

PREDICTING CHARGE

| IA | | | | | | | | | | | | VIII A | | | | | | |
|------|----|-------|----|------|-----|-------|--------|--------|----------------------------------|----|-----|--------|------|-----|-------|--------|----|----|
| II A | | | | | | | | | | | | III A | IV A | V A | V I A | V II A | He | |
| H | Li | Be | | | | | | | | | | | B | C | N | O | F | Ne |
| Na | Mg | III B | | IV B | V B | V I B | V II B | VIII B | | IB | IIB | Al | Si | P | S | Cl | Ar | |
| K | Ca | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr | |
| Rb | Sr | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I | Xe | |
| Cs | Ba | La* | Hf | Ta | W | Re | Os | Ir | Pt | Au | Hg | Tl | Pb | Bi | Po | At | Rn | |
| Fr | Ra | Ac* | Rf | Db | Sg | Bh | Hs | Mt | *inner transition metals go here | | | | | | | | | |

You can reliably determine the charge using our method for Groups IA, IIA, IIIB, Aluminum, and the Group VA, VIA, and VIIA NONMETALS

Aluminum (Al): At atomic number 13, it is three electrons away from neon (Ne), and 5 electrons away from argon (Ar). Prediction: Aluminum will lose three electrons to form the cation Al^{3+}

Bromine (Br): At atomic number 35, bromine is one electron away from krypton (Kr). Prediction: Bromine will gain one electron to form the anion Br^-

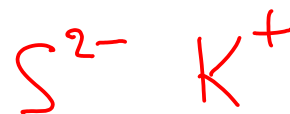
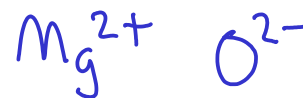
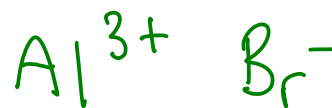
Strontium (Sr): At atomic number 38, strontium is two electrons away from krypton. Prediction: Strontium will lose two electrons to form the cation Sr^{2+}

EXAMPLES

| IA | | EXAMPLES | | | | | | | | | | VIII A | | | | | | |
|----|-----|----------|-----|----|-----|-------|--------|----|------------------------------------|-----|----|--------|-----|----|-----|------|-------|----|
| IA | IIA | | | | | | | | | | | IIIA | IVA | VA | VIA | VIIA | VIIIA | |
| H | Li | Be | | | | | | | | | | | B | C | N | O | F | He |
| Na | Mg | | | | | | | | | | | Al | Si | P | S | Cl | Ar | |
| | | IIIB | IVB | VB | VIB | VII B | VIII B | | IB | IIB | | | | | | | | |
| K | Ca | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr | |
| Rb | Sr | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I | Xe | |
| Cs | Ba | La* | Hf | Ta | W | Re | Os | Ir | Pt | Au | Hg | Tl | Pb | Bi | Po | At | Rn | |
| Fr | Ra | Ac* | Rf | Db | Sg | Bh | Hs | Mt | *"inner" transition metals go here | | | | | | | | | |

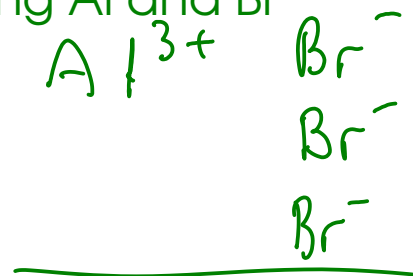
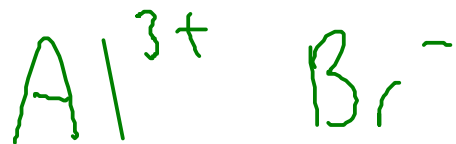
Find the formulas of:

- (1) an ionic compound containing Al and Br
- (2) an ionic compound containing Mg and O
- (3) an ionic compound containing S and K



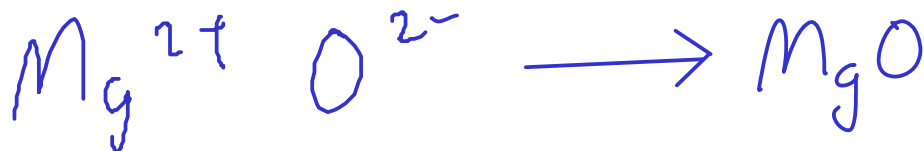
Find the formula of:

* an ionic compound containing Al and Br



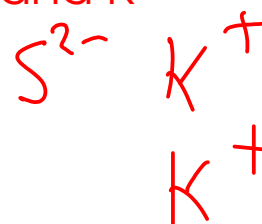
Find the formula of:

* an ionic compound containing Mg and O



Find the formula of:

* an ionic compound containing S and K



Reminder: Write ionic compound formulas with the cation (+ charge) first ----->



TRANSITION METAL IONS

| IA | | TRANSITION METAL IONS | | | | | | | | | | VIII A | | | | | |
|-----|------|-----------------------|------|-----|------|-------|--------|----|------------------------------------|-------|------|--------|------|-------|--------|----|----|
| I A | II A | III B | IV B | V B | VI B | VII B | VIII B | IB | IIB | III A | IV A | V A | VI A | VII A | VIII A | | |
| H | Li | | | | | | | | | | | | | | He | | |
| | Be | | | | | | | | | | | | | | | | |
| Na | Mg | | | | | | | | | | | | | | | | |
| K | Ca | Sc | Ti | V | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr |
| Rb | Sr | Y | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I | Xe |
| Cs | Ba | La* | Hf | Ta | W | Re | Os | Ir | Pt | Au | Hg | Tl | Pb | Bi | Po | At | Rn |
| Fr | Ra | Ac* | Rf | Db | Sg | Bh | Hs | Mt | *"inner" transition metals go here | | | | | | | | |

The transition metals always form CATIONS!

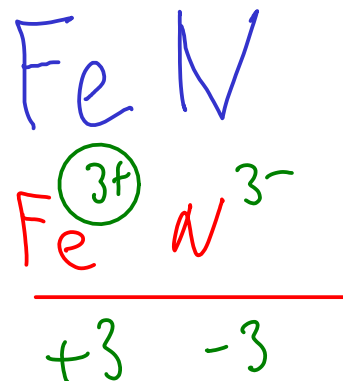
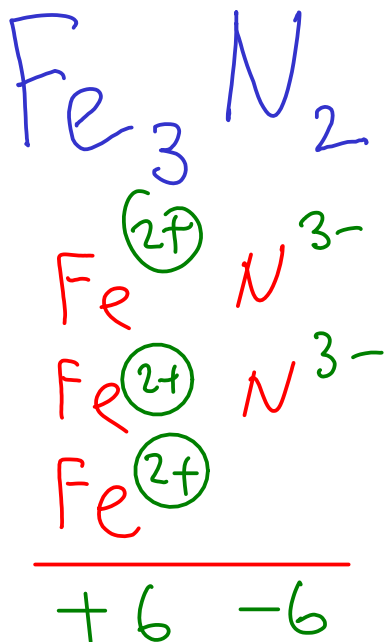
However, many transition metals are capable of forming SEVERAL DIFFERENT CATIONS!

Example: Iron (Fe) forms two cations, depending on the situation: Fe^{2+} or Fe^{3+}

TRANSITION METAL CATIONS

- So how do you know which cation you're dealing with? For now, you'll have to be told
- Either the chemical formula of an ionic compound or the name of an ionic compound can tell you what charge is on the transition metal cation.

Examples:



* The iron ions in this compound have a charge of +3 and are called "iron(III)" ions ... pronounced "iron three". The compound is called iron(III) nitride.

* The iron ions in this compound have a charge of +2 and are called "iron(II)" ions ... pronounced "iron two". The compound is called iron(II) nitride.

POLYATOMIC IONS

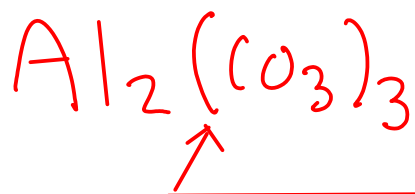
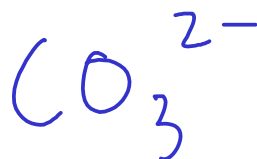
- Some MOLECULES can gain or lose electrons to form CATIONS or ANIONS. These are called POLYATOMIC IONS

- Polyatomic ions form ionic compounds in the same way that single-element ions do.

Example: CO_3^{2-} : CARBONATE ION

* Compare
to
 Al_2O_3

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



* Use parenthesis when an ionic compound's formula contains more than one of a polyatomic ion.

See the web site or Openstax page 100 - table 2.5 for a list of common polyatomic ions!

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)

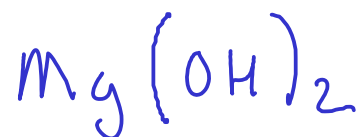
 $\text{C}_2\text{H}_3\text{O}_2^-$: "acetate ion" SO_4^{2-} : "sulfate ion" NO_3^- : "nitrate ion" SO_3^{2-} "sulfite ion" NO_2^- : "nitrite ion"

* 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



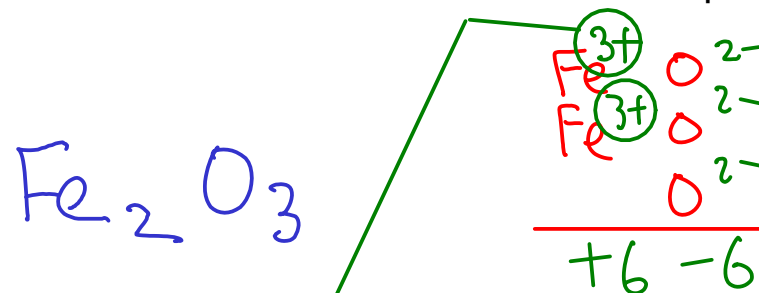
sodium sulfide



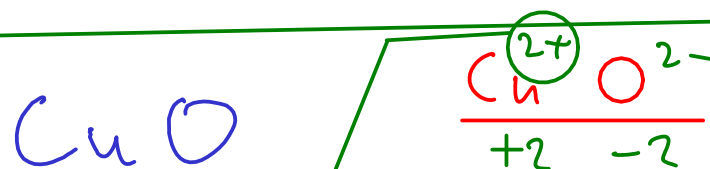
barium phosphate

* Remember to include the Roman numeral for CHARGE when you're writing transition metal compound names!

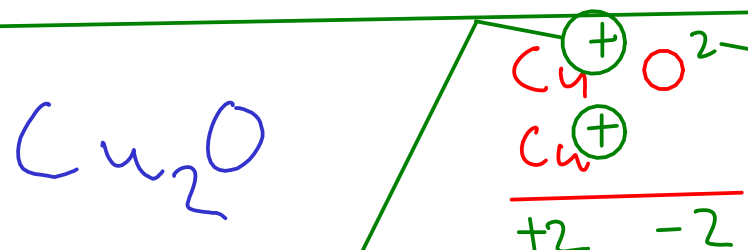
(See Openstax p 100 for a chart of polyatomic ions)



iron(III) oxide



copper(II) oxide



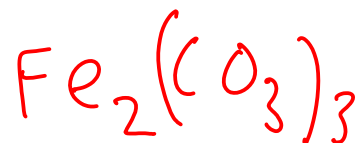
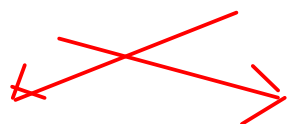
copper(I) oxide

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

