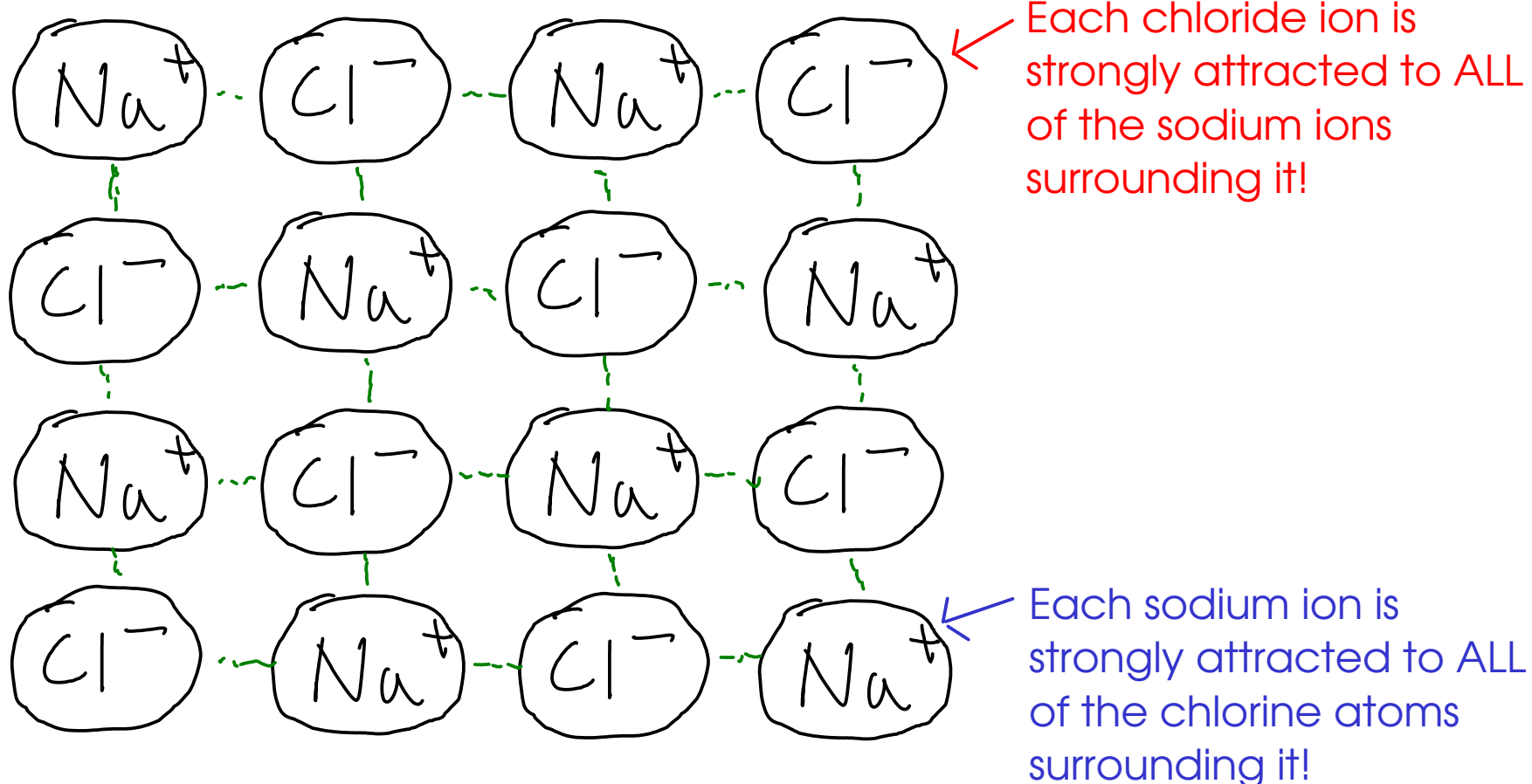


IONIC COMPOUNDS

- ionic compounds are held together by ELECTROSTATIC INTERACTIONS

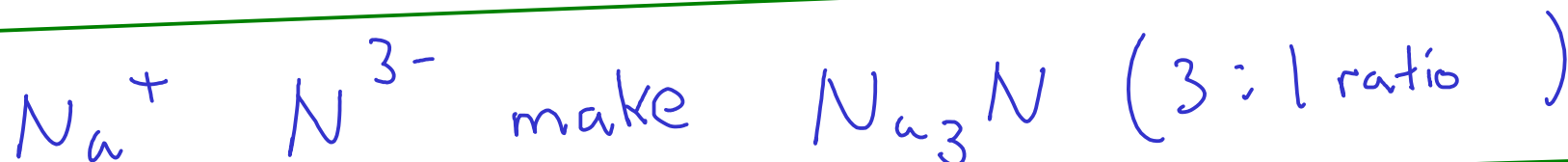
(in other words, the attraction between oppositely charged ions!)



