

3.2: Naming binary ionic compounds

Binary ionic compounds are compounds composed of monoatomic cations and monoatomic anions. For example, NaCl is a binary ionic compound composed of monoatomic cations Na^+ and monoatomic anions Cl^- . Another example is CaCl_2 composed of monoatomic cations Ca^{2+} and monoatomic anions Cl^- .

Charge on monoatomic ions

Nonmetals and metalloids of group 14 to group 17 usually form monoatomic anions. The charge on the anions is equal to the group number minus eighteen. For example, halogens in group 17 have charge: $17-18 = -1$, oxygen in group 16 has charge: $16-18 = -2$, and nitrogen in group 15 has charge: $15-18 = -3$. Metals usually form cations: metals of group 1 form +1, metals of group 2 form +2, and aluminum of group 13 form +3 charge on cations, as shown in Fig. 3.2.1. Other metals have variable charges in compounds. The charge of the metals having variable charge can be calculated from the compound's chemical formula because the total -ve charge should be equal to the total +ve charge to make the compound neutral.

✓ Example 3.2.1

calculate the charge of iron ion in FeCl_2 ?

Solution

There are two chloride anions, each with a -1 charge, making a total of -2. So the charge on cation has to be +2 to balance the negative charge. Answer: Fe^{2+} .

✓ Example 3.2.2

Calculate the charge on an iron ion in Fe_2O_3 ?

Solution

There are three oxygen anions, each with a -2 charge, making -6. So the total charge on two iron atoms should be +6, i.e., the charge on iron atoms is +3. Answer: Fe^{3+} .

1																		18	
1		2												13	14	15	16	17	He
2	Li ⁺	Be ²⁺													C ⁴⁻	N ³⁻	O ²⁻	F ⁻	Ne
3	Na ⁺	Mg ²⁺												Al ³⁺		P ³⁻	S ²⁻	Cl ⁻	Ar
4	K ⁺	Ca ²⁺				Cr ³⁺ Cr ⁶⁺	Mn ²⁺	Fe ²⁺ Fe ³⁺	Co ²⁺	Ni ²⁺	Cu ⁺ Cu ²⁺	Zn ²⁺				As ³⁻	Se ²⁻	Br ⁻	Kr
5	Rb ⁺	Sr ²⁺									Ag ⁺	Cd ²⁺					Te ²⁻	I ⁻	Xe
6	Cs ⁺	Ba ²⁺									Pt ²⁺	Au ⁺ Au ³⁺	Hg ₂ ²⁺ Hg ²⁺					At ⁻	Rn
7	Fr ⁺	Ra ²⁺																	

Figure 3.2.1: The charges on common ions. Download for free at <https://openstax.org/details/books/chemistry>.

Names of monoatomic ions

Name of a monoatomic anion

The name of a monoatomic anion is the element's name with the last syllable replaced with -ide ion. For example, Cl^- is a chloride ion, O^{2-} is an oxide ion, N^{3-} is a nitride ion, S^{2-} is sulfide ion, and C^{4-} is a carbide ion, derived from the element names chlorine, oxygen, nitrogen, sulfur, and carbon, respectively.

Name of a monoatomic cation having a fixed charge

Alkali metals have +1, alkaline earth metals have +2, and aluminum has +3 charge. Their name is the name of the element ending with ion. For example, Na^+ is a sodium ion, Ca^{2+} is a calcium ion, and Al^{3+} is an aluminum ion.

Name of a monoatomic cation having a variable charge

The names of the cations that have a variable charge is the name of the element followed by charge in roman numeral enclosed in small brackets and ending with ion. For example, Fe^{2+} is an iron(II) ion, and Fe^{3+} is an iron(III) ion, Cu^+ is a copper(I) ion, and Cu^{2+} is a copper(II) ion.

