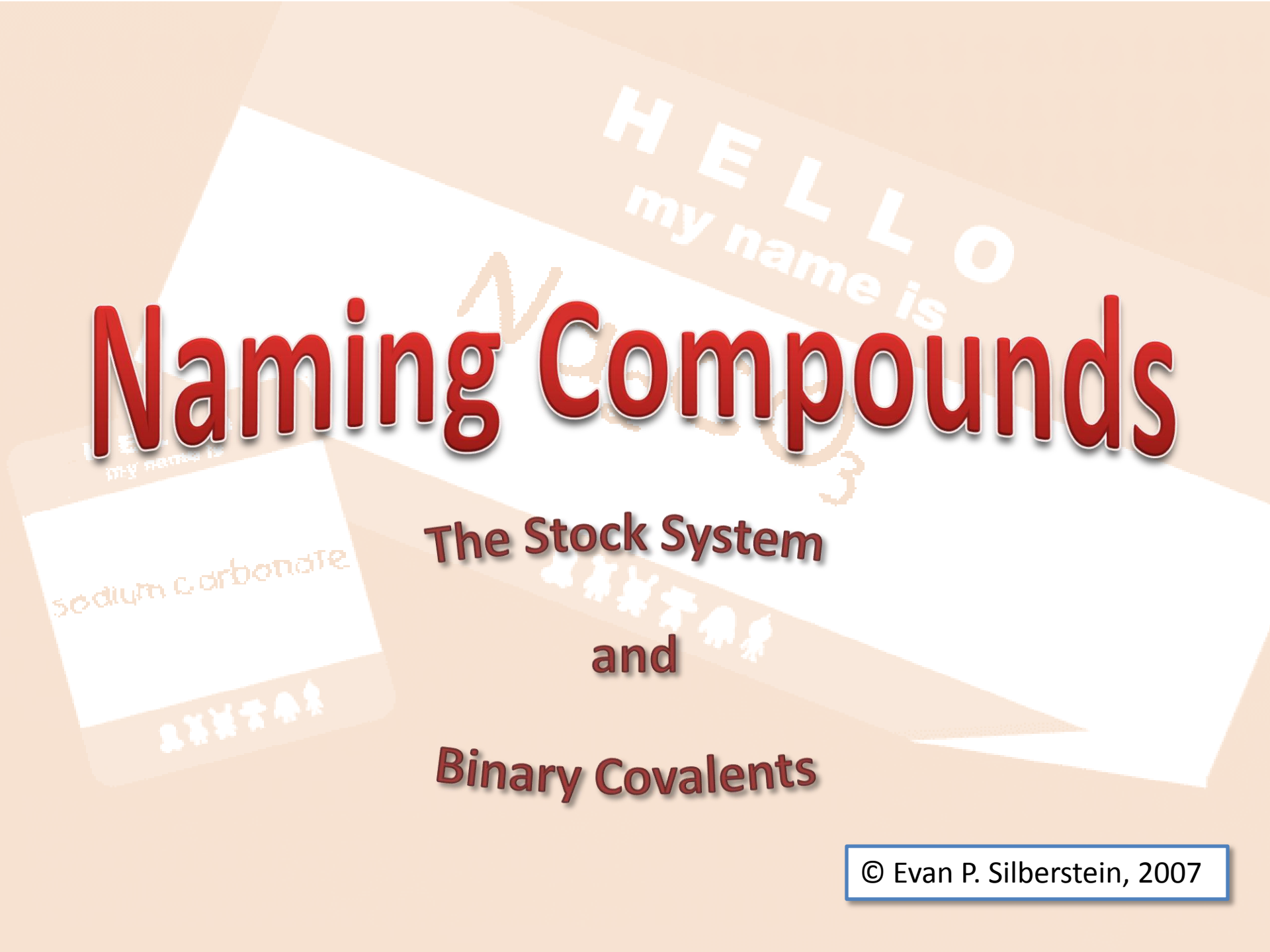
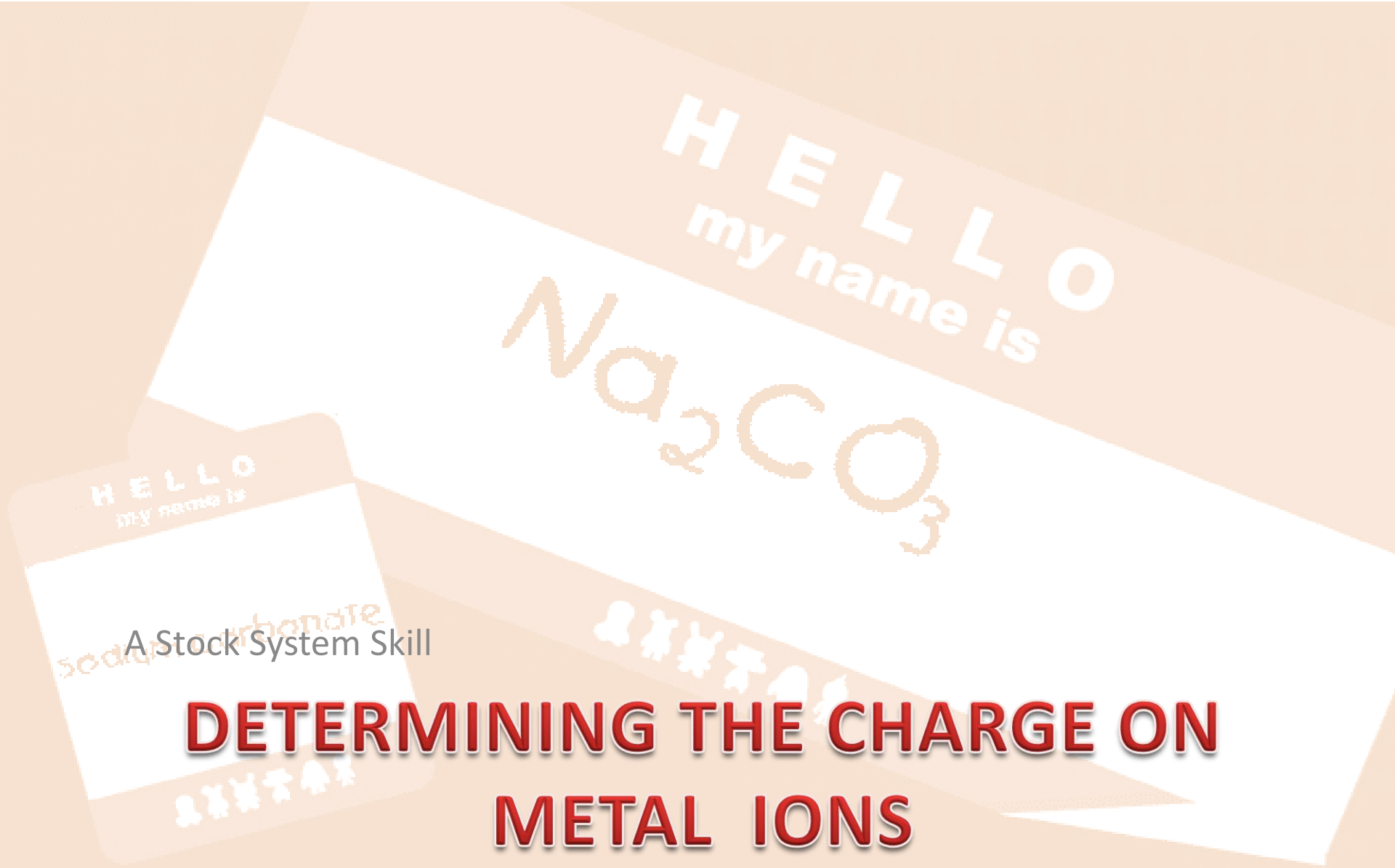


