3.3: Lewis Representation of Ionic Compounds

As mentioned in Section 3.1, elements can also *transfer* electrons to another element in order to achieve the noble gas configuration. Consider sodium. Sodium (Na) is in Group 3A. Its first energy level is completely filled ($1s^2$), the second energy level is also filled ($2s^2\ 2p^6$) and there is a single electron in the third energy level ($3s^1$). Energetically, the easiest way for sodium to achieve an octet of valence electrons is by *transferring* its valence electron to an acceptor atom. This will leave the sodium atom with the same electron configuration as neon ($1s^2 2s^2\ 2p^6$), and will satisfy the "octet rule". Because sodium *loses* one electron (with its negative charge) the sodium atom must now have a positive charge. Atoms, or covalently bound groups of atoms with a positive charge are called **cations**, and the sodium cation is written as Na^+.

If the acceptor atom in the example above was chlorine, the third valence shell would now be filled, matching the electron configuration of argon. Because the chlorine atom has *accepted* an electron, with its negative charge, the chlorine atom must now have a negative charge. Atoms, or covalently bound groups of atoms with a negative charge are called **anions**, and the chlorine anion is written as Cl^-. Although electron transfer has occurred between the two atoms in this example, there is *no direct bond* holding the sodium cation and the chlorine anion together, other than the simple electrostatic attraction between the two charged atoms. This is the real difference between ionic and covalently bound atoms; covalent molecules are held together in a *specific geometry* which is dictated by the electrons that they share. Ionic compounds are held together by simple electrostatic attraction and, unless these atoms are present in organized crystals, there is no defined geometric order to this attraction. Ionic compounds are often referred to as **salts**.

? Exercise 3.3.1

a. Hydrogen and oxygen react to form water, H_2O. Draw a Lewis diagram for water using the line-bond shorthand.
b. Draw the Lewis diagram for the molecules, hydrogen chloride, BrCl, and hydrogen cyanide (HCN).