Chemical Equilibrium

Equilibrium is a state of a system where the entropy is at its maximum and the free energy is at its minimum. This state is considered to be the most stable state of the system. In chemical reactions, equilibrium is reached when all the measurable properties such as moles, pressure, and concentration become constant. At equilibrium, the rate of the forward reaction is equal to the rate of the backward reaction.

Graphical Overview of Equilibrium

Let's understand equilibrium with the help of a graph. Consider the reaction A ⟶ B, which is taking place in a container of volume V. Initially, at time t = 0, we have 10 moles of reactant A. As the reaction proceeds, the moles of A will decrease and the moles of B will increase. Eventually, there will be a point where the rate of the forward reaction is equal to the rate of the backward reaction, and this is called the equilibrium state.

When a reaction reaches equilibrium, it means that the forward and backward reactions are occurring at the same rate. At equilibrium, the concentration of reactants and products becomes constant. For example, if 20% of the reaction is completed at equilibrium, it means that 20% of the reactant has been converted into products. The number of moles of reactants and products does not change at equilibrium. Concentration, which is defined as the number of moles per unit volume, also becomes fixed at equilibrium. The concentration of reactants and products can be represented graphically over time. There can be different scenarios where the concentration of reactants is greater than, equal to, or less than the concentration of products at equilibrium. These different scenarios can be represented by different graphs. The point where the concentration of reactants and products becomes constant is the equilibrium position. At this point, the system is most stable.

Graphs can accurately represent equilibrium by showing the concentration of reactants and products over time. The concentration of reactants decreases with time and then becomes constant, while the concentration