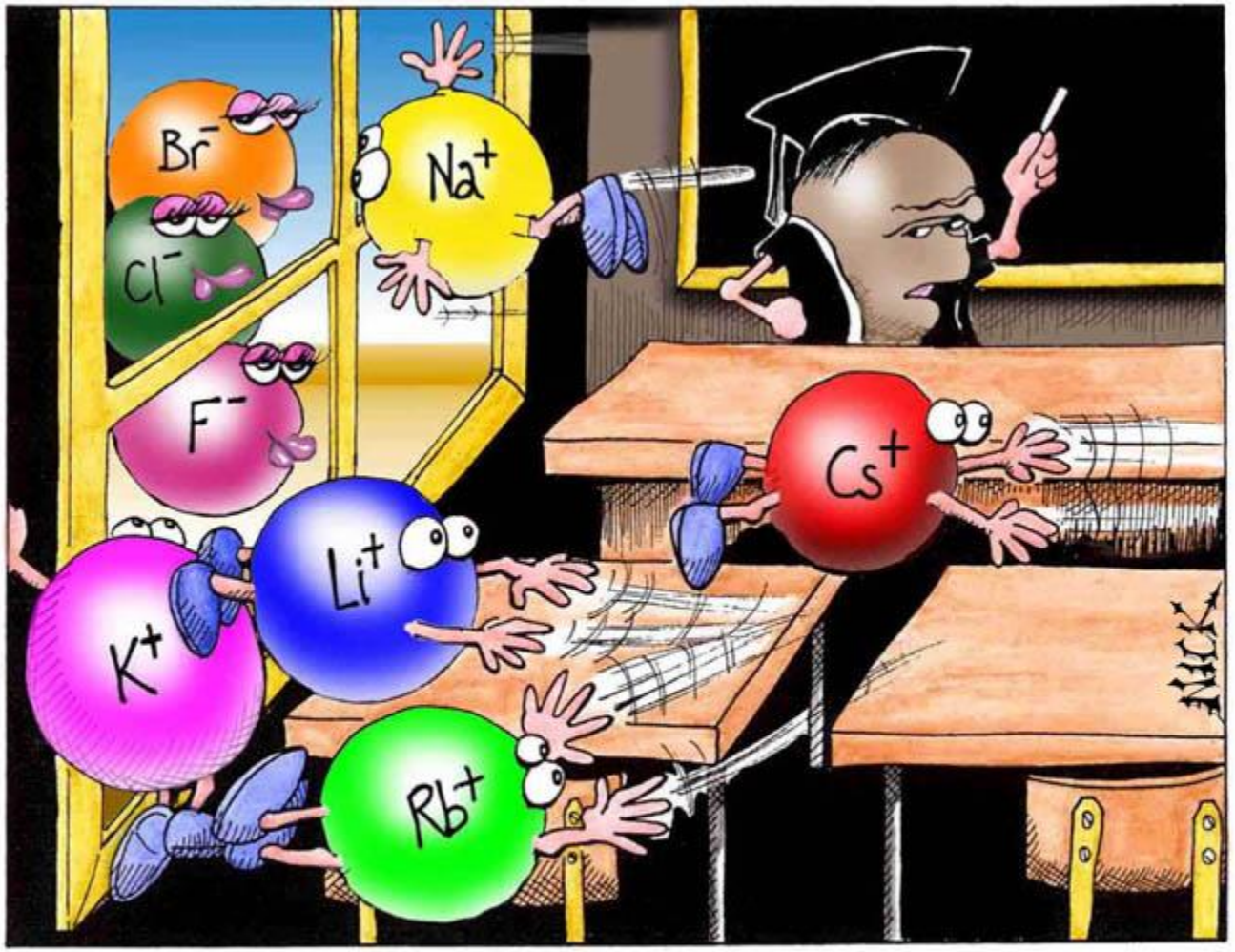
Names & Formulas of Ionic Compounds



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"Perhaps one of you gentlemen would mind telling me just what it is outside the window that you find so attractive..?"

Monatomic ion:

- **single atom** with a positive or negative **charge**.

