Naming Ionic Compounds

Unit: Nomenclature & Formulas

NGSS Standards/MA Curriculum Frameworks (2016): HS-PS2-6

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

- Write names for ionic compounds using the stock system, including Roman numerals where appropriate.
- Write formulas for ionic compounds based on their names.

Success Criteria:

- Compound names contain the correct cation (including a Roman numeral if necessary) and anion in the correct order (cation first, then anion).
- Chemical formulas have correctly balanced charges.
- Chemical formulas have polyatomic ions in parentheses when necessary.

Tier 2 Vocabulary: compound

Language Objectives:

- Explain when a cation does or does not need a Roman numeral.
- Explain the relationship between the charges of the ions and the subscripts in the formula.

Notes:

ionic compound: a compound made out of the ions of a metal and a nonmetal

cation: an ion with a positive charge, such as Na^+ or Ca^{2+}

anion: an ion with a negative charge, such as Cl^- or S^{2-}

Naming the Anion

- If an anion is a single element, the name of the ion is the name of the element with the ending changed to "ide". For example, the Cl^- ion is made from chlorine, so it is called "chloride". The O^{2-} ion is made from oxygen, so it is called oxide.
- If the anion is a polyatomic ion, its name is just the name of the polyatomic ion. For example, the NO_3^- ion is named "nitrate".

Use this space for summary and/or additional notes:

Naming the Cation

- If the cation is a single element that has only one possible charge, the name of the cation is the name of the element. For example, the K^+ ion is simply named "potassium", and the Ca^{2+} ion is simply named "calcium".
- If the element can have more than one possible charge, the name of the cation is the name of the element followed by a Roman numeral, indicating the charge, in parentheses. For example, chromium can make cations with three different charges:

Formula of Cation	Name of Cation
Cr^{2+}	chromium (II)
Cr^{3+}	chromium (III)
Cr^{6+}	chromium (VI)

- If the cation is a polyatomic ion, its name is the name of the polyatomic ion. For example, the NH_4^+ ion is named "ammonium".

Naming the Compound

stock system: a system of naming compounds by naming the ions that they're made of. The cation (positive ion) is always listed first and the anion (negative ion) is always listed last.

Examples:

Formula	Cation		Anion		Name of Compound
NaCl	Na^+	sodium	Cl^-	chloride	sodium chloride
$CaBr_2$	Ca^{2+}	calcium	Br^-	bromide	calcium bromide
Fe_2O_3	Fe^{3+}	iron (III)	O^{2-}	oxide	iron (III) oxide
FeO	Fe^{2+}	iron (II)	O^{2-}	oxide	iron (II) oxide
K_2SO_4	K^+	potassium	SO_4^{2-}	sulfate	potassium sulfate

Notice that the number of atoms in the chemical formula is not represented anywhere in the name of an ionic compound.

Use this space for summary and/or additional notes:

Writing Formulas from Names

The name of every ion must have enough information to describe its element(s) and its charge. This means that if you know the name of an ion, you know the formula and the charge.

To convert the name of a compound to its formula:

1. Write down the cation and anion, including their charges.
2. Add subscripts to balance the charges. (Don't forget to put polyatomic ions in parentheses when you need more than one!)

Sample Problems:

1. What is the chemical formula for calcium phosphate?

   Calcium is Ca^{2+} and phosphate is PO_4^{3-}. The L.C.M. of the charges is 6. This means we need 3 Ca^{2+} ions to get to +6, and 2 PO_4^{3-} ions to get to −6. Therefore, the formula must be:

   $$Ca_3(PO_4)_2$$

2. What is the formula for nickel (II) chloride?

   Nickel (II) is Ni^{2+} (remember that the Roman numeral tells us the charge) and chloride is Cl^-. The L.C.M. of the charges is 2, which means we need one Ni^{2+} ion to get to +2, and 2 Cl^- ions to get to −2. Therefore, the formula must be:

   $$NiCl_2$$

Use this space for summary and/or additional notes:

Homework Problems

In the chart below:

- Write the element symbol(s) for the cation (positive ion) and anion (negative ion).
- Determine the charges of both ions.
- Balance the charges and write the formula of the resulting compound.

Cation Name	**Cation Formula**	**Anion Name**	**Anion Formula**	**Formula of Compound**
ammonium	NH_4^+	phosphate	PO_4^{3-}	$(NH_4)_3PO_4$
				$SnCl_2$
				FeO
calcium		bromide		
potassium		oxide		
copper (I)		carbonate		
copper (II)		chloride		
magnesium		nitrate		
ammonium		hydroxide		
barium		phosphate		
chromium (VI)		sulfate		

Use this space for summary and/or additional notes: