

Ionic Compounds Containing Transition Metals

The transition metals are the elements located in the middle of the periodic table (in groups 3-12). Unlike the group 1A and 2A metal ions, the charges of transition metal ions are not easily determined by their location on the periodic table. Many of them have more than one charge (also known as an **oxidation state**). There are *eight* transition metals that you should highlight on your periodic table:

Co, Cr, Cu, Fe, Mn, Hg, Sn, and Pb

Each of these elements form **more than one** ion and therefore must be labeled accordingly. For example, iron forms two ions: Fe^{2+} and Fe^{3+} . We call these ions "iron (II) ion" and "iron (III) ion" respectively. (See "Table of Transition Metal Ions").

When naming any ion from the elements listed above, you **MUST** include a Roman numeral in parentheses following the name of the ion. The this roman numeral is equal to the **charge** on the ion. We don't include the "+" because all metal ions are positive. Here are two more examples:

Pb^{4+} = "lead (IV) ion"

Cr^{3+} = "chromium (III) ion"

Similarly, when naming a **compound** containing one of these transition metals, you must include the Roman numeral as well. "Iron Chloride" isn't specific enough since the compound could contain either iron (II) or iron (III) ion. You must specify the charge on the iron.

Iron (II) chloride contains the Fe^{2+} ion. When combined with chloride, Cl^- , we know the formula must be FeCl_2 .

Iron (III) chloride contains the Fe^{3+} ion. This time, three chlorides are required to form a neutral compound. Therefore, the formula is FeCl_3 .

By looking at the formula of an ionic compound, we can determine the charge (oxidation state) of the metal.

Example: Write the **name** of Co_2O_3

1. Recognize that Co, cobalt, is a transition metal. This means that you must include a Roman numeral after its name. So, the basic name will be Cobalt (___) Oxide.
2. To find the charge on cobalt, use oxide as a key. Oxide has a charge of -2 so three oxides will have a charge of -6 .
3. What balances a -6 charge? A $+6$ charge! So, the positive half of the compound must equal $+6$.
4. Since there are two cobalt ions, the charge is split between them. So, each one has a $+3$ charge. Therefore, we are using the Co^{3+} ion and the compound is called **cobalt (III) oxide**.

Remember that anions (negative ions) always have a definite charge. When dealing with compounds containing transition metals, *look to the anion first*. Determine the charge of the anion and then solve to figure out the charge of the cation.

When dealing with metals other than the transition metals, you don't need Roman numerals. In other words, calcium ion, Ca^{2+} is **always** $+2$. Don't call CaCl_2 "calcium (II) chloride." Its name is "calcium chloride."

Nomenclature Worksheet 4:
Ionic Compounds Containing Transition Metals

Please complete the following table:

Name of Ionic Compound	Formula of Ionic Compound
1. Copper (II) sulfate	
2. Copper (I) oxide	
3. Chromium (III) cyanide	
4. Cobalt (II) hydroxide	
5. Silver bromide	
6. Zinc nitrate	
7. Iron (III) acetate	
8. Lead (IV) sulfate	
9.	FeCl_2
10.	PbSO_3
11.	$\text{Co}_2(\text{CO}_3)_3$
12.	AgNO_3
13.	$\text{Zn}(\text{CN})_2$
14.	CuClO_3
15.	$\text{Cr}(\text{OH})_3$
16.	Hg_2O