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Experiment worksheet

3.5 Metal cations and non-metal anions combine to form ionic compounds

Pages 78–79 and 198

Skills lab 3.5: Ionic compounds

Ionic compounds are those formed from the bonding of ions. Consider sodium chloride, which is produced when sodium and chlorine meet and react. In this compound, the metal sodium is present in the form of positively charged ions (Na^+) and the non-metal chlorine is present as negatively charged ions (Cl^-). Notice that the:

- metal is named first and its name is not changed
- non-metal is named second and the end of its name is changed from -ine to -ide.

This obeys the following standard naming convention.

- The positively charged ion (cation) in the compound is written first and keeps the name of the metal from which it was formed.
- The negatively charged ion (anion) in the compound is written second. The end of the name of the non-metal from which it formed is replaced with -ide.
- Some transition metals can form more than one ion. In these cases, a Roman numeral is used to show the charge on the ion. For example, copper forms two ions: one with a 1+ charge and one with a 2+ charge. These ions are called copper(I) and copper(II) ions, respectively.

Cations		Anions	
Name	**Formula**	**Name**	**Formula**
Lithium	Li^+	Fluoride	F^-
Sodium	Na^+	Chloride	Cl^-
Potassium	K^+	Bromide	Br^-
Magnesium	Mg^{2+}	Iodide	I^-
Calcium	Ca^{2+}	Oxide	O^{2-}
Aluminium	Al^{3+}	Sulfide	S^{2-}
Silver	Ag^+	Nitride	N^{3-}
Zinc	Zn^{2+}		
Copper(II)	Cu^{2+}		
Iron(II)	Fe^{2+}		
Iron(III)	Fe^{3+}		

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The formula for sodium chloride is NaCl, whereas the formula of magnesium chloride is $MgCl_2$. The formula NaCl means that the cations and anions are present in a ratio of 1:1. That is, for every Na^+ ion present in a sodium chloride crystal, there is one Cl^- ion present. The formula $MgCl_2$ means that the cations and anions are present in a ratio of 1:2. That is, for every Mg^{2+} ion present in a magnesium chloride crystal, there are two Cl^- ions present. This is necessary to achieve an overall neutral charge.

We can use this principle to determine the formula of an ionic compound. First, use Table 8.1 to list the formulas of the cations and anions present. Then, work out the simplest ratio they need to be in so that the total positive charge and total negative charge are equal.

Example

1 What is the formula for iron(II) oxide?

- The ions are Fe^{2+} and O^{2-}.

- Because the charges 2+ and 2– are equal, the ions only need to be in a ratio of 1:1.

- Therefore, the formula is FeO.

2 What is the formula for silver sulfide?

- The ions are Ag^+ and S^{2-}.

- Because the charges are 1+ and 2–, the ions need to be in a ratio of 2:1 (making it a total of 2+ and 2–).

- Therefore, the formula is Ag_2S.

Your turn

Write the formulas for:

a lithium bromide	
b iron(III) chloride	
c sodium nitride	
d aluminium oxide	

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