

The Law of Mass Action states that the rate of a chemical reaction is directly proportional to the concentrations of the reactants. For the reversible reaction $A + B \rightleftharpoons C + D$, the forward reaction rate (V_f) is proportional to the concentrations of A and B: $V_f \propto [A][B]$ or $V_f = K_f[A][B]$, where K_f is the forward reaction rate constant. Similarly, the backward reaction rate (V_b) is proportional to the concentrations of C and D: $V_b \propto [C][D]$ or $V_b = K_b[C][D]$, where K_b is the backward reaction rate constant. At equilibrium, the forward and backward rates are equal: $V_f = V_b$. This leads to the equation $K_f[A][B] = K_b[C][D]$, which can be rearranged to give the equilibrium constant: $K_{eq} = [C][D] / [A][B] = K_f / K_b$