There are no "molecules" in ionic compounds - in the sense that you can't point to a discrete unit of atoms that are connected to only each other

IONIC FORMULAS

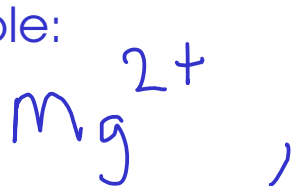
- since there are no "molecules", an ionic formula cannot describe how many and what kinds of atoms are in a molecule!
 - all ionic compounds are observed to be (overall) electrically neutral, so the IONS they contain must be present in such a way that the charges BALANCE EACH OTHER
- an ionic formula gives the SMALLEST WHOLE NUMBER RATIO OF CATION TO ANION in the ionic compound



WRITING AN IONIC FORMULA

- if you know the ions that make up a compound, all you need to do is find the smallest ratio of cation to anion the compound needs to have an overall charge of zero

Example:



If a simple ionic compound is made of these two ions, what is its formula?



← more - than +, so add more Mg^{2+}



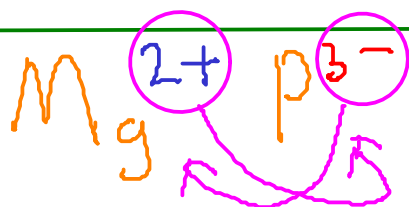
← more + than -, so add P^{3-}

← more - than +, so add Mg^{2+}



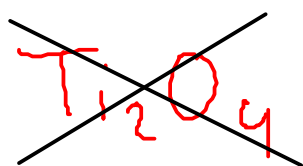
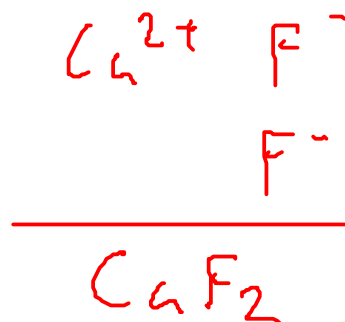
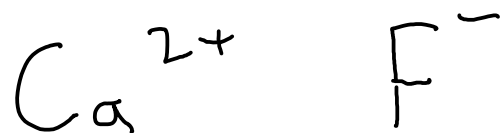
In the final formula, don't write the charges on the ions!

Ionic formulas are ALWAYS written with the cation first, and the anion second!

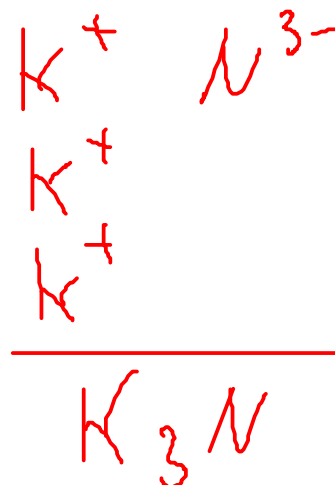
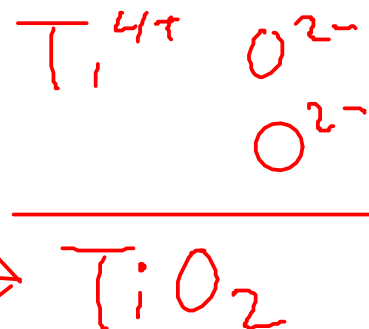


"cross method" to determine ratio

More examples:



simplify



You can also use the "cross method", as described in your textbook, to write formulas. Use caution, as the "cross method" will sometimes give you the wrong formula! It would give you the wrong answer for this one!

PREDICTING CHARGES

- how do you figure out the charge that an element might take when it becomes an ion?
 - for many main group elements, you can predict the charge using the periodic table!

IA																	VIII A	
H	IIA											III A	IV A	V A	VI A	VII A	VIII A	He
Li	Be											B	C	N	O	F	Ne	
Na	Mg	IIIB	IVB	VB	VIB	VIIB	VIIIB	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	*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
Fr	Ra	*	Rf	Db	Sg	Bh	Hs	Mt	*"inner" transition metals go here									

Elements in group VIII A - the "noble gases" - do not form ions!

Many OTHER main-group elements form either anions or cations that have the same overall number of electrons as the NEAREST (in terms of atomic number) noble gas!

PREDICTING CHARGE

IA												VIII A					
H	IIA											III A	IV A	V A	VIA	VII A	He
Li	Be											B	C	N	O	F	Ne
Na	Mg	IIIB	IVB	VB	VIB	VII 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, III B, Aluminum, and the Group VA, VIA, and VII A 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^-

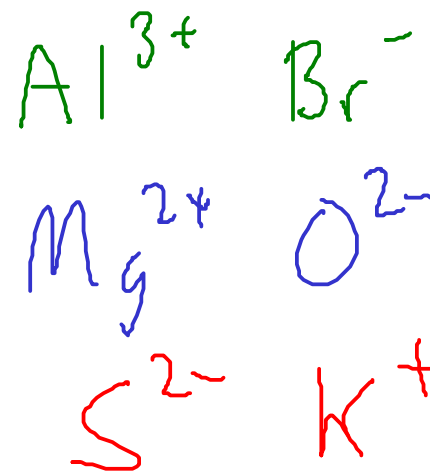
Strontium (Sr): At atomic number 38, strontium is two electrons away from krypton. Prediction: Strontium will lose two electrons to form the cation Sr^{2+}

EXAMPLES

IA		EXAMPLES										VIII A							
IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIII A		
H	Li	Be												B	C	N	O	F	He
Na	Mg		III B	IV B	V B	V I B	V II B	V III 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										

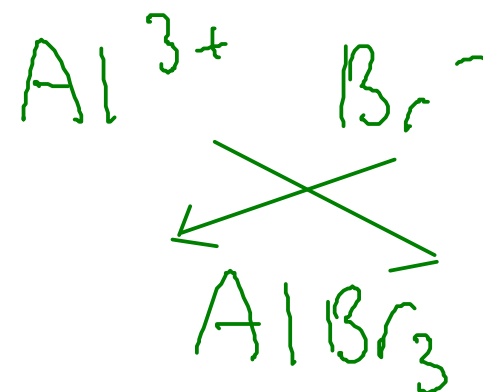
Find the formulas of:

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



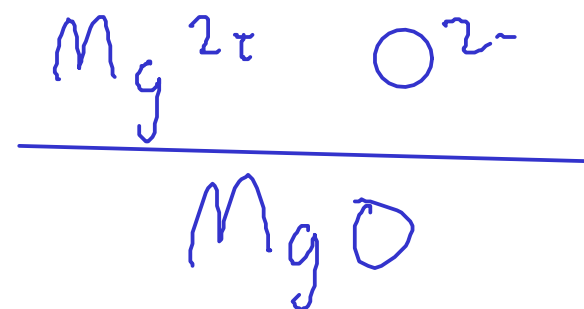
Find the formula of:

* an ionic compound containing Al and Br



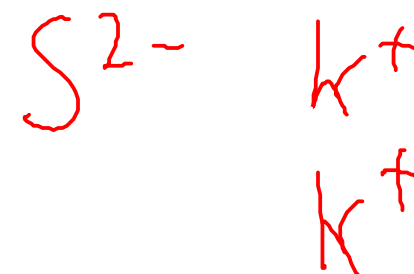
Find the formula of:

* an ionic compound containing Mg and O



Find the formula of:

* an ionic compound containing S and K



Remember: Write cations (+) first in ionic formulas!



TRANSITION METAL IONS

IA		TRANSITION METAL IONS										VIII A					
H	IIA											III A	IV A	V A	VIA	VII A	He
Li	Be											B	C	N	O	F	Ne
Na	Mg	IIIB	IVB	VB	VIB	VII 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								

The transition metals always form CATIONS!

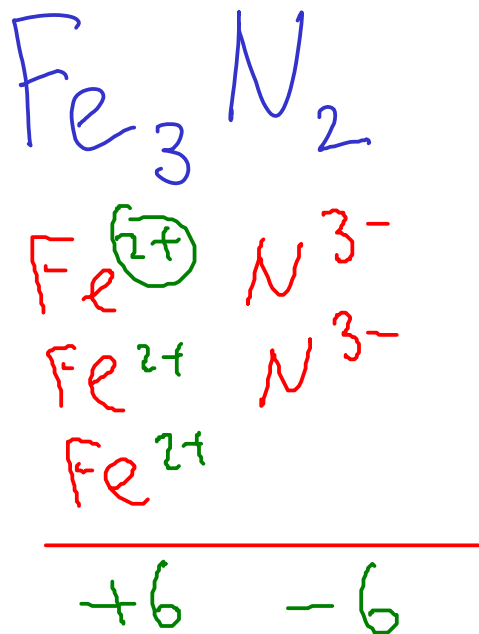
However, many transition metals are capable of forming SEVERAL DIFFERENT CATIONS!

