

NAMES OF IONS

- To properly discuss ions and ionic compounds, we have to know how to name them!

CATIONS

3 kinds:

① Main group cations (metals that take only one charge when forming ions)

- The element's name is the same as the ion's name!



② Transition metal cations (from metals that can form several cations)

- The CHARGE of the cation must be given. Use a ROMAN NUMERAL after the element name to indicate charge!



③ Polyatomic cations

- Memorize list.



ANIONS

2 kinds

①

Main-group nonmetals

- Use the STEM NAME of the element, then add "-ide" suffix

 N^{3-} : "nitride" ion P^{3-} : "phosphide ion" S^{2-} : sulfide ion O^{2-} : "oxide ion" F^{-} : "fluoride ion"

②

Polyatomic ions

- Memorize list.(see web site)

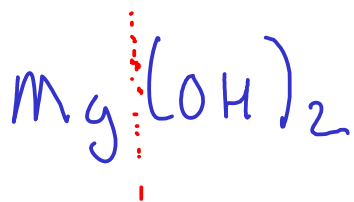
 $\text{C}_2\text{H}_3\text{O}_2^-$: "acetate ion" SO_4^{2-} : "sulfate ion" NO_3^- : "nitrate ion" SO_3^{2-} "sulfite ion" NO_2^- : "nitrite ion"

* Polyatomic ions ending in "-ate" and "-ite" suffixes always contain oxygen! "-ate" ions have more oxygen atoms than their "-ite" counterparts.

NAMING IONIC COMPOUNDS

- The name of the compound is based on the name of the ions in the compound
- Cation first, anion second

Examples:



magnesium hydroxide



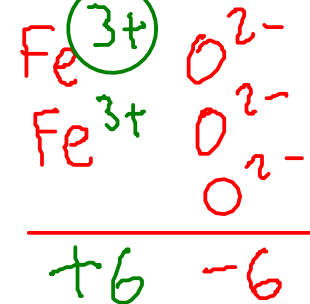
sodium sulfide



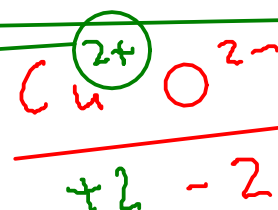
beryllium bromide



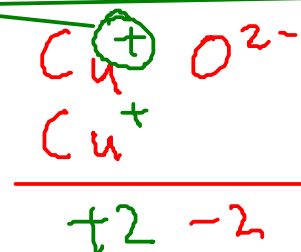
iron(III) oxide



copper(II) oxide



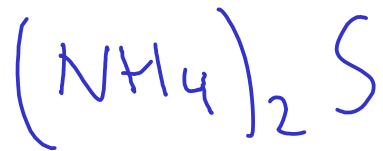
copper(I) oxide



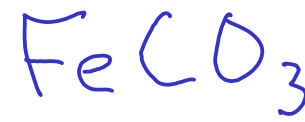
Remember to include the Roman numeral for CHARGE in the name of transition metal compounds!

