4.4: Covalent Bonds in H2 and Other Molecules

Lewis symbols can be used to show how some atoms of elements on the left side of the table with only one or two outer-shell electrons can lose those electrons to form cations such as Na^+ or Ca^{2+}. It is also easily seen that atoms from groups near the right side of the periodic table can accept one or two electrons to gain stable octets and become anions such as Cl^- or O^{2-}. But, it is difficult to impossible to take more than two electrons away from an atom to form cations with charges greater than +2 or to add 3 or more electrons to form anions with charges of -3 or even more negative, although ions such as Al^{3+} and N^{3-} do exist. So atoms of elements in the middle of the periodic table and the nonmetals on the right have a tendency to share electrons in covalent bonds, rather than becoming ions.

It is readily visualized how mutually attracting ions of opposite charge are held together in a crystalline lattice. Shared electrons in covalent bonds act to reduce the forces of repulsion between the positively charged nuclei of the atoms that they join together. That is most easily seen for the case of the hydrogen molecule, H_2. The nuclei of H atoms consist of single protons, and the two H atom nuclei in the H_2 molecule repel each other. However, their 2 shared electrons compose a cloud of negative charge between the two H nuclei, shielding the nuclei from each other's repelling positive charge and enabling the molecule to exist as a covalently bound molecule (Figure 4.7).

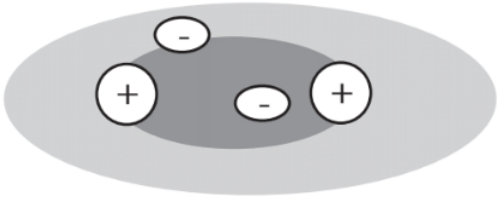

Figure 4.7. Electrons in motion between and around mutually repelling H nuclei shield the nuclei from each other constituting a single covalent bond that holds the H_2 molecule together