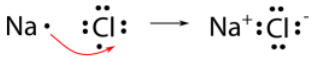
5.1.7: Ionic Bonds

Learning Objectives

- Define an ionic bond, ionic compound, and electrostatic force
- Recognize the complexity of three-dimensional ionic bond interactions involved in ionic compounds

Oppositely charged particles attract each other. This attractive force is often referred to as an **electrostatic attraction**. An **ionic bond** is the electrostatic electrostatic attraction that holds ions together in an **ionic compound**. The strength of the ionic bond is directly dependent upon the quantity of the charges and inversely dependent on the distance between the charged particles. A cation with a 2+ charge will make a stronger ionic bond than a cation with a 1+ charge. A larger ion makes a weaker ionic bond because of the greater distance between its electrons and the nucleus of the oppositely charged ion.

We will use sodium chloride as an example to demonstrate the nature of the ionic bond and how it forms. As you know, sodium is a metal and loses its one valence electron to become a cation. Chlorine is a nonmetal and gains one electron in becoming an anion. However, electrons cannot be simply "lost" to nowhere in particular. A more accurate way to describe what is happening is that a single electron is transferred from the sodium atom to the chlorine atom as shown below.



The ionic bond is the attraction of the Na^+ ion for the Cl^- ion. It is conventional to show show the cation without dots around the symbol to emphasize that the original energy level that contained the valence electron is now empty. The anion is now shown with a complete octet of electrons.

Ionic compounds are held together by attractive electrostatic interactions between cations and anions. In contrast to the simplified electron transfer depicted above for sodium and chlorine, the cations and anions in ionic compounds are arranged in space to form an extended three-dimensional array that maximizes the number of attractive electrostatic interactions and minimizes the number of repulsive electrostatic interactions (Figure 5.1.7.1). In other words, each ion is attracted to many of its neighboring ions forming a sodium chloride crystal or **ionic solid**.

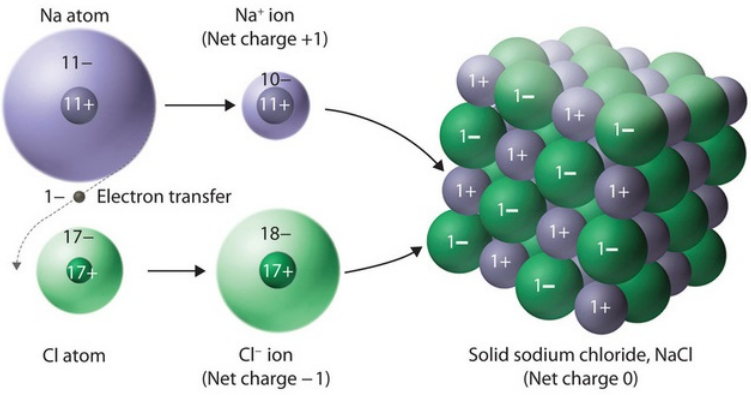


Figure 5.1.7.1: Ionic Bonding. The ionic compound NaCl forms when electrons from sodium atoms are transferred to chlorine atoms. The resulting Na^+ and Cl^- ions form a three-dimensional solid that is held together by attractive electrostatic interactions.

Contributors and Attributions

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