Page 63 (9th edition): Chart of polyatomic ions

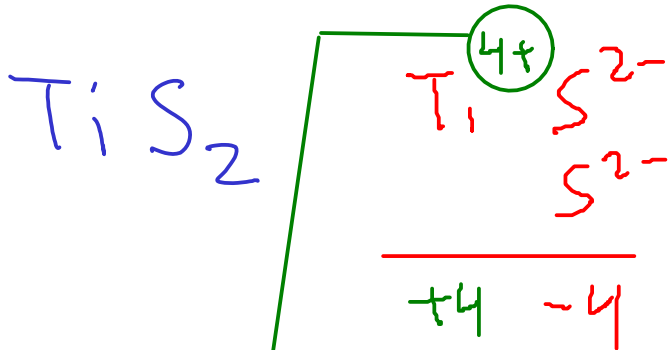
NAMING IONIC COMPOUNDS



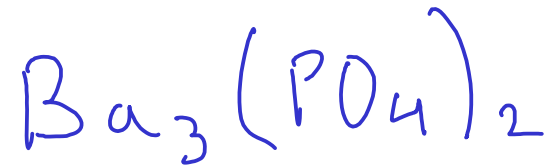
ammonium sulfide



iron(II) carbonate



titanium(IV) sulfide



barium phosphate



barium phosphide

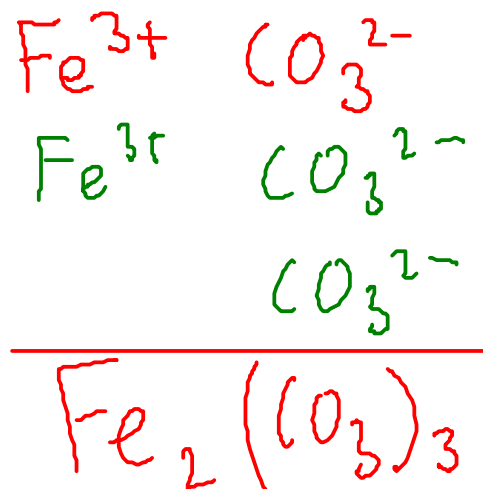
Spelling
matters!

DETERMINING THE FORMULA OF AN IONIC COMPOUND FROM THE NAME

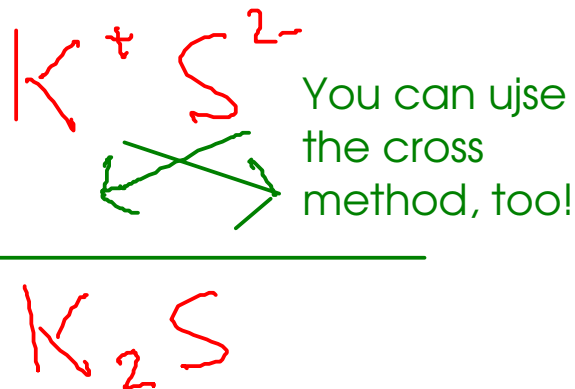
- The name of an ionic compound is made of the names of the CATION and ANION in the compound.
- To get the FORMULA, you must figure out the SMALLEST RATIO of cation to anion that makes the charges balance out

Examples:

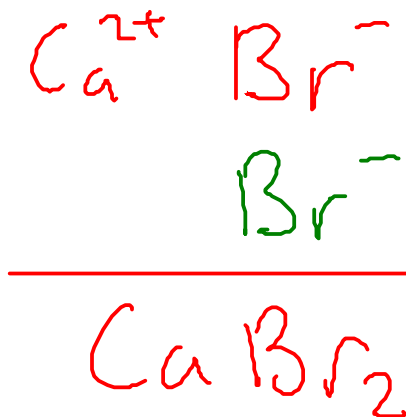
iron(III) carbonate



potassium sulfide

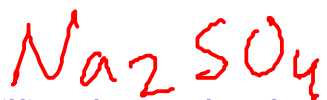


calcium bromide



DETERMINING IONIC FORMULAS

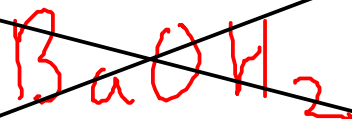
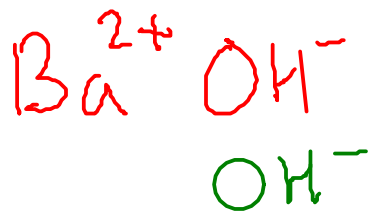
sodium sulfate