Naming Compounds

The Stock System

and

Binary Covalents

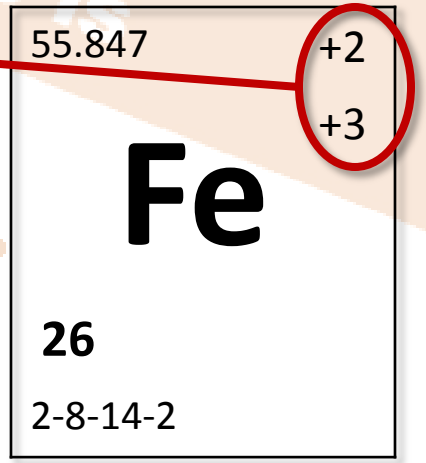


A Stock System Skill

DETERMINING THE CHARGE ON METAL IONS

Polyvalent Metals

- Some metals, such as iron, have more than one positive oxidation state.
- They are called polyvalent metals.
- Polyvalent metals form more than one compound from the same elements.
  - $Fe^{+2} + Cl^{-} \rightarrow$? **$FeCl_2$**
  - $Fe^{+3} + Cl^{-} \rightarrow$? **$FeCl_3$**



The Polyvalent Problem

- $FeCl_2$ and $FeCl_3$ are different substances. They can't have the same name.
- What makes them different?

  The oxidation state of the iron.
- Since polyvalent metals form different compounds based on their oxidation states, it is necessary to know their oxidation states in order to name them.