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

TRANSITION METAL CATIONS

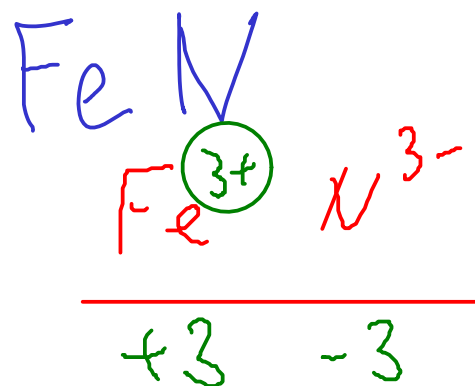
- So how do you know which cation you're dealing with? For now, you'll have to be told
- Either the chemical formula of an ionic compound or the name of an ionic compound can tell you what charge is on the transition metal cation.

Examples:



* The form of iron in this compound has a charge of +2, and is called "iron(II) ion" (pronounced "iron two")

* The compound is called "iron(II) nitride"



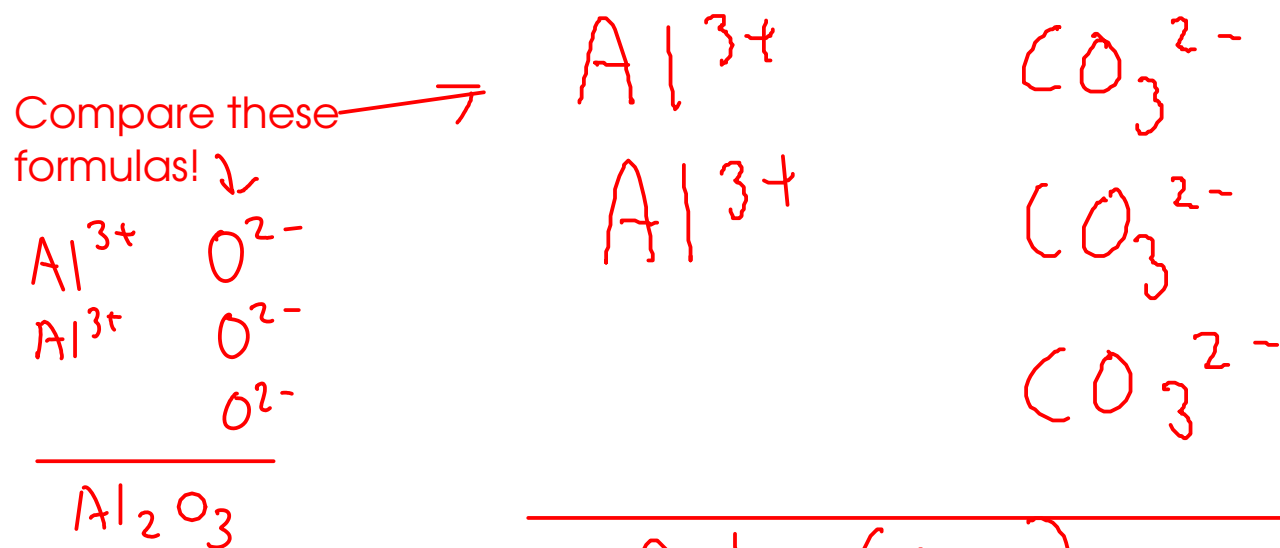
* The form of iron in this compound has a charge of +3, and is called "iron(III) ion" (pronounced "iron three")

* The compound is called "iron(III) 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



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

A chart of common polyatomic ions is available on the course web site!

(p130 - 7th edition)

NAMES OF IONS

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

CATIONS

3 kinds:

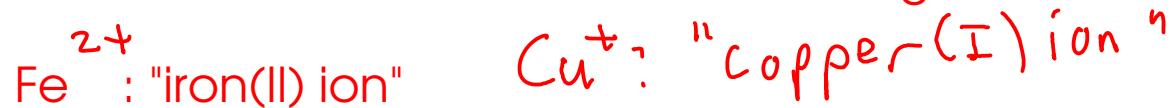
① Main group cations (metals that take only one charge when forming ions)

- 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.



98 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

- List (see web site) (also p130 in textbook 7th ed)

$\text{C}_2\text{H}_3\text{O}_2^{-}$: "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.