NS G3 (pg 1 of 2) Writing Chemical Formulas for Binary Ionic Compounds

Name___________________Per___

Introduction – review of our class discussion

As you learned in Unit F, metals have loose *valence* electrons, and nonmetals have higher nuclear charge, thus electrons that are more tightly held. Thus when metals and nonmetals come together, to each achieve valence octets, the nonmetals steal electrons from metals. Remember that the number of valence electrons determines the number of electrons that will be lost or gained. The column that the element is in on the Periodic Table can tell us the number of valence electrons. The Table is grouped this way because elements in the same column behave the same way chemically.

No atom can randomly throw off e− or gain e− unless there is some other atom around to accept or provide them. So Na is "standing on the corner," with one very exposed electron − the one extra valence e− and along comes chlorine, able to to acquire one more e− in its valence shell to complete an octet. The atoms come close enough and make the transfer of e− with each atom becoming an ion (and then the opposite charges hold them together), making an ionic compound with the NaCl unit held together by an ionic bond.

Representative Elements – Binary Ionic Compounds

(*Binary* means two elements only)

Using Groups: metals 1A, 2A, 3A, nonmetals 5A, 6A, 7A

What if sodium was around oxygen instead? Na has the one exposed valence electron, but oxygen has room in its valence shell for two electrons in order to achieve an octet. So two Na's are required by the oxygen atom to provide the total of 2e− thereby filling the oxygen octet, making the compound Na_2O

This is the start of writing the chemical formulas for ionic compounds. Remember that the column that the atom is in on the Periodic Table tells us how many valence electrons an atom has which impacts how many e^- that atom is able to lose or gain which results in a particular ion. The short-hand way to write chemical formulas for ionic compounds (remember this is just metals + nonmetals) is to look at the combination of the two ions and combine the correct number of each ion so the total positive charge will be equal (though opposite) to the total negative charge.

The atoms	The ions	The rational for the compound	The formula	The name
Na & Cl	Na^+ Cl^-	Since the +/− charges are equal, only one of each ion is needed to be neutral; no subscripts	NaCl	Sodium chlor*ide*
Na & O	Na^+ O^{2-}	Two sodiums needed to make 2+ to balance with 2−. Use the "criss-cross" method.	Na_2O	Sodium ox*ide*
Na & P	Na^+ P^{3-}	Three sodiums will provide a total of 3 electrons and ending up with a total of 3+ charge which balances the phosphorus' 3− charge. Use the "criss-cross" method.	Na_3P	Sodium phoph*ide*
Ba & F	Ba^{2+} F^-	Two fluorines needed to make 2− to balance the 2+. Use the "criss-cross" method.	BaF_2	Barium flour*ide*
Ba & S	Ba^{2+} S^{2-}	Since the +/− charges are equal, only one of each ion is needed to satisfy; no subscripts	BaS	Barium sulf*ide*
Ba & N	Ba^{2+} N^{3-}	Three bariums will provide a total of 6 electrons (6+ charge) which will satisfy two nitrogens that need a total of 6 electrons (6− charge). Use the "criss-cross" method.	Ba_3N_2	Barium nitr*ide*

A few reminders:

- At this point you have the tools needed to combine elements in columns 1A, 2A, and 3A with columns 5A, 6A, and 7A.
- Notice that the metal (+ ion, cation) is always written first, and the nonmetal (− ion, anion) is always written second.
- Be sure and pay attention to upper and lower case letters, Cs and CS do NOT have the same meaning.
- Remember that the placement of numbers around a symbol have very particular meanings
  - ✓ charges are written as superscripts (top right, X^{2+})
  - ✓ number of ions present in the formula are written as subscripts (lower right, X_3)
  - ✓ Check out the back to see what you should know about charges so far….→

So what about the rest of the metals?

So far the discussion has included only some of the metals in the periodic chart, NS G4 will look at the transition metals and the "other six" metals under the staircase ($_{31}$Ge, $_{50}$Sn, $_{51}$Sb, $_{82}$Pb, $_{83}$Bi, $_{84}$Po).

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