

Ions are anything that has a _____

The charges are sometimes called **oxidation numbers**, or **oxidation states**

The oxidation number of compounds always add up to _____ Ex. NaCl, MgCl₂

Pure elements are neutral, and have an oxidation number of _____ Ex. Ag, Na, S

_____ elements also have an oxidation number of 0 (memorize these)

Ex. H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂

The Periodic Table can give us a hint to the oxidation numbers of ions

| | | | | | | | |
|----|-----|--|------|-----|----|-----|------|
| IA | IIA | | IIIA | IVA | VA | VIA | VIIA |
|----|-----|--|------|-----|----|-----|------|

Elements between 3A and 7A may have different oxidation numbers!

Special cases

Usually +1, _____ can be -1. When it does, it is called a _____

NaH is called _____ CaH₂ is called _____

Usually -2, Oxygen can be -1, but is always found in the following form: _____

When it does, it is called a _____

H₂O₂ is called _____ Na₂O₂ is called _____

Practice

What is the oxidation numbers for the following atoms, if they were ions?

Ca O Na

Mg Cl N

Transition metals

Many transition metals can have _____ oxidation numbers

_____ on the oxidation number, the metals are named differently

There are two ways to name the metals, Latin roots (_____ way), and Stock Method (_____ way)

Copper, Cu, can have an oxidation of +1 or +2

_____ will be **cuprous**, or **copper (I)**

_____ will be **cupric**, or **copper (II)**

Iron, Fe, can have an oxidation of +2 or +3

_____ will be **ferrous**, or **iron (II)**

_____ will be **ferric**, or **iron (III)**

For latin roots, the “-ous” suffix is added to the _____ positive, and “-ic” suffix added to the _____ positive

For Stock Method, the Roman Numerals inside parentheses shows the _____ number. I, II, III, IV, V, VI

Memorize the common transition metal ion names (both ways) on Table 5.2, page 118

Special case

Mercury (I) is always paired together as _____

Mercury (II) is just _____

Practice

What is the oxidation number for the following atoms?

Gold (III)

Silver (II)

Lead (IV)

Tin has a Latin root of **stann-**, and is Sn^{4+} or Sn^{2+}

What is the Latin name for Sn^{4+} ?

Sn^{2+} ?

Cobalt has a Latin root of **cobalt-**, and is Co^{3+} or Co^{2+}

What is the Latin name for Co^{3+} ?

Co^{2+}

How to name ionic compounds

Binary ionic compounds are formed when a _____ cation (metal) and a monoatomic anion (non-metal) bond to form a compound. Ex. NaCl, CaCl_2

To name ionic compounds, just add the names of the ions

All _____ (metals) will have their elemental names

Anions (non-metals) are a little more complex

For monatomic anions, just add a “_____” suffix to the root of the elemental name

For example, fluorine will become _____

Some common monatomic anion names: Nitride, phosphide, oxide, sulfide, chloride, bromide, iodide

Practice: What is the binary ionic compound called?

Metal name + root of non-metal + ide

KCl MgBr₂

Li₂O Al₂S₃

Make sure to write it in two ways!

FeO Hg₂F₂

PbCl₄ FeBr₃

Co₂O₃

Ternary Ionic Compounds

Most ternary ionic compounds will contain a monatomic cation, and a _____ anion

Just combine those two to name the compound

Please memorize the following polyatomic ions and their charges, and the ones found on pg 127, Table 5.4

Hydroxide OH⁻ Bromate BrO₃⁻ Carbonate CO₃²⁻ Phosphate PO₄³⁻

Nitrate NO₃⁻ Cyanide CN⁻ Sulfate SO₄²⁻

Examples of ternary compounds

Mg(NO₃)₂ K₂SO₄

Warning: polyatomic ions are one big unit. Nitrate, NO₃⁻, does not break down into an individual Nitrogen and 3

Writing formulas from names

What is the formula for aluminum nitride?

Since Al has a charge of 3+, and nitride of 3-, they are already balanced and we can leave the formula to just

The ions have to balance each other out!

What is the formula for lithium oxide?

What is the formula for aluminium oxide?

When using the cross over method, also make sure to reduce the number

Example: Calcium sulfate. Instead of $\text{Ca}_2(\text{SO}_4)_2$, it is just _____

What is the chemical formula?

Magnesium oxide

Beryllium phosphate

Calcium fluoride

Ferric hydroxide

Lithium hydroxide

Ferrous hydroxide

Lithium sulfate

Stannic sulfate

Aluminum carbonate

Lead (II) carbonate

Table 5.2 Common Type II Cations

| Ion | Systematic Name | Older Name |
|--------------------|-----------------|------------|
| Fe^{3+} | iron(III) | ferric |
| Fe^{2+} | iron(II) | ferrous |
| Cu^{2+} | copper(II) | cupric |
| Cu^+ | copper(I) | cuprous |
| Co^{3+} | cobalt(III) | cobaltic |
| Co^{2+} | cobalt(II) | cobaltous |
| Sn^{4+} | tin(IV) | stannic |
| Sn^{2+} | tin(II) | stannous |
| Pb^{4+} | lead(IV) | plumbic |
| Pb^{2+} | lead(II) | plumbous |
| Hg^{2+} | mercury(II) | mercuric |
| Hg_2^{2+} | mercury(I) | mercurous |

*Mercury(I) ions always occur bound together in pairs to form Hg_2^{2+} .

Table 5.4 Names of Common Polyatomic Ions

| Ion | Name | Ion | Name |
|---------------------------|--|------------------------------------|--|
| NH_4^+ | ammonium | CO_3^{2-} | carbonate |
| NO_2^- | nitrite | HCO_3^- | hydrogen carbonate (bicarbonate is a widely used common name) |
| NO_3^- | nitrate | ClO^- | hypochlorite |
| SO_3^{2-} | sulfite | ClO_2^- | chlorite |
| SO_4^{2-} | sulfate | ClO_3^- | chlorate |
| HSO_4^- | hydrogen sulfate (bisulfate is a widely used common name) | ClO_4^- | perchlorate |
| OH^- | hydroxide | $\text{C}_2\text{H}_3\text{O}_2^-$ | acetate |
| CN^- | cyanide | MnO_4^- | permanganate |
| PO_4^{3-} | phosphate | $\text{Cr}_2\text{O}_7^{2-}$ | dichromate |
| HPO_4^{2-} | hydrogen phosphate | CrO_4^{2-} | chromate |
| H_2PO_4^- | dihydrogen phosphate | O_2^{2-} | peroxide |