



## CHE 1020: Exploring ionic formulas and names<sup>1</sup>

This Introduction to Chemistry course focuses on ionic compounds. This activity helps you learn to relate their formulas to their names. Please work in groups!

The periodic table shown here shows the most common charges of ions formed by some metals and nonmetals. **Please note that this table doesn't show all possible charges for transition metals.**

Periodic Table of the Elements

Period	Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																			He
2		Li <sup>+</sup>	Be <sup>2+</sup>												C <sup>4-</sup>	N <sup>3-</sup>	O <sup>2-</sup>	F <sup>-</sup>	Ne
3		Na <sup>+</sup>	Mg <sup>2+</sup>											Al <sup>3+</sup>		P <sup>3-</sup>	S <sup>2-</sup>	Cl <sup>-</sup>	Ar
4		K <sup>+</sup>	Ca <sup>2+</sup>				Cr <sup>3+</sup> Cr <sup>6+</sup>	Mn <sup>2+</sup>	Fe <sup>2+</sup> Fe <sup>3+</sup>	Co <sup>2+</sup>	Ni <sup>2+</sup>	Cu <sup>+</sup> Cu <sup>2+</sup>	Zn <sup>2+</sup>			As <sup>3-</sup>	Se <sup>2-</sup>	Br <sup>-</sup>	Kr
5		Rb <sup>+</sup>	Sr <sup>2+</sup>									Ag <sup>+</sup>	Cd <sup>2+</sup>				Te <sup>2-</sup>	I <sup>-</sup>	Xe
6		Cs <sup>+</sup>	Ba <sup>2+</sup>								Pt <sup>2+</sup>	Au <sup>+</sup> Au <sup>3+</sup>	Hg <sub>2</sub> <sup>2+</sup> Hg <sup>2+</sup>					At <sup>-</sup>	Rn
7		Fr <sup>+</sup>	Ra <sup>2+</sup>																
				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
				**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**

From Chemistry LibreTexts

### Part A: Focus on electropositive metals that form only one ion:

1. What types of elements can form more than one ion? What region of the periodic table are those elements found in and what are they called?
2. Consider ions of potassium (K) and sulfur (S). Write the chemical formulas for all possible ionic compounds of these ions. Remember that the sum of charges must be net neutral zero!
3. Consider the ions of iron (Fe) and sulfur (S). Write chemical formulas for all possible ionic compounds of these ions. Again, the sum of charges must be net neutral zero!

<sup>1</sup> Adapted from POGIL activities



4. Look at the formulas and names of ionic compounds shown in the table below.
- Which element is named first, the metal or nonmetal?
  - What is the charge of the aluminum ion in aluminum oxide?
  - Explain why aluminum oxide has a ratio of 2 aluminum ions to 3 oxide ions?

formula	name
NaCl	sodium chloride
CaS	calcium sulfide
Rb <sub>2</sub> S	rubidium sulfide
Ba <sub>3</sub> P <sub>2</sub>	barium phosphide
SrS	strontium sulfide
Be <sub>3</sub> P <sub>2</sub>	beryllium phosphide
Al <sub>2</sub> O <sub>3</sub>	aluminum oxide
SrCl <sub>3</sub>	strontium chloride

5. The name of the molecular compound carbon dioxide gives a hint about the number of oxygen atoms in the compound. Is there anything in the name 'aluminum oxide' that indicates that it has two aluminum ions and three oxide ions?
6. Could you create an ionic compound with any other ration of aluminum and oxide ions?
7. Why doesn't the name of ionic compounds need to specify the number of ions in the compound?
8. How is the name of the second, nonmetal, element of ionic compounds modified?
9. Name these ionic compounds.
- Li<sub>2</sub>O
  - MgF<sub>2</sub>
  - Al<sub>2</sub>S<sub>3</sub>
  - K<sub>3</sub>N
10. Write the chemical formulas of these ionic compounds.
- barium chloride
  - magnesium oxide
11. Would the name 'iron sulfide' adequately and accurately describe the two compounds whose formulas you created in question 3? Explain.



**Part B: Metals that form more than one ion: transition metals**

As you've seen, some metal atoms can form more than one ion; that is, they form ions with different charges. This complicates naming a bit because the name must tell the reader which charge the metal ion has in each compound.

formula	name
Cu <sub>2</sub> O	copper (I) oxide
CuO	copper (II) oxide
SnF <sub>2</sub>	tin (II) fluoride
SnF <sub>4</sub>	tin (IV) fluoride
PbO	lead (II) oxide
PbO <sub>2</sub>	lead (IV) oxide
FeCl <sub>2</sub>	iron (II) chloride
FeCl <sub>3</sub>	iron (III) chloride

- How do the names of the ionic compounds shown in the table above differ from those in the first part of this exercise?
- Do the Roman numerals tell you how many cations or anions there are in the ionic compound? Analyze two specific examples.
- Remembering that all ionic compounds must have a net charge of zero, answer these questions using the ionic formulas of the compounds.
  - What is the charge on the copper cations in copper (I) oxide and copper (II) oxide?
  - What is the charge of the iron cations in iron (II) chloride and iron (III) chloride?
- Given your answers to the previous question, what do the Roman numerals indicate?
- Use what you've learned to fill in the missing information in the table below.

formula	cation charge	name
PbCl <sub>4</sub>	+2	lead (IV) chloride
Fe <sub>2</sub> O <sub>3</sub>		
SnO		
CuBr <sub>2</sub>		



17. For each of the compounds in the table below, determine the type of metal in the compound and name the compound to complete the table.

formula	metal forms one ion	metal forms multiple ions	name
CaBr <sub>2</sub>			
MgO			
Ag <sub>3</sub> N (t)			
SnCl <sub>2</sub>			
CuF <sub>2</sub>			
K <sub>3</sub> P			
Zn <sub>3</sub> N <sub>2</sub> (t)			
HgO			

(t) While the periodic table on the first page of this exercise shows only one charge for the metals in these compounds, they are transition metals so please name them accordingly. Ag can take a +2 charge and Zn can take a +1 charge though both ions are rare.

18. During this activity you have developed a process for naming ionic compounds when given their formula and a periodic table. Create a flowchart of questions or criteria that describe this process for naming ionic compounds.