***Ion:*** **atom or group of atoms (*polyatomic)* that has a net positive or negative charge**

***Cations*: positively charged ions** **Ex. $Ba^{2+}$, $NH_4^+$**

***Anions*: negatively charged ions** **Ex. $Cl^-$, $CO_3^{2-}$**

**Noble gases (group 8A): Inert and stable**

***Atoms of main group elements tend to achieve noble gas electron configuration by gain/loss of electrons OR by sharing electrons***

**Hydrogen is unique: $H^+$ (common) or $H^-$ (hydride ion)**

**Alkali metals: lose 1e to form 1+ ions**

**Group 2A: lose 2e to form 2+ ions**

**Aluminum: lose 3e to form $Al^{3+}$ ion**

**Group 7A: gains 1e to form 1- ions**

**Group 6A: gains 2e to form 2- ions**

**N and P: gain 3e to form $N^{3-}$ and $P^{3-}$ ions**

***Nomenclature of monoatomic ions:***

***Cations*: Metals**

***Type I metals*:**

- **one kind of charge (Ex. $Ca^{2+}$)**

- **alkali metals, alkaline earth metals, aluminum, silver, zinc and cadmium**

- **naming: name of the element + word "ion"**

***Type II metals*:**

- **more than one kind of charged ion (Ex. $Fe^{2+}$ and $Fe^{3+}$)**

- **naming: name of the element (charge indicated by Roman numeral) + word "ion"**

***mono-atomic anions*: suffix "ide" is substituted for the ending of the name of the element, followed by the word "ion". *Ex. chloride ion***

## Naming binary ionic compounds:

**cation (metal) always comes first in name / formula**

**Type I: Ex. Sodium chloride, NaCl**
**Magnesium oxide, MgO**
**Aluminum oxide, $Al_2O_3$**

**Type II: Ex. Iron (II) chloride. $FeCl_2$**
**Iron (III) chloride, $FeCl_3$**

**For Type II metal:** ***determine charge on the metal by balancing the positive and negative charges in the compound***

***Elements that form only one type of cation do not need to be identified by a Roman numeral. Metals that DO NOT require a Roman numeral are: alkali metals, alkaline earth metals, aluminum, silver ($Ag^+$), cadmium($Cd^{2+}$) and zinc ($Zn^{2+}$).***

## *Naming / formulas of Binary covalent compounds*

- between two nonmetals
- element farther left of the periodic table is written first. *Ex.* $SF_6$
- if two elements in the same group, element that is lower in its group is written first
  *Ex.* $IF_3$

- Name of first element remains unchanged

- Suffix "ide" replaces the ending of name of second element

- Use prefixes to indicate number of each kind
  *Mono* omitted for first element, but not for the second, Ex. Carbon monoxide
  Drop "o" or "a" of a prefix if element name begins with a vowel

Ex. Carbon monoxide and *not carbon monooxide*
Nitrogen tetroxide and *not nitrogen tetraoxide*

**Polyatomic ions: ions containing more than one atom**

**Naming compounds with polyatomic ions:**

- **ionic; follow same rules as with binary ionic compounds**
- **metal/cation written first**
- **if Type II metal (forms more than one kind of cation), show charge in parantheses as Roman numeral**
- **polyatomic ion is then named or written**

# *Flowchart for Naming acids*

| Anion | | Acid |
|---|---|---|
| ____ ide | → | hydro ____ ic acid |
| chloride, $Cl^-$ | | hydrochloric acid, HCl(aq) |
| cyanide, $CN^-$ | | hydrocyanic acid, HCN(aq) |
| ____ ate | → | _____ic acid |
| chlorate, $ClO_3^-$ | | chloric acid, $HClO_3$(aq) |
| Perchlorate, $ClO_4^-$ | | perchloric acid, $HClO_4$(aq) |
| Sulfate, $SO_4^{2-}$ | | sulfuric acid, $H_2SO_4$(aq) |
| ____ ite | → | _____ous acid |
| chlorite, $ClO_2^-$ | | chlorous acid, $HClO_2$(aq) |
| Hypochlorite, $ClO^-$ | | hypochlorous acid, HClO(aq) |
| Sulfite, $SO_3^{2-}$ | | sulfurous acid, $H_2SO_3$(aq) |

# Hydrated ionic compounds

- Ionic compounds with a specific number of water molecules associated with each formula unit
- number is shown after a centered dot
- indicated in the systematic name by a Greek prefix before the word hydrate
- Ex. $MgSO_4 \cdot 7H_2O$ magnesium sulfate heptahydrate
- water molecules, referred to as "*waters of hydration*"
- Ex. when heated strongly, blue copper (II) sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$) is converted to white copper (II) sulfate ($CuSO_4$)

## Molecular compounds of hydrogen are special cases

**$H_2O$ water**
**$NH_3$ ammonia**
**$CH_4$ methane**

***When dissolved in water*: *free $H^+$ ions*; *binary* acids**

| | |
|---|---|
| **HCl (aq)** | ***hydrochloric acid*** |
| **HBr(aq)** | ***hydrobromic acid*** |
| **$H_2S$(aq)** | ***hydrosulfuric acid*** |

**Oxyacids**: ***$H^+$ with oxyanions***

| | |
|---|---|
| **$SO_4^{2-}$** | **$H_2SO_4$ *(aq)*** |
| **$PO_4^{3-}$** | **$H_3PO_4$ *(aq)*** |
| **$ClO_4^-$** | **$HClO_4$ *(aq)*** |
| **$NO_3^-$** | **$HNO_3$ *(aq)*** |