Balancing Charges

Unit: Nomenclature & Formulas

MA Curriculum Frameworks (2016): HS-PS2-6

Mastery Objective(s): (Students will be able to…)

- Write chemical formulas for ionic compounds.

Success Criteria:

- Subscripts are chosen so that positive and negative charges are balanced (equal).

Tier 2 Vocabulary: bond, charge

Language Objectives:

- Explain the process and necessity of balancing charges.

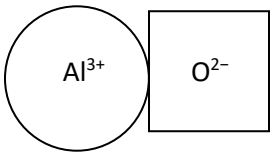
Notes:

If you have an ionic compound (a compound made of positive and negative ions), the positive and negative charges will attract each other (because opposite charges attract). This will continue to happen until the total amount of positive charge equals the total amount of negative charge, and there is no more attraction. When this happens in chemistry, we say that the charges are ***balanced***.

Use this space for summary and/or additional notes:

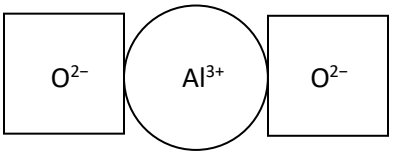
For example, suppose we made a compound from Al^{3+} ions and O^{2-} ions.

1. If we start with an Al^{3+} ion, it is positive, so it will attract a negative O^{2-} ion. This gives:



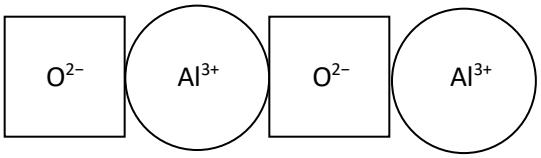
the total charge is now +1

2. Because the net (overall) charge is positive (+1), it will attract another negative O^{2-} ion, giving:



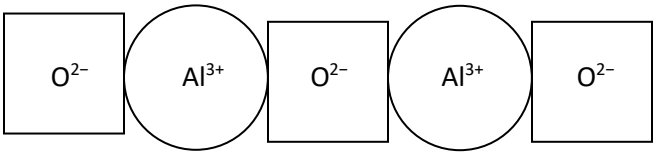
total charge is now −1

3. Now the group is negative, so it will attract a positive Al^{3+} ion, giving us:



total: +2

4. Now the group is positive, so it will attract another negative O^{2-} ion, giving us:



total: 0

5. Finally, all of the positive and negative charges have exactly balanced, and the compound has no net charge. Now it doesn't attract any more positive or negative ions.

6. To balance the charges, we needed 2 Al^{3+} ions and 3 O^{2-} ions, which means the formula for this compound is $(Al^{3+})_2(O^{2-})_3$ or simply Al_2O_3.

Use this space for summary and/or additional notes:

Shortcuts for Balancing Charges

Find the L.C.M.

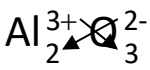
In an ionic compound, *the total positive and total negative charge will always be equal*, and will be the least common multiple (L.C.M.) of the charges of the positive and negative ions.

In the compound made from aluminum and oxygen the charges of the ions are +3 (for Al), and −2 (for O). The LCM of 3 and 2 is 6, which means the total positive charge in the formula will be +6, and the total negative charge in the formula will be −6.

To get +6, we need 2 Al^{3+} ions, and to get −6 we need 3 O^{2-} ions. Thus, the formula is once again $(Al^{3+})_2(O^{2-})_3$ or simply Al_2O_3.

Cross the Charges and Reduce to Lowest Terms

Often, you can "cross the charges" to get the formula:



This always gives a correct ratio, although the ratio may not be in lowest terms. (For example, crossing the charges for Fe^{2+} and O^{2-} would give the compound Fe_2O_2, but the correct formula should be reduced to FeO.)

Use this space for summary and/or additional notes:

Homework Problems

In the chart below,

- Look up and add the appropriate charges to the cation and anion (if the charges are not already labeled).
- Balance the charges and write the formula of the resulting compound.

Cation	Anion	Chemical Formula
NH_4^+	$(PO_4)^{3-}$	$(NH_4)_3\,PO_4$
Sr	S	
Na	Cl	
Ca	Br	
K	O	
Cu^+	Cl	
Cu^{2+}	Cl	
Mg	S	
Ba	P	
Cr^{6+}	O	

Use this space for summary and/or additional notes: