Naming Compounds

Maple Leaf Spelling Bee Commercial

Vitamin names

Outcome:

Write formulas and names for polyatomic compounds using IUPAC nomenclature.

Elemental Molecules:

You are responsible for knowing the **DIATOMIC** molecules.

DIATOMIC ***Molecules*** contain **2 ATOMS** of the **SAME** **ELEMENT**, and are **NEVER** found as **SINGLE ATOMS**.

Hydrogen (H_2)
Oxygen (O_2)
Fluorine (F_2)
Bromine (Br_2)
Iodine (I_2)
Nitrogen (N_2)
Chlorine (Cl_2)

} **H, O, F, Br, I, N, Cl**

Astatine (At_2). →Another diatomic!

NOTE:

Some elements can also exist as **POLYATOMIC** **MOLECULES** like ***S_8*** (***Sulfur***) and ***P_4*** (***Phosphorus***)

Naming Compounds

We use a standard system of naming (**IUPAC** – International Union of Pure and Applied Chemistry) to name all chemical compounds.

There is a different way to name chemicals depending on whether they are **ionic** or **covalent**

Covalent Bonds	Ionic Bonds
- Two **NON-METALS** - Is a **SHARING** of electrons Ex) ***CCl_4, CO_2, NO_2***	- A **METAL** and a **NON-METAL** - Electrons are **TRANSFERRED** Ex) ***NaCl, CaS, MgH_2***

Naming COVALENT Compounds

Writing COVALENT names from formulas:

- We use a **PREFIX** system of **NOMENCLATURE** to name covalent compounds to show the number of each kind of atom:

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

Rules:

- The ***1st element*** is named in **FULL**, using **PREFIXES** only when there **MORE** than **1 ATOM** (mono is understood).
- The **SECOND** element is **SHORTENED** and given an "**IDE**" suffix, and the appropriate **PREFIX**.

Naming COVALENT Compounds

Writing COVALENT names from formulas:

Examples:

CO → Carbon mon oxide

CO_2 → Carbon di oxide

SF_6 → Sulphur hexafluoride

N_2O_5 → dinitrogen pentoxide

NO_3 → nitrogen trioxide

* NO_3^- Nitrate

Formulas of COVALENT compounds

To find the **FORMULA** of a **COVALENT** compound, simply write the **SYMBOL** and the **NUMBER** of each atom (**SUBSCRIPT**) in the order that they are in the name.

Examples:

Sulphur dioxide → SO_2

Trinitrogen heptoxide → N_3O_7

Dihydrogen Monoxide → H_2O

Naming BINARY IONIC Compounds

Writing IONIC names from formulas:

When naming any ionic compound the name of the **CATION** (**POSITIVE** ion) is written first, followed by the name of the **ANION** (**NEGATIVE** ion).

→ **See "COMMON ION" Side of the PERIODIC TABLE.**

Rules:

1. Name the **CATION** by writing the **FULL NAME** of the **METALLIC** element.
2. Name the **ANION** by **ABBREVIATING** the full name of the **NON-METALLIC** element and adding the suffix "**IDE**".

→**NO PREFIXES!!!!!** They are not needed!

Naming BINARY IONIC Compounds

Examples:

$NaCl$ → Sodium chloride

$ZnBr_2$ → Zinc bromide

Al_2O_3 → Alumium oxide

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

Formulas of BINARY IONIC Compounds

- Write the chemical **SYMBOL** of each element present.
- Use your periodic table to obtain the **CHARGES** on each atom involved in the ionic bond.
- **COMBINE** the atoms so the **CHARGES** **NEUTRALIZE** and the resulting compound is **NEUTRAL**. (***criss-cross method or lowest common multiple***)

Examples:

Magnesium chloride:

- ***Mg*** and ***Cl***
- ***Mg*** has a charge of 2***+***, ***Cl*** has a charge of ***1-.***
- When **TWO** Cl^- ions combine with **ONE** Mg^{2+} ion, the overall charge is **ZERO**, therefore $MgCl_2$ is a **NEUTRAL** compound.

$MgCl_2$

Try these ones…

Write formulas for the following binary ionic compounds

Lithium Phosphide

Li^{+} P^{3-}

Li_3P

Lead (IV) oxide

Pb^{4+} O^{2-}

Strontium Nitride

Sr^{2+} N^{3-}

Sr_3N_2

Pb_2O_4

2 : 4

$\frac{2}{4}$

Aluminum Oxide

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

Al_2O_3

Naming With Transition Metals

You may have noticed that some ions have **<u>ROMAN</u>** **<u>NUMERALS</u>** after their names. These indicate different **<u>OXIDATION</u>** **<u>STATES</u>.**

Some metals can form **<u>TWO</u>** or **<u>MORE</u>** **<u>IONS</u>** due to their **<u>ELECTRON</u>** arrangement (ex. iron → ***Fe^{2+}* or *Fe^{3+}***)

Writing names from formulas:

We must be able to show which ion is present, so we use **<u>ROMAN</u>** **<u>NUMERALS</u>** in **<u>BRACKETS</u>**:

Ex) Fe^{2+} → Iron(II)

Fe^{3+} → Iron(III)

Transition Metal Examples:

$FeCl_2$

1-
1-
2+ 2-

Iron (II) Chloride

FeO

2+ 2-

Iron (II) oxide

Fe_2O_3

3+ 2-
3+ 2-
2-
6+ 6-

Iron (III) oxide

Try these ones…

Name the following ionic compounds with transition metals

$PbCl_4$ Lead (IV) chloride

1-
1-
1-
1-
4-

$PbCl_2$ Lead (II) chloride

Fe_2O_3

Formulas of Compounds with Transition Metals:

This follows the same rules as **BINARY IONIC** compounds from the previous lesson. Be sure to use the **CORRECT CHARGE** in the **POSITIVE** ion.

Example:

Iron (II) chloride

- Fe has a charge of **2+** (as indicated by the Roman numeral, Cl has a charge of **1-**
- **ONE** Fe atom combined with **TWO** Cl atoms results in a **NEUTRAL** charge
- Therefore, the formula is $FeCl_2$

Try these ones…

Write formulas for the following ionic compounds with transition metals

Cadmium (II) Oxide

Cd^{2+} O^{2-} CdO mercury(I) Hg_2^{2+}

Manganese (III) sulphide

Mn^{3+} S^{2-} Mn_2S_3

Mercury (II) Nitride

Hg^{2+} N^{3-} Hg_3N_2

Naming With Complex Ions

Complex ions are **GROUPS** of atoms made **STABLE** by **SHARING ELECTRONS**, which then become even more **STABLE** by **GAINING** or **LOSING ELECTRONS**.

Ex) Nitrate → NO_3^-
Ammonium → NH_4^+

Unlike **NEUTRAL** molecules, complex ions carry an **ELECTRIC CHARGE** and do not exist by themselves.

We follow the naming rules for **BINARY IONIC** compounds, but we treat the complex ion as a single ion.

Naming with Complex Ions

The **COMPLEX** part(s) of the ion are **NAMED** according to the "ion" side of the periodic table.

Note:
You may see the following names for complex ions:

→ ***Bicarbonate*** = HCO_3^- (**HYDROGEN CARBONATE**)
→ ***Bisulfate*** = HSO_4^- (**HYDROGEN SULFATE**)

Ex) Baking soda is called sodium bicarbonate, but it can also be called sodium hydrogen carbonate.

Examples:

$NaNO_3$ — Sodium nitrate

$ZnClO_3$ — Zinc chlorate

$Pb(SO_4)_2$ — lead (IV) sulphate

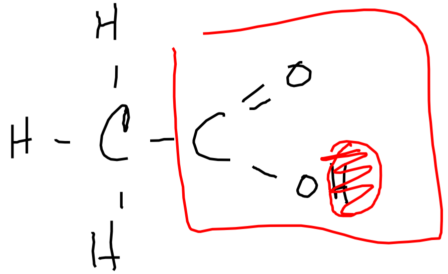
Try these ones…

CH_3COOH

CH_3CH_2OH

Write the names for the following ionic compounds that contain complex ions

$(NH_4)Cl$ ammonium chloride



$NaHCO_3$ Sodium bicarbonate (hydrogen carbonate)

CH_3COO^-

$C_2H_3O_2^-$

$Mg(C_2H_3O_2)_2$ Magnesium acetate

Formulas of Complex Ions

When placing a **SUBSCRIPT** number after the **FORMULAS** for a complex ion, the **GROUP** is first **BRACKETED**.

Examples:

Barium sulphate

Ba^{2+} SO_4^{2-} $Ba(SO_4)$

Aluminum hydroxide

Al^{3+} OH^{-} $Al(OH)_3$

Iron (III) sulphate

Fe^{3+} SO_4^{2-} $Fe_2(SO_4)_3$

Try these ones...

Write formulas for the following ionic compounds that contain complex ions

Copper (I) phosphate

Cu^{+} PO_4^{3-} Cu_3PO_4

Barium bromate

Ba^{2+} BrO_3^{-} $Ba(BrO_3)_2$

Magnesium Hydrogen Sulphate

Mg^{2+} HSO_4^{-} $Mg(HSO_4)_2$

Ionic compounds with different amounts of oxygen

The most common (**<u>NORMAL</u>**) form of the complex ions that contain oxygen end in "**<u>ATE</u>**". We add/change the **<u>PREFIX</u>** or a **<u>SUFFIX</u>** for the **<u>ANION</u>** (negative ion) to indicate how the **<u>NUMBER</u>** of **<u>OXYGEN</u>** atoms is different from the **<u>NORMAL</u>** amount.

Look at ***Chlorate*** on the back of the periodic table…

per chlorate = ClO_4^- (+1)

Chlorate = ClO_3^-

chlor ite = ClO_2^- (−1)

hypo chlor ite ClO^- (−2)

Notice the Pattern!

Ionic compounds with different amounts of oxygen

Rules:

- ***1 more oxygen***: use **PREFIX** "**PER**" on anion
- ***1 less oxygen***: use **SUFFIX** "**ITE**" instead of "ate" on anion
- ***2 less oxygen***: use prefix "**HYPO**" and suffix "**ITE**" on anion

per nitrate = NO_4^-
nitrate = NO_3^-
nitrite = NO_2^-
hypo nitrite = NO^-

Examples:

$NaNO_3$ — Sodium nitrate

K_3PO_2 — potassium hypophosphite

Li_2SO_3 — Lithium sulphite

$Zn(ClO_4)_2$ — Zinc perchlorate

Try these ones…

Write formulas for the following ionic compounds with varied oxygen.

Sodium phosphite

Na^{+} PO_3^{3-} Na_3PO_3

Lead (II) persulphate

Pb^{2+} SO_5^{2-} $PbSO_5$

Lithium silicate

Li^{+} SiO_3^{2-} Li_2SiO_3

$Mg_3(PO_5)_2$

Magnesium perphosphate

$Al(NO_4)_3$

Aluminum pernitrate