CHEMISTRY LAB: FORMULAS AND CHARGES

WHAT TO TURN IN: Data Table 1, Data Table 2, Questions #1-4

Introduction

A *chemical formula* is a combination of *symbols* and numerical *subscripts* that represents the composition of a compound. The symbols indicate which elements are present and the numerical subscripts indicate the relative proportion of each element in the compound. When atoms acquire a charge they are called *ions*. Ions consisting of more than one atom are *polyatomic ions*. It is important that all scientists use the same system for writing chemical formulas. This helps to ensure clear and consistent transmission of information. Therefore, the following rules should be used for writing chemical formulas:

1. In a neutral compound the sum of the oxidation numbers of the elements and the charges on polyatomic ions in that compound must equal zero.
2. One positive (+) charge will neutralize one negative (-) charge.
3. Ions with positive charges are written first.
4. When the relative proportion of an element in a compound is greater than one, the symbol for that element must be followed by a numerical subscript indicating its relative proportion, as in $MgCl_2$.
5. When the relative proportion of a polyatomic ion in a compound is greater than one, the symbol for the polyatomic ion must be enclosed by parentheses, followed by the correct numerical subscript, as in $Al_2(SO_4)_3$.
6. After combining, any subscripts that can be reduced must be reduced in an ionic compound formula. Example: $Al_3(PO_3)_3$ must be reduced to $AlPO_3$.

Objectives

In this experiment, you will

- cut out models of ions
- match the necessary number of ions until the positive and negative charges equal 0
- predict the correct formulas for the compounds listed

Equipment

- Scissors
- Colored pencils or markers
- Glue stick, liquid glue or tape
- Pencil and paper
- Sheet of ion models

Combining Substances

(NOTE: the correct monatomic anion names are not listed—you have to do that later!)

1. aluminum ion and bromine ion
2. sodium ion and oxygen ion
3. iron(II) ion and sulfur ion
4. aluminum ion and nitrate ion
5. potassium ion and sulfate ion
6. iron(III) ion and chlorine ion
7. ammonium ion and sulfur ion
8. aluminum ion and oxygen ion
9. iron(III) ion and sulfate ion
10. sodium ion and phosphate ion

Procedure

1. Prepare another data table with seven columns on a plain sheet of paper. Use a ruler. Title it **Data Table 1: ions and formulas**.
2. Complete the data table. Remember, BI = binary ionic; TI = ternary ionic.
3. Prepare a data table on a plain sheet of paper. Title it **Data Table 2: cut-out squares**. This is where you will glue your ion combinations.
4. Color each type of ion the same color: such as all cations yellow, all anions green.
5. Cut out each of the "ion" squares from the ion sheet.
6. Construct formulas for the following **combining substances** *listed on the previous page*. You may do this with the crisscross method, but you can check it this way:

   For example, the formula for a compound containing magnesium and chlorine may be determined in the following way: Place the Mg ion on a piece of paper. Place enough Cl ions alongside the Mg ion to balance the charges. (Positive charges must equal negative charges). The formula balances out as $MgCl_2$.

   *** Honors chemistry students must alternate + and – charges. ***
7. When you have the correct combination of ions, glue or tape them down on the paper.
8. Continue for all 10 combinations listed.

DATA TABLE 1: ions and formulas

CATION		ANION		COMPOUND	COMPOUND	BI
SYMBOL	NAME	SYMBOL	NAME	FORMULA	NAME	or TI ?
1._____	_____	_____	_____	_____	_____	_____
2._____	_____	_____	_____	_____	_____	_____
3. _____	_____	_____	_____	_____	_____	_____

etc…

DATA TABLE 2: cut-out squares (on plain paper)

Questions

1) Compare and contrast *monatomic ions* and *polyatomic ions*.
2) Most polyatomic ions end in –ATE or –ITE. Name at least two which end in –IDE.
3) Why is "$NaCl_2$" an incorrect formula?
4) Consider the formula $Ca_3(PO_4)_2$.
   a) How many calcium atoms are there in the entire formula?
   b) What is the charge on the calcium ion?
   c) How many oxygen atoms are there in the entire formula?
   d) How many phosphate ions are there in the entire formula?
   e) Name this compound.