Ch 7/9: Ionic and Metallic Bonding/Chemical Names and Formulas

**7.1/9.1 Ions/Naming Ions:**

**Valence Electrons:**

* Electrons in the highest occupied energy level
* Determines the chemical properties
* = to the group number (groups 1,2, 13-18 ***minus 10***)

**Electron dot structures (Lewis structures):**

* Shows valence electrons as dots

Ex. Ca

[**Octet Rule**](file:///\\swain.local\storage-ns\homes\high\staff\kgray\Kgray%20folder\Chemistry\chapter%207,8-%20ionic,%20metallic,%20covalent%20bonding\Ionic%20bonds%20and%20formulas.flipchart)**:**

* gain (-) or lose (+) electron(s) = noble gas configuration (8 valence electrons)
* Exceptions – transition metals =pseudo noble gas configurations

(18 electrons in outer energy level)

ex. Ag= 1s22s22p63s23p6 4s23d104p65s1 4d10

Ag+1 =1s22s22p63s23p6 4s23d104p64d10

**Oxidation Number (the Charge)**:

* + or – # = # of electrons an atom has gained, lost or shared to become stable
* Can have more than one oxidation #

**Ions:**

* Charged atom(s) –loses or gains electrons
* Monatomic Ions- ions composed of 1 atom with a +/- charge
* [Polyatomic Ion**s**](file:///H:\Kgray%20folder\Chemistry\chapter%204,5-atomic%20structure,%20electrons%20in%20atoms\Chapter%205-%20Electrons%20in%20the%20atom\Ch%205%20Electrons%20in%20the%20atom\chemistry%20reference%20table.pdf)**-**ions composed of more than 1 atom

(behaving as a unit) with a +/- charge

**Types**:

**Cations:**

* + charge
* Lose valence electron(s) (ionization)
* Mostly metals

**Example:**

Ionization of Na:

Na• loss of valence electron Na+1 + e-

Ionization

Na 1s22s22p63s1  Na+ 1s22s22p6

**Anions:**

* - charge
* Gain valence electron(s)
* Mostly non-metals (or polyatomics)

**Example:**

O t 2e- gain 2 valence electron O -2

oxygen atom oxide ion

O 1s22s22p4 O -2 1s22s22p6

[**Naming of Cations**](file:///\\swain.local\storage-ns\homes\high\staff\kgray\Kgray%20folder\Chemistry\chapter%207,8-%20ionic,%20metallic,%20covalent%20bonding\fixed%20vs.%20variable%20oxidation%20numbers%20(charges).flipchart):

* Name = element’s name + ion (ex. Na+ = sodium ion)
* **Transition Metals,Sn, Pb**-Stock system – use Roman numerals to ID

the charge (ex. Fe+2 = Iron(II) ion, Fe+3 = Iron(III) ion)

**Naming of Anions:**

* Name = ending of the element’s name dropped and ***ide*** added

(ex. fluorine (F-1) = fluor***ide***)

**Naming Polyatomic Ions:**

* No said rule- depends on the # of oxygens present
* Endings- ite, ate (exceptions-cyanide, hydroxide, ammonium)
  + **–*ite*** = one less oxygen than ***ate***

Ex. chlorite- ClO**2-1**; chlorate- ClO**3**-1

* + **Hypo** = one less oxygen than ***ite***

Ex. Hypochlorite- ClO**-1**

* + **Per** = one more oxygen than ***ate***

Ex. Perchlorate- ClO**4-1**

**7.2 Ionic Bonds and Ionic Compounds:**

**Formation of Ionic Compounds:**

* Composed of cations and anions
* Electrically neutral

**Ionic Compounds Properties:**

* [Crystalline solids](file:///\\swain.local\storage-ns\homes\high\staff\kgray\Kgray%20folder\Chemistry\chapter%207,8-%20ionic,%20metallic,%20covalent%20bonding\Ionic%20bonds%20and%20formulas.flipchart)
* Metals/Nonmetals
* High melting points
* Electrolytic -Good conductors of electricity when in water

or melted

* Soluble in water

**Ionic Bonds:** [**Ionic bond song**](https://www.youtube.com/watch?v=QIfTT-_-xLo)

* Electrostatic force that holds ions together

Ex.

