Chapter 12 – Equilibrium

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- Products can reverse into reactants:

1. $\begin{array}{l} 2\,NO_2 \longrightarrow N_2O_4 \quad (forward) \\ 2\,NO_2 \longleftarrow N_2O_4 \quad (reverse) \end{array}$

- Reaction rate is dependent on concentration (high concentration, fast rate; low concentration, slow rate)
- Forward rate vs. Reverse rate:
    1. Once equilibrium is reached, the concentrations stay the same, even though reactions continue (forward rate = reverse rate)
- Equilibrium Expressions (Only for gases and aqueous solutions)
    1. Ex. $N_2 + 3\,H_2 \rightleftharpoons 2\,NH_3$, where k_c is a concentration constant, and k_p is a pressure constant

$$\begin{aligned} k_c &= \frac{[NH_3]^2}{[N_2][H_2]^3} \\ k_p &= \frac{P_{NH_3}}{P_{N_2} \cdot P_{H_2}} \\ k_p &= k_c\,(RT)^{\Delta n} \end{aligned} \tag{1}$$

- If coefficients are multiplied by n, then:

$$k = k^n \tag{2}$$

- If the reaction is reversed, then:

$$k = \frac{1}{k} \tag{3}$$

- If the reaction occurs in multiple steps, multiply the individual k values by each other
- Important to note: liquids and solids are not included in the k expression, regard them as ones