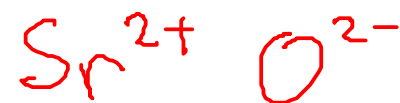
tin(II) phosphate



barium hydroxide



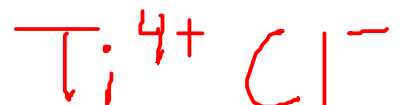
strontium oxide



chromium(III) nitrate



titanium(IV) chloride

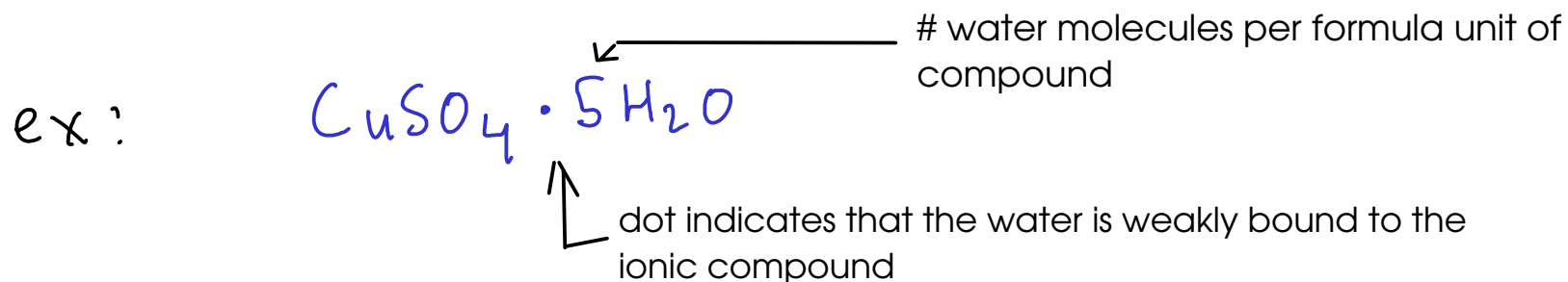


Don't forget PARENTHESIS when you have more than one polyatomic ion in a formula!

HYDRATES

- many ionic compounds are formed by crystallizing the compound from water. Sometimes, this causes water molecules to become part of the crystal structure.

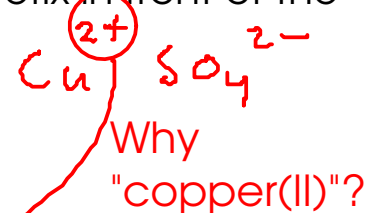
- This water is present in a definite ratio to the ions in the compound. Can be removed by heating, but will NOT evaporate if the compound is left standing.



- many DESSICANTS are hydrates that have had their water molecules driven off. They will slowly reabsorb water from the air (and keep the environment in a dessicator at a low humidity)

- Hydrates are named using the name of the ionic compound, and a Greek prefix in front of the word "hydrate" to indicate how many water molecules are associated

Copper (II) sulfate pentahydrate



MOLECULAR COMPOUNDS

- There are several kinds of molecular compound. We will learn to name two simple but important classes

① BINARY MOLECULAR COMPOUNDS

- molecular compounds containing only two elements

② ACIDS

- molecular compounds that dissolve in water to release H^+ ions
- corrosive to metals (react with many to produce hydrogen gas)
- contact hazard: can cause chemical burns to eyes and skin
- sour taste
- turn litmus indicator RED
- two kinds of acids:

① BINARY ACIDS

- contain hydrogen and one other element

② OXYACIDS

- contain hydrogen, OXYGEN, and another element

Usually from
Group VIIA

BINARY MOLECULAR COMPOUNDS

- Named based on the elements they contain, plus prefixes to indicate the number of atoms of each element in each molecule

① FIRST ELEMENT

- Add a GREEK PREFIX to the name of the element.
- Omit the "MONO-" (1) prefix if there is only one atom of the first element

② SECOND ELEMENT

- Add a GREEK PREFIX to the STEM NAME of the element
- Add the suffix "-ide" (as if you were naming an anion)
- DO NOT omit the "mono-" prefix if there is only one atom of the second element

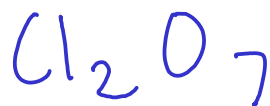
SEE COURSE WEB SITE FOR A LIST OF GREEK PREFIXES!
THESE ARE THE SAME PREFIXES USED FOR THE HYDRATES!

BINARY MOLECULAR COMPOUNDS

Examples:



boron trifluoride

dichlorine heptaoxide
(or dichlorine heptoxide)carbon
monoxidecarbon
dioxide

*Note: metalloids like boron behave chemically like nonmetals do.

carbon tetrachloride



dihydrogen monoxide



dinitrogen tetrafluoride

 MgCl_2 : magnesium chloride, not magnesium dichloride.

Why not? This compound is ionic. We can tell easily (in most cases) by simply looking at the first element. If the first element's a metal, we have an ionic compound.

ACIDS

① BINARY ACIDS

- named after the element (other than hydrogen) they contain
- common binary acids include a Group VIIA element
- named: "Hydro-" + STEM NAME OF ELEMENT+ "-ic acid"

Four
common
binary
acids

HF : hydrofluoric acid ✖ dissolves glass!

