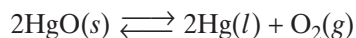


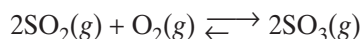
combine to form mercury(II) oxide at the same rate that mercury(II) oxide decomposes into mercury and oxygen. The amounts of mercury(II) oxide, mercury, and oxygen can then be expected to remain constant as long as these conditions persist. At this point, a state of dynamic equilibrium has been reached between the two chemical reactions. Both reactions continue, but there is no net change in the composition of the system. *A reversible chemical reaction is in **chemical equilibrium** when the rate of its forward reaction equals the rate of its reverse reaction and the concentrations of its products and reactants remain unchanged.* The chemical equation for the reaction at equilibrium is written using double arrows to indicate the overall reversibility of the reaction.



Module 7: Equilibrium

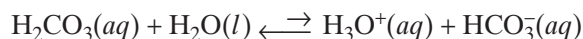
Equilibrium, a Dynamic State

Many chemical reactions are reversible under ordinary conditions of temperature and concentration. They will reach a state of equilibrium unless at least one of the substances involved escapes or is removed from the reaction system. In some cases, however, the forward reaction is nearly completed before the rate of the reverse reaction becomes large enough to establish equilibrium. Here, the products of the forward reaction are favored, meaning that at equilibrium there is a higher concentration of products than of reactants. Hence, we can say that the equilibrium “lies to the right,” because products predominate, and products conventionally are written on the right-hand side of a chemical equation. An example of such a system is the formation of sulfur trioxide from sulfur dioxide and oxygen.



Notice that the equation is written showing an inequality of the two arrow lengths. The forward reaction is represented by the longer arrow to imply that the product is favored in this reaction.

In other cases, the forward reaction is barely under way when the rate of the reverse reaction becomes equal to that of the forward reaction, and equilibrium is established. In these cases, the amounts of reactants remain high and the amounts of products are low. Here we say that the equilibrium “lies to the left,” because the reactants are the predominant species. An example of such a system is the acid-base reaction between carbonic acid and water.



In still other cases, both forward and reverse reactions occur to nearly the same extent before chemical equilibrium is established. Neither reaction is favored, and considerable concentrations of both reactants