Table 9.1

Ionic Charges of Representative Elements

1A	2A	3A	4A	5A	6A	7A	8A
Li^+	Be^{2+}			N^{3-}	O^{2-}	F^-	
Na^+	Mg^{2+}	Al^{3+}		P^{3-}	S^{2-}	Cl^-	
K^+	Ca^{2+}			As^{3-}	Se^{2-}	Br^-	
Rb^+	Sr^{2+}					I^-	
Cs^+	Ba^{2+}						

end in -ide

Metals with More than One Ionic Charge

- Some transition metals form more than one cation with different charges

  ex – Iron can form two different cations:

  Fe^{2+} - Iron(II)

  Fe^{3+} - Iron (III)

Caution: **Silver** is always **Ag^{+}**

Zinc is always **Zn^{2+}**

Metals with More than One Ionic Charge

- Group 14 metals also form multiple cations

  Tin can form two different cations:

  Sn^{2+} - tin(II)

  Sn^{4+} - tin(IV)

  Lead can form two different cations:

  Pb^{2+} - lead(II)

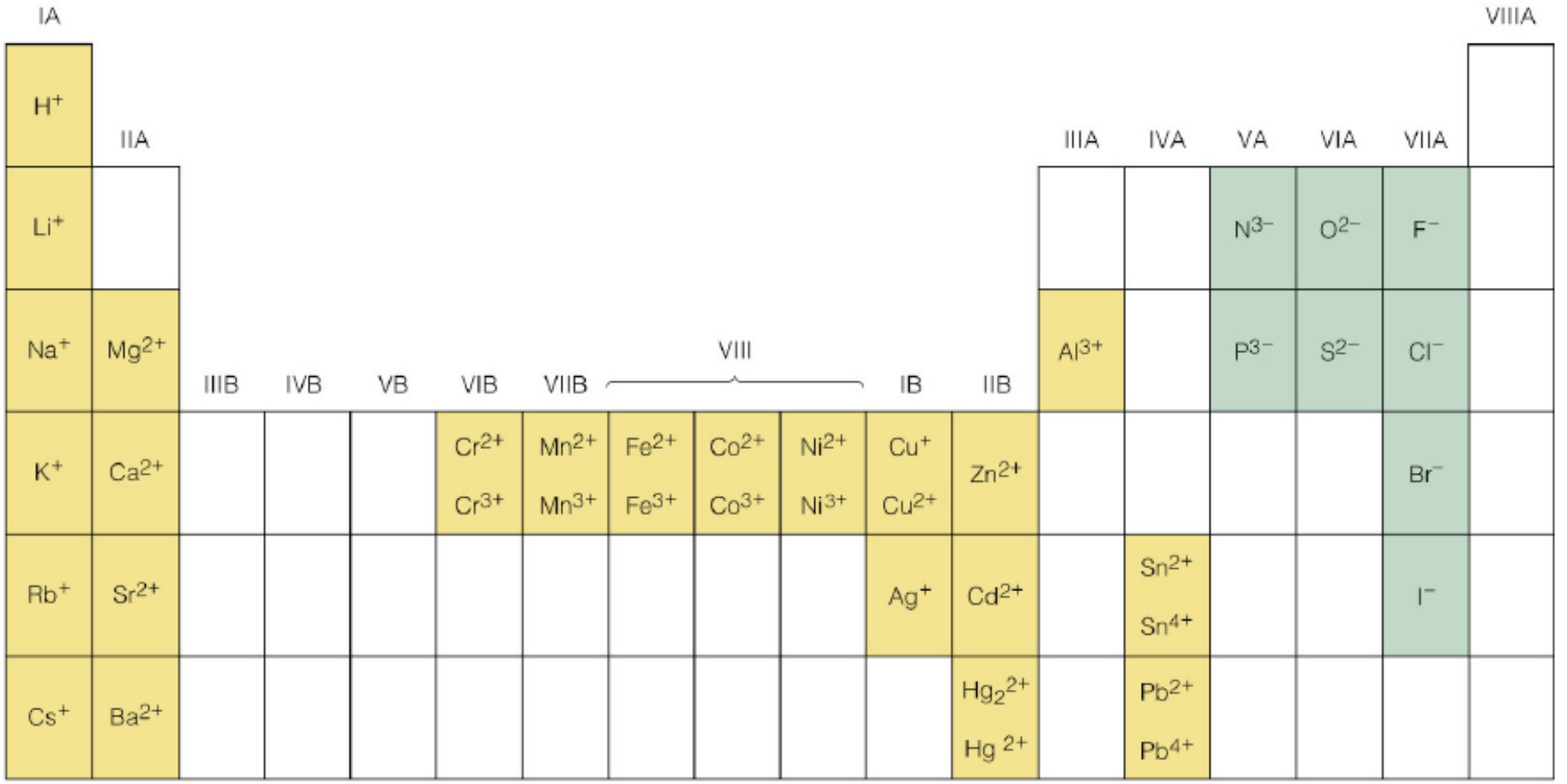
  Pb^{4+} - lead(IV)

