ChemQuest 24

Ionic Bonding

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hour: \_\_\_\_\_

**Information**: Naming Ions

To write an ion, you write the symbol of the atom and put the charge in the upper right corner. Consider the following examples: Al3+, O2-, Mg2+. You should verify that each of the charges is correct.

Positive and negative ions are named differently. Positive ions retain the same name as the parent atom. For example, Al3+ is called the “aluminum ion” and Mg2+ is called the “magnesium ion.” Negative ions are named a little differently. For negative ions, you change the ending of the name to “-ide”. Therefore, O2- is named oxide and P3- is named phosphide.

**Critical Thinking Questions**

* + - 1. Sulfur forms a negatively charge ion. Is the name of the ion sulfur or sulfide? Explain why.
			2. Sodium forms a positive ion. Is the name of the ion sodium or sodide? Explain why.
			3. Write the symbol (including the charge) AND the name for each of the ions for each of the following. The first is done for you.

a) Cl b) Ca c) N d) K e) S f) B g) P

 Cl-1

 chloride

**Information**: Ionic Bonding and Formulas

There are two ways in which atoms can “bond” to each other and form a compound. The means of bonding that we will consider now is called ionic bonding.

**Ionic bonding** occurs between a **metal** and a **nonmetal**. As you know, opposite charges attract.

Ionic bonding is when two ions of opposite charge attract and bond to each other forming an ionic compound.

Consider the following examples of formulas for ionic compounds:

* One Na+ (sodium ion) and one Cl- (chloride ion) bond to make NaCl, “sodium chloride.”
* One Mg2+ (magnesium ion) and two F- (fluoride ion) bond to make MgF2, “magnesium fluoride.”
* Three Ca2+ (calcium ion) and two N3- (nitride ion) bond to make Ca3N2, “calcium nitride.”
* One Al3+ (aluminum ion) and one N3- (nitride ion) bond to make AlN, “aluminum nitride.”

The small numbers at the bottom right of each symbol in a formula are called “subscripts”. Subscripts tell us how many of each type of atom are present. For example in the formula Mg3N2 there are three magnesium ions and two nitride ions.

**Critical Thinking Questions**

* + - 1. Consider the formula NaCl in the above example. It tells us that one Na+ ion is bonded to one Cl- ion. What is the overall charge for NaCl? Is it positive, negative, or neutral?
			2. Consider MgF2.
1. What is the charge on a magnesium ion?
2. What is the charge on a fluoride ion?
3. What is the overall charge on MgF2? Note: The formula “MgF2” tells us that one Mg2+ ion bonds with two F- ions.
	* + 1. Given your answer to question 4 and 5c, what do you think is the overall charge on any ionic compound?
			2. Calcium nitride is written like this: Ca3N2.
4. What is the charge on one calcium ion?
5. What is the charge on one nitride ion?
6. In the formula, Ca3N2, there are 3 calcium ions. What is the total charge on 3 calcium ions? (Hint: multiply 3 times your answer to part a.)
7. In the formula, Ca3N2, there are 2 nitride ions. What is the total charge on 2 nitride ions? (Hint: multiply 2 times your answer to part b.)

e) Why do you think it MUST be written like Ca3N2 and not something like CaN2 or Ca2N3? In other words why do exactly three calcium ions bond with exactly two nitride ions? (Hint: think about what your answers to part c and d equal when added together.)

* + - 1. Why do you think sodium nitride is written Na3N instead of Na2N?
			2. The formula Ca3N2 can never be written as N2Ca3. To find out why, take note of each of the four example formulas given above.
1. What do the first ions named all have in common?
2. What do the second ions named all have in common?
3. Now, why can’t Ca3N2 ever be written like N2Ca3?
	* + 1. There are two rules to follow when writing formulas for ionic compounds. One has to do with charges (see questions 4 ad 5) and the other has to do with which atom to write first and which one to write second (see question 6). What are these two rules?
			2. What is wrong with the following formulas?
4. Al2S b) PNa3 c) MgS2

**Information**: Writing Formulas

Let’s say you needed to write the formula for the compound formed by magnesium and chlorine.

Follow the two steps below to write the formulas:

Step 1: Write the charges for each of the ions. The positive ions should be written first.

Mg+2 and Cl-1

Step 2: Write the positive one first and make sure the charges equal zero. We will need TWO chloride ions to cancel out one magnesium ion.

MgCl­2

Note: many times you can use the “crisscross” method. Write the ions next to each other and like in step one above and then crisscross the charges like below:



* + - 1. Write the formula and name for the compound that forms when the following atoms form ionic compounds. The first is done for you.

a) lithium and chlorine b) barium and sulfur c) magnesium and iodine

 LiCl

 lithium chloride

d) oxygen and aluminum e) calcium and phosphorus f) sodium and sulfur

1. Given the following compounds, determine the charge on the unknown ion “X”. The first one is done for you.
2. X2S b) MgX



c) X3P2 d) X3N