Sample Problem

Find the oxidation state of iron in $Fe_2(S_2O_3)_3$

Ion	Fe	S_2O_3	
Subscript	2	3	
Oxidation State	+3	−2	*TOTAL*
Total	+6	−6	= 0

STEP 1

STEP 2

STEP 5

STEP 4

STEP 3

Prepare a table as above

- **Step 1:** List the subscripts for the metal and the nonmetal ions.
- **Step 2:** Look up the oxidation state of the nonmetal ion on the *Periodic Table.*
- **Step 3:** Multiply the oxidation state of the nonmetal by its subscript to get the total charge.
- **Step 4:** Determine the total charge of the metal ions by calculating the number which, when added to the total charge of the nonmetal ion, gives the compound a total charge of zero.
- **Step 5:** Divide the total charge of the metal ions by the subscript of the metal to get the oxidation state.

Naming Compounds of Metals and Nonmetals

THE STOCK SYSTEM

Naming with the Stock System

Naming metal ions

- The metal always comes first in the name and the formula.
- Monatomic metal ions
  - univalent (only one oxidation state): the ion is named the same as the element.
    - ✓ Na = sodium; Na^{+} = sodium
    - ✓ Ba = barium; Ba^{+2} = barium
  - polyvalent (multiple oxidation states): a roman numeral indicates the oxidation state.
    - ✓ Fe^{+2} = iron II; Fe^{+3} = iron III
    - ✓ Cu^{+1} = copper I; Cu^{+2} = copper II
    - ✓ Sn^{+2} = tin II; Sn^{+4} = tin IV
- Polyatomic metal ions: Look on *Table E* – NH_4^{+} = ammonium

Naming nonmetal ions

- The nonmetal always comes last in the name and in the formula.
- Monatomic nonmetal ions - delete the last part of the element's name and add "IDE."
  - S = sulfur; S^{-2} = sulfIDE
  - O = oxygen; O^{-2} = oxIDE
  - I = iodine; I^{-1} = iodIDE
- Polyatomic nonmetal ions: Look on *Table E*.
  - SO_4^{-2} = sulfate
  - OH^{-} = hydroxide

Sample Stock System Naming

What is the name of SnS_2

- Sn is monatomic.
  - It has more than one oxidation state.
  - Find the oxidation state.
- Sn is *tin*.
- The nonmetal is sulfur
  - It is monotomic
  - Remove the ending and add IDE

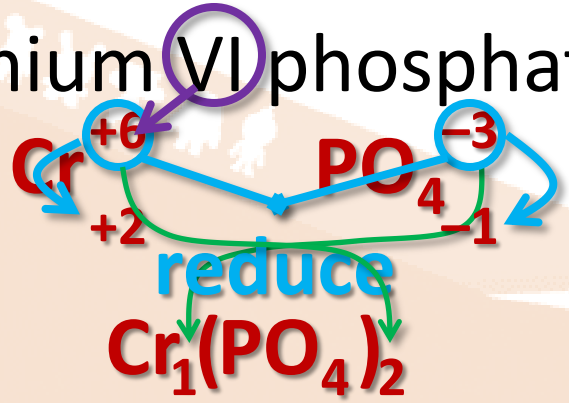
- Make a table.

Ion	Sn	S	
Subscript	1	2	
Oxidation State	+4	−2	*TOTAL*
Total	+4	−4	= 0

- Sn^{+4} is *tin IV*.
- S^{-2} is *sulfide*.
- The name of the compound is *tin IV sulfide*

From Names to Formulas

- In order to write the formula from the name, you need to:
  - Identify the ions and their symbols;
  - Determine the ions' oxidation states; and
  - Apply the crossover rule.
- **Example**: chromium VI phosphate
  - Symbols and oxidation states
  - Crossover:



When Nonmetals Combine

BINARY COVALENT COMPOUNDS

Nonmetals meet Nonmetals

- Nonmetals are two-faced elements!
- Although they normally have negative oxidation states, nonmetals can behave like metals and have positive oxidation states.
- As a result, two nonmetals can combine to form compounds.

Identifying the Metal

- Binary compounds consist of two elements , usually a metal and a nonmetal.
- Binary compounds can also form between two nonmetals by covalent bonding. They are called ***Binary Covalent Compounds.***
  - Nonmetals in binary covalent compounds can behave like metals and have positive oxidation states.
  - In compounds between two nonmetals, the element with the lower electronegativity acts as the metal.

Naming Binary Covalent Compounds

- The metal is written first in the name and the formula.
  - The name of the metal is the same as the name of the element (S = sulfur, S+4 = sulfur)
  - If there is more than one atom of the metal, the number of atoms is indicated with a prefix.
- The nonmetal is written last in the name and formula.
  - The name of the nonmetal is the same as the name of the element minus the final syllable or two, plus IDE (O = oxygen, O^{-2} = oxide).
  - The number of nonmetal atoms is indicated with a prefix (even when there is only one).

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

Examples

- CO_2 - **carbon dioxide**
- N_2O_5 - **dinitrogen pentoxide**

  (*NOTE:* the "a" in penta is dropped to avoid putting two vowels together)
- SO_3 - **sulfur trioxide**
- $SiCl_4$ - **silicon tetrachloride**

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