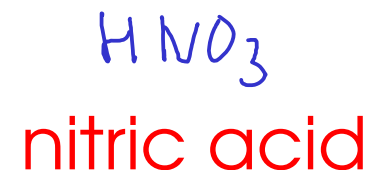
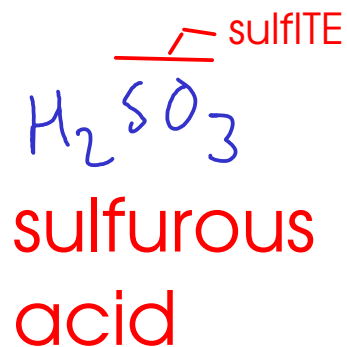
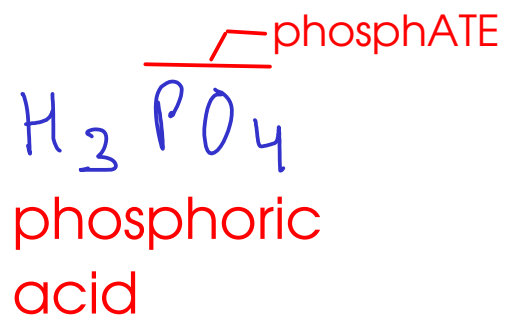
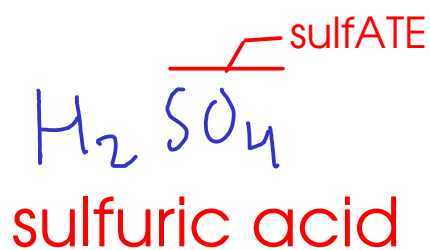
HCl : hydrochloric acid ✖ most common binary acid!

HBr : hydrobromic acid

HI : hydroiodic acid

② OXYACIDS

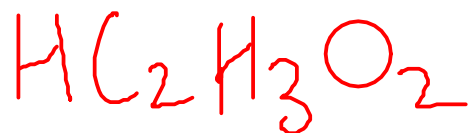
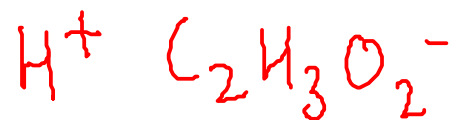
- Easy to think about as HYDROGEN IONS combined with POLYATOMIC IONS
- These acids are not true ionic compounds, but they interact with water to PRODUCE ions!
- named based on the polyatomic ion they contain, with an ending change:
 - ① - ions ending in -ATE form acids ending in -IC
 - ② - ions ending in -ITE form acids ending in -OUS



OXYACID EXAMPLES

acetic acid

based on acetate



nitrous acid

based on nitrite



carbonic acid

based on carbonate



The number of hydrogen atoms at the beginning of the formula equals the charge of the anion the acid is based on!

SUMMING UP CHEMICAL NOMENCLATURE

- You need to be able to tell, by looking at a name OR a formula, what kind of compound you are working with!

DON'T GET THE NAMING SYSTEMS MIXED UP! EACH KIND OF COMPOUND IS NAMED WITH ITS OWN SYSTEM!

FROM A CHEMICAL NAME

- If the name has a Roman numeral, the name of a metal, or "ammonium", the compound is likely IONIC
- If the name has a Greek prefix AND the prefix is NOT in front of the word "hydrate", the compound is BINARY MOLECULAR
- If the name contains the word "acid":
 - ... and starts with "hydro-", then the compound is a BINARY ACID
 - ... and does not start with "hydro-", the compound is an OXYACID

78 FROM A CHEMICAL FORMULA

- if the formula contains a metal or the NH_4^+ ion, it is likely IONIC

- If the formula starts with H and is not either water (H_2O) or hydrogen peroxide (H_2O_2), the compound is likely an ACID. Which kind?

- BINARY ACIDS contain only two elements

- OXYACIDS contains oxygen

- If the formula contains only nonmetals (and is not an ammonium compound or an acid), the compound is likely MOLECULAR

Examples:

PCl_3 : BINARY MOLECULAR
Name: phosphorus trichloride

NH_4Cl : IONIC (ammonium ion)
Name: ammonium chloride

H_3PO_4 : OXYACID (hydrogen, phosphate)
Name: phosphoric acid