

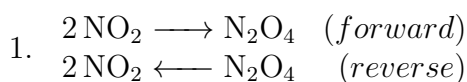
# Chapter 12 – Equilibrium

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- Products can reverse into reactants:



- 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.  $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ , where  $k_c$  is a concentration constant, and  $k_p$  is a pressure constant

$$\begin{aligned}k_c &= \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} \\k_p &= \frac{P_{\text{NH}_3}}{P_{\text{N}_2} \cdot P_{\text{H}_2}^3} \\k_p &= k_c (RT)^{\Delta n}\end{aligned}\tag{1}$$

- 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