Na• + Cl Na+1 Cl -1

1s22s22p63s1 1s22s22p63s23p5 1s22s22p6 1s22s22p63s23p6

**Chemical formula:**

* Shows kinds and # s of atoms in the smallest representative unit
* Subscript – indicates the # of atoms of each element in the compound

**Formula Units:**

* Lowest whole number ratio of ions in an ionic compound

(Law of Multiple and Definite Proportions)

Ex. NaCl lowest whole number ratio = 1:1

Ex. MgCl2 lowest whole number ratio = 1:2 (1 Mg+2 ion to 2 Cl-1)

**9.2 Naming and Writing Formulas for Ionic Compounds:**

[**Writing Formulas**](file:///\\swain.local\storage-ns\homes\high\staff\kgray\Kgray%20folder\Chemistry\chapter%207,8-%20ionic,%20metallic,%20covalent%20bonding\Formulas%20and%20names%20practice%20problems.flipchart) **for Ionic Compounds:**

* Cation symbol followed by anion symbol
  + - * Add subscripts
      * Assign Oxidation #s
      * Crisscross method- oxidation # (charge) crosses

over to become the subscript

ex. Fe+3 O-2

Fe2  O3

**Writing formulas for Polyatomic Compounds:**

* Cation symbol followed by the polyatomic ion symbol
* Add subscripts (crisscross)
* ( )needed if more than 1 unit of the same polyatomic

ion is needed

Ex. Ca+ 2 NO3-1

Ca (NO3)2

Ca(NO3)2

[**Naming Ionic Compounds**](file:///\\swain.local\storage-ns\homes\high\staff\kgray\Kgray%20folder\Chemistry\chapter%207,8-%20ionic,%20metallic,%20covalent%20bonding\Formulas%20and%20names%20practice%20problems.flipchart)**:**

* Cation name first followed by anion name

Ex. Cs2O = cesium oxide

* Cations that form more than 1 oxidation # – include

roman numeral in name

Ex. CuO = copper(II) oxide

[**Naming Polyatomic Compounds**](file:///\\swain.local\storage-ns\homes\high\staff\kgray\Kgray%20folder\Chemistry\chapter%207,8-%20ionic,%20metallic,%20covalent%20bonding\Formulas%20and%20names%20practice%20problems.flipchart)**:**

* Cation name first followed by the polyatomic anion name (exception – ammonium ion = + 1 charge)

Ex. NaClO = sodium hypochlorite

* Cations that form more than 1 ion – include roman numeral

Ex. Cr(NO2)3 = Chromium(III) nitrite

**9.4 Naming and Writing formulas for Acids and Bases:**

**Bases:**

* Ionic compound that produces hydroxide ions (OH**-1**) when

dissolved in water

**Naming Bases:**

* Named same way ionic compounds
* Anion =hydroxide ion (OH**-1**)

Ex. NaOH = sodium hydroxide

**Formulas for Bases:**

* Same way as ionic compounds

Ex. Iron(III) Hydroxide = Fe(OH)**3**

**Acids:**

* Ionic compound that contains 1 or more hydrogen atoms
* Produces hydrogen ions (H+1) when dissolved in water

(Arrhenius acid)

**Naming Acids:**

* Consists of a cation (hydrogen ions) and an anion
* H**n**X formula: H = hydrogen; **n**= # of Hydrogens;

X= monatomic or polyatomic anion

|  |  |  |  |
| --- | --- | --- | --- |
| Naming Acids Rules | | | |
| **Anion ending** | **Example** | **Acid name** | **Example** |
| *-ide* | Chloride, Cl-1 | *Hydro*-(stem)-*ic* acid | *Hydro*chlor*ic* acid |
| *-ite* | Sulfite, SO**3-2** | (stem)-*ous* acid | Sulfur*ous* acid |
| *-ate* | Nitrate, NO**3-1** | (stem)-*ic* acid | Nitr*ic* acid |

**Writing Formulas for Acids:**

* Use the naming rules in reverse:

Ex. 1 Hydrochloric acid = HCl

Ex. 2 Sulfurous acid = H**2**SO**3**

Ex. 3 Nitric acid = HNO**3**

**Acids to know: HCl** (hydrochloric acid)**, HNO3** (nitric acid)**,**

**H2SO4** (sulfuric acid)**, HC2H3O2 (HCH3COOH)** (acetic acid)

**7.3 Bonding in Metals**

**Metallic bonds**:

* Metals made up of closely packed cations rather than neutral atoms
* Valence electrons – “[sea of electrons](file:///H:\Kgray%20folder\Chemistry\chapter%207,8-%20ionic,%20metallic,%20covalent%20bonding\sea%20of%20electrons.flipchart)” (b/w + ions and electrons)
* Metallic bonds:
  + - Consist of the attraction of the free-floating valence electrons
    - Forces of attraction that hold metals together

**Metallic Properties:**

b/c of mobility of valence electrons

* Good conductors
* Ductile and malleable