3.4: Identifying Molecular and Ionic Compounds

The tendency for two or more elements to combine and form a molecule that is stabilized by covalent bonds (a molecular compound) can be predicted simply by the location of the various elements on the periodic table. In Chapter 1, we divided the elements in the periodic table into (seemingly) arbitrary groupings; the metals, the non-metals, the semi-metals, and so on. These groupings are not arbitrary, but are largely based on physical properties and on the tendency of the various elements to bond with other elements by forming either an ionic or a covalent bond. As a general rule of thumb, compounds that involve a metal binding with either a non-metal or a semi-metal will display ionic bonding. Compounds that are composed of only non-metals or semi-metals with non-metals will display covalent bonding and will be classified as molecular compounds. Thus, the compound formed from sodium and chlorine will be ionic (a metal and a non-metal). Nitrogen monoxide (NO) will be a covalently bound molecule (two non-metals), silicon dioxide (SiO_2) will be a covalently bound molecule (a semi-metal and a non-metal) and $MgCl_2$ will be ionic (a metal and a non-metal). Later in this chapter we will see that many covalent compounds have bonds that are highly **polarized** with greater electron density around one atom than the other. These compounds are often described as having "ionic character" and these types of covalent bonds can often be readily broken to form sets of ions.

? Exercise 3.4.1

a. Determine whether each of the following compounds is likely to exist as a molecule, or as an ionic compound:

i. Hydrogen fluoride; HF
ii. Silicon tetrachloride; $SiCl_4$
iii. Elemental sulfur as S_8
iv. Disodium dioxide; Na_2O
v. PF_3
vi. Be_3N_2
vii. AlP
viii. CBr_4