1.2.1

Chemical Reactions

Close examination of the periodic table will show that the atoms of all of the elements in the last column of the table (i.e., helium, neon, argon, etc.) have eight electrons in their outer shells (with the exception of helium). Therefore, their outer electron shells are full. These elements are known as the noble gases, they are all stable, meaning that they do not react with other elements and are given the name **noble** gases. The octet rule states that if there are eight electrons in the outer electron shell, the element is stable. The atoms of all of the other elements have vacancies in their outer electron shells and will react with other atoms to fill their outer shells. At the broadest level, this process is described using chemical reactions.

In a chemical reaction, the substances used to start the reaction are called **reactants** and the resultant substances following the reaction are called **products**. To describe the reaction visually, we use a chemical equation (similar to a mathematical equation) where the reactants are on the left side of the equation and the products on the right side. Instead of an equal sign we use an arrow. The arrow allows us more flexibility to describe the direction of the equation as oftentimes the products can go back towards the reactants. Chemical reactions that proceed in only one direction are called **irreversible** reactions, while chemical reactions that can run in either direction are called **reversible** reactions. Reversible chemical reactions are dependent upon a principle called **LeChatlier's** principle which states that the system will proceed in a direction that minimizes the amount of change. In other words, it will process in whichever way will bring the system back into homeostatic equilibrium or homeostasis. For example, if we add a reactant or remove a product the equation will go towards the products (right) and if we add product or remove a reactant the equation will drive towards the reactants (left). It is important to understand that homeostatic equilibrium does not mean equal parts of reactants and products, because every chemical reaction has a different equilibrium point with some favoring reactants and some favoring products. This concept is described as the **equilibrium constant (K)** which is equal to the concentration of products over the concentration of reactants at equilibrium. If K = 1, then there are equal amounts of products and reactants. A K-value less than 1 would indicate more reactants than products and a K value above 1 would favor products over reactants at equilibrium.