NAMING IONIC COMPOUNDS

Learning Outcomes

- I can write the name of ionic compounds when given the formula.
- I can write the formula of an ionic compound when given the name.

Ionic Compounds

- Ionic compounds are formed when a metal and non-metal ions combine to form a single molecule

Naming Simple Ionic Compounds (one metal and one non-metal, both have only one charge).

Rules: using potassium (K) and bromine (Br) in an ionic compound.

① Metal always comes 1st

potassium bromide

③ The ending of non-metal is changed to "ide" for simple ions.

② Non-metal always comes 2nd

*Do not capitalize names.

lithium

- Example: lithium and iodine → lithium iodide
  sodium and oxygen → sodium oxide

Practice Problems 1

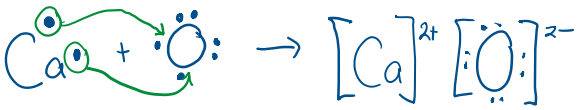
1a. Li_3N → lithium nitride
b. $MgBr_2$ → magnesium bromide
c. Ag_2O → silver oxude
d. RbF → rubidium fluoride
e. AgI → silver iodide

Writing Formulas for Simple Ionic Compounds

- Steps:
  1. Identify each ion and its charge
  2. Determine the ratio of cations (+ ions) to anions (- ions) so that positives and negatives are balanced (sum to zero).
- Example: calcium oxide $Ca^{2+} + O^{2-} \rightarrow CaO$

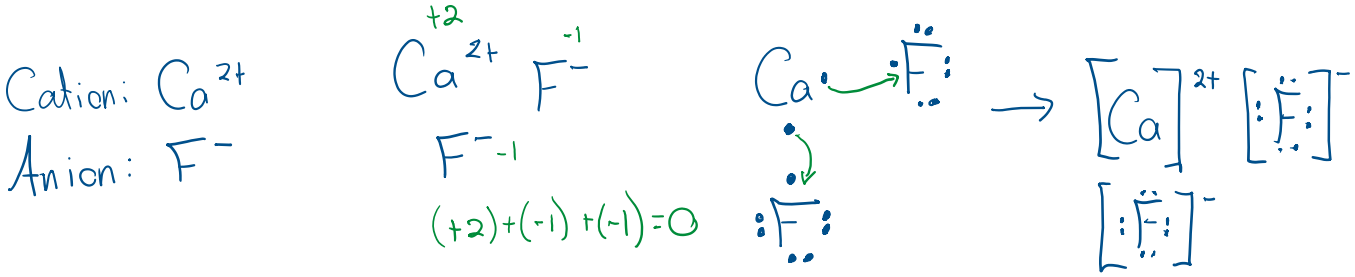
	Ions	Charges
Cation	Ca^{2+}	$(2+) \times 1 = 2^+$
Anion	O^{2-}	$(2-) \times 1 = 2^-$
		0 ✓ charges balance

One of each since

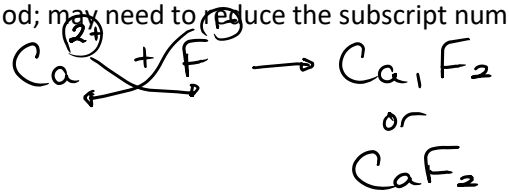


Visual of why the charges balance using Lewis Dot.

- Example: calcium fluoride $Ca^{2+} + F^- \rightarrow CaF_2$



Note that by swapping the ion charge for the quantity of the other ion, the quantity number is found → called the "criss-cross" method; may need to reduce the subscript number afterwards.



Practice Problems 2

1a. $Na^+ + Br^- \rightarrow$ NaBr

b. $Zn^{2+} + I^- \rightarrow$ ZnI_2

c. $K^+ + S^{2-} \rightarrow$ K_2S

d. $Al^{3+} + S^{2-} \rightarrow$ Al_2S_3

e. $Ca^{2+} + O^{2-} \rightarrow$ CaO

f. $Al^{3+} + P^{3-} \rightarrow$ AlP

2a. Strontium nitride → $Sr^{2+} + N^{3-} \rightarrow Sr_3N_2$

b. Lithium oxide → $Li^{1+} + O^{2-}$ Li_2O

c. Silver sulphide → $Ag^{1+} + S^{3-}$ Ag_3S

d. Barium phosphide → $Ba^{2+} + P^{3-} \rightarrow Ba_3P_2$

e. Sodium nitride → $Na^{1+} + N^{3-} \rightarrow Na_3N$

Multivalent Metals in Ionic Compounds (metal has more than one ion charge)

- Q: How do I name an ionic compound if the metal is multivalent (i.e., has more than one charge)?
- A: Use a roman numeral in brackets to indicate the charge on the metal.
- Roman Numerals used are:

1	2	3	4	5	6	7
I	II	III	IV	V	VI	VII

- Name Examples: titanium (III) oxide
  iron (II) nitride

Name formula to compound formula:

When given the name of the compound, use the Roman numeral as the ion charge when determining the compound formula.

- Example: nickel (III) iodide

$Ni^{3+} + I^{1-}$

Ni_1I_3 or NiI_3

- When given the **formula** and you need to determine the **written name**, you must use the formula to determine the charge of the metal ion.
  - You can use the charge of the non-metal to determine which charge to use of the multivalent metal.
    - SnS

$Sn^{2+} + S^{2-}$

SnS

tin (II) sulfide

"S" has a charge of 2-, so the charge of tin must be 2+ to be equivalent since there is only one of each atom.

  - If the number of atoms for each element in the formula are not the same, reverse the criss-cross method to determine the ion charge of the metal
    - Fe_2O_3

Fe_2O_3

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

Fe_2O_3

Practice Problems 3

1a. Copper (I) nitride → Cu_3I

b. Iron (II) phosphide → Fe_3P_2

c. Manganese (II) oxide → MnO

d. Manganese (IV) oxide → MnO_2

e. Chromium (II) bromide → $CrBr_2$

1a. Fe_2O_3 → $Fe^{3+} + O^{2-}$ → iron (III) oxide

b. PbF_4 → $Pb^{4+} + F^{1-}$ → lead (IV) fluoride

c. FeI_2 → $Fe^{2+} + I^{1-}$ → iron (II) iodide

d. HgI_2 → $Hg^{2+} + I^{1-}$ → mercury (II) iodide

e. Hg_3N_2 → $Hg^{2+} + N^{3-}$ → mercury (II) nitride

Polyatomic Ions (one of the ions is made up of two or more elements)

- A polyatomic ion is an ion made up of more than one type of atom joined by a covalent bond
- Most polyatomic ions act as non-metal ions
- Example: CO_3^{2-} carbonate
  PO_4^{3-} phosphate
  NH_4^+ ammonium
- When naming ionic compounds that contain a polyatomic atom, use the name given in the data booklet. Do not change the name given on the polyatomic ion sheet.
  - Example: $KClO_2$ = potassium chlorite
    NH_4F = ammonium fluoride
- When writing the formula for a compound containing a polyatomic ion, use the ion charge given on the polyatomic ion sheet and follow the criss-cross method.
  - Example: sodium sulphate = $Na^{1+} + SO_4^{2-} = Na_2SO_4$

    calcium chromate = $Ca^{2+} + CrO_4^{2-} = CaCrO_4$

    * equal charges reduce to 1

    cobalt (III) nitrite = $Co^{3+} + NO_2^{1-} = Co(NO_2)_3$

    brackets are used to show that there are 3 polyatomic ions (3 of everything inside the brackets)

Practice Problems 4

1a. KCH_3COO → potassium acetate

b. $Ca(CH_3COO)_2$ → calcium acetate

c. $(NH_4)_3P$ → ammonium phosphide

d. $(NH_4)_3PO_4$ → ammonium phosphate

e. $Al(OH)_3$ → aluminium oxide

2a. Potassium permanganate → $KMnO_4$

b. Sodium chromate → Na_2CrO_4

c. Ammonium nitrate → NH_4NO_3

f. Lead (II) perchlorate → $Pb(ClO_4)_2$

g. Iron (II) hydrogen sulphide → $Fe(HS)_2$

h. Vanadium (V) cyanide → $V(CN)_5$