📌 Ions in body fluids

The ions that are important in body fluids include sodium ion (Na^+), potassium ion (K^+), calcium ion (Ca^{2+}), magnesium ion (Mg^{2+}), and chloride ion (Cl^-), as shown in Fig. 3.2.2. Na^+ is present in fluids inside the cells. It regulates and controls body fluids. K^+ is present in fluids outside the cells and regulates body fluids and cell functions. Ca^{2+} and Mg^{2+} are present in the body fluids outside the cells, where Ca^{2+} is needed for muscle contraction, Mg^{2+} is needed for muscle contraction, nerve control, and enzymes. Cl^- is primarily present to balance the charge of the cations in the body fluids.

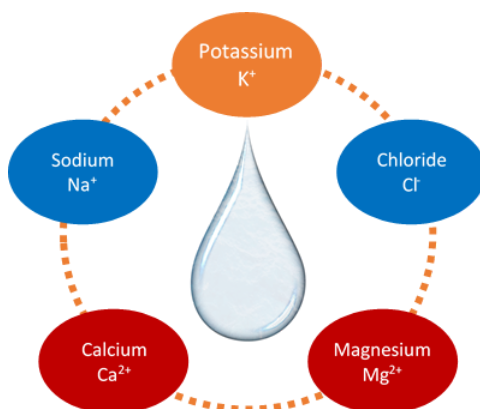


Figure 3.2.2: Electrolytes usually found in body fluids.

Writing the formula of a binary ionic compounds

The formula of an ionic compound is the symbol of the cation element with a subscript number followed by the symbol of the anion element with a subscript number. The formula shows the simplest whole-number ratio of the constituent elements in the subscripts, such that the total positive charge is equal to the total negative charge. script on the right of the symbols tell the number if they're more than one atom of the element.

📌 Rules of writing the formula of a binary ionic compound

The rules are illustrated in Fig. 3.2.3:

1. Write cation followed by anion with charges,
2. swap the charge as a subscript of the opposite ion,
3. simplify the subscript to the simplest whole-number ratio,
4. use the simplified subscript in the final formula, and
5. do not write the subscript if it is one.

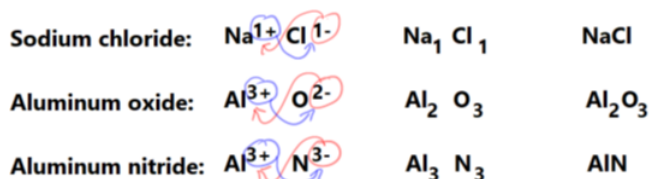


Figure 3.2.3: Rules to write the formula of the binary ionic compounds.

Writing the names of an ionic compound from the formula

Writing the name of ionic compounds of cations with fixed charge

If the cation has a fixed charge in compounds, the name starts with the name of the element of the cation, followed by the name of the anion without the word ion at the end. For example, KI is potassium iodide, and CaCl_2 is calcium chloride.

Writing the name of ionic compounds of cations with variable charge

Write the name of the cation, including the charge in roman numerals enclosed in small brackets but without the word ion at the end, followed by the name of the anion, without ion at the end. For example, FeCl_2 is iron(II) chloride, and Fe_2O_3 is iron(III) oxide. Additional examples are given in Table 1.

Transition metals with fixed charge

Silver, zinc, and cadmium cations have fixed charges: Ag^+ , Zn^{2+} , and Cd^{2+} . Names of these cations are the names of the element with or without charge shown in roman numerals, both ways it is correct.

Table 1: Examples of writing names from the formulae of binary ionic compounds

Example#	Formula	Name of the cation	Name of the anion	Name of the compound
1	NaCl	Sodium ion	Chloride ion	Sodium chloride
2	Al_2O_3	Aluminum ion	Oxide ion	Aluminum oxide
3	FeCl_3	Iron(III) ion	Chloride ion	Iron(III) chloride
4	CuO	Copper(II) ion	Oxide ion	Copper(II) oxide
5	AgCl	Silver(I) ion, or Silver ion	Chloride ion	Silver(I) chloride, or Silver chloride

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