Table 9.2

Symbols and Names of Common Metal Ions with More than One Ionic Charge

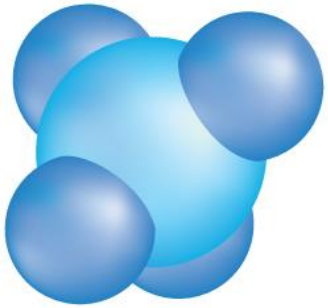
Symbol	Stock name	Classical name
Cu^{+}	Copper(I) ion	Cuprous ion
Cu^{2+}	Copper(II) ion	Cupric ion
Fe^{2+}	Iron(II) ion	Ferrous ion
Fe^{3+}	Iron(III) ion	Ferric ion
$^{*}Hg_2^{2+}$	Mercury(I) ion	Mercurous ion
Hg^{2+}	Mercury(II) ion	Mercuric ion
Pb^{2+}	Lead(II) ion	Plumbous ion
Pb^{4+}	Lead(IV) ion	Plumbic ion
Sn^{2+}	Tin(II) ion	Stannous ion
Sn^{4+}	Tin(IV) ion	Stannic ion
Cr^{2+}	Chromium(II) ion	Chromous ion
Cr^{3+}	Chromium(III) ion	Chromic ion
Mn^{2+}	Manganese(II) ion	Manganous ion
Mn^{3+}	Manganese(III) ion	Manganic ion
Co^{2+}	Cobalt(II) ion	Cobaltous ion
Co^{3+}	Cobalt(III) ion	Cobaltic ion

Ion charges

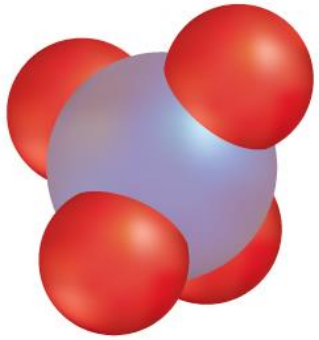

IA
IIA
IIIB
IVB
VB
VIB
VIIB
VIII
IB
IIB
IIIA
IVA
VA
VIA
VIIA
VIIIA
H+
Li+
Na+
Mg2+
K+
Ca2+
Cr2+
Cr3+
Mn2+
Mn3+
Fe2+
Fe3+
Co2+
Co3+
Ni2+
Ni3+
Cu+
Cu2+
Zn2+
Al3+
N3−
O2−
F−
P3−
S2−
Cl−
Br−
Rb+
Sr2+
Ag+
Cd2+
Sn2+
Sn4+
I−
Cs+
Ba2+
Hg2 2+
Hg 2+
Pb2+
Pb4+

Polyatomic Ions

- **Groups of atoms** with **positive** or **negative charge**



Ammonium ion (NH_4^+)



Phosphate ion (PO_4^{3-})

Names and Formulas of Common Polyatomic Ions

Name	Symbol	Charge
ammonium	NH_4^+	+1
nitrate	NO_3^-	-1
nitrite	NO_2^-	-1
acetate	$C_2H_3O_2^-$	-1
hydroxide	OH^-	-1
hydrogen carbonate (bicarbonate)	HCO_3^-	-1
carbonate	CO_3^{2-}	-2
sulfate	SO_4^{2-}	-2
sulfite	SO_3^{2-}	-2
phosphate	PO_4^{3-}	-3

Writing Ionic Compound Formulas

Example: Barium nitrate

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges, if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

$$Ba^{2+} \quad (NO_3^-)_2$$

4. Erase charges.

Not balanced!

Writing Ionic Compound Formulas

Example: Barium nitrate

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges , if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

$Ba(NO_3)_2$

4. Erase charges.

Writing Ionic Compound Formulas

Example: Ammonium sulfate

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges, if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

$$(NH_4^+)_2SO_4^{2-}$$

Not balanced!

4. Erase charges.

Writing Ionic Compound Formulas

Example: Ammonium sulfate

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges, if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

$$(NH_4)_2SO_4$$

4. Erase charges.

Writing Ionic Compound Formulas

Example: Iron(III) chloride

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges, if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

Fe^{3+} Cl^{-}_{3}

Not balanced!

4. Erase charges.

Writing Ionic Compound Formulas

Example: Iron(III) chloride

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges, if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

$$Fe Cl_3$$

4. Erase charges.

Writing Ionic Compound Formulas

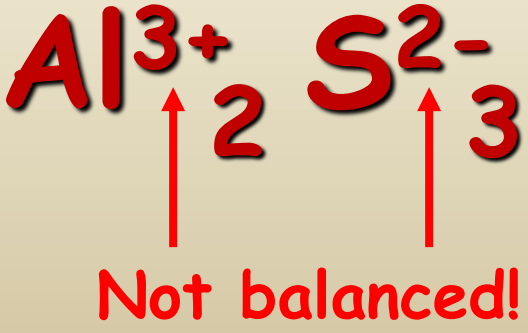
Example: Aluminum sulfide

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges, if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

4. Erase charges.



Writing Ionic Compound Formulas

Example: Aluminum sulfide

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges, if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

4. Erase charges. Al_2S_3

Writing Ionic Compound Formulas

Example: Magnesium carbonate

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Erase charges.

Mg^{2+} CO_3^{2-}

They are balanced!

Writing Ionic Compound Formulas

Example: Magnesium carbonate

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Erase charges.

$MgCO_3$

Writing Ionic Compound Formulas

Example: Zinc hydroxide

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges , if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

$$Zn^{2+}(OH^{-})_2$$

Not balanced!

4. Erase charges.

Writing Ionic Compound Formulas

Example: Zinc hydroxide

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Balance charges , if necessary, using subscripts. Use parentheses if you need more than one of a polyatomic ion.

$$Zn(OH)_2$$

4. Erase charges.

Writing Ionic Compound Formulas

Example: Aluminum phosphate

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

3. Erase charges.

Al^{3+} PO_4^{3-}

They ARE balanced!

Writing Ionic Compound Formulas

Example: Aluminum phosphate

1. Write the formulas for the cation and anion, including CHARGES!

2. Check to see if charges are balanced.

$AlPO_4$

3. Erase charges.

Naming Ionic Compounds

- Cation first, then anion
- Monatomic cation = name of the element
  - Ca^{2+} = calcium ion
- Monatomic anion = root + -ide
  - Cl^- = chlor<u>ide</u>
  - $CaCl_2$ = calcium chloride

Naming Ionic Compounds

- Cation first, then anion
- Polyatomic cation = name of the ion
  - NH_4^+ = ammonium
- Polyatomic anion = name of the ion
  - NO_3^- = nitrate
  - NH_4NO_3 = ammonium nitrate

Naming Ionic Compounds
(continued)

Metals with multiple oxidation states

- some metals form more than one cation
- use Roman numeral in name
  - $PbCl_2$
  - Pb^{2+} is cation
  - $PbCl_2$ = lead(II) chloride

Name the Compounds.

1. Al_2O_3 Aluminum oxide
2. $Fe(OH)_3$ Iron(III) hydroxide
3. Na_2S Sodium sulfide
4. $BaSO_4$ Barium sulfate