D. B. College (Jaynagar) Lect-5
Chemistry Department B.Sc. (I) (Hons)
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Chemical Equilibrium

Factors affecting Equilibrium Const.

1. Representation:

$A \rightleftharpoons B$ $\quad K_c = \frac{[B]}{[A]}$

$B \rightleftharpoons A$ $\quad K_c' = \frac{[A]}{[B]}$

$K_c' = \frac{1}{K_c}$

2. Stoichiometry:

$3A \rightleftharpoons 3B$

$$K_c' = \frac{[B]^3}{[A]^3} = K_c^3$$

$nA \rightleftharpoons nB \quad K_c' = K_c^n$

$\frac{1}{3}A \rightleftharpoons \frac{1}{3}B \quad K_c' = \frac{[B]^{1/3}}{[A]^{1/3}} = \left(\frac{[B]}{[A]}\right)^{1/3}$

$\frac{1}{n}A \rightleftharpoons \frac{1}{n}B \quad K_c' = K_c^{1/n}$

3. Muti-Step reacⁿ, —

① $A \rightleftharpoons B \quad K_1 = [B]/[A]$

② $C \rightleftharpoons D \quad K_2 = \frac{[D]}{[C]}$

① + ② $A + C \rightleftharpoons B + D$ $\quad K = \frac{[B][D]}{[A][C]}$

$K = K_1 \cdot K_2$

① − ② $A + B \rightleftharpoons B + C$ $\quad K = \frac{[B][C]}{[A][D]}$

$K = \frac{K_1}{K_2}$

$A \rightleftharpoons B \quad K_1$

$B \rightleftharpoons C \quad K_2$

$C \rightleftharpoons D \quad K_3$

$A \rightleftharpoons D \quad K = K_1 \cdot K_2 \cdot K_3$

$D \rightleftharpoons A \quad K = \frac{1}{K_1 \cdot K_2 \cdot K_3}$

Ques $A \rightleftharpoons B \quad K_1$

$C \rightleftharpoons B \quad K_2$

$C \rightleftharpoons D \quad K_3$

$D \rightleftharpoons A \quad K = ?$

②

$\frac{1}{K_2}$

$A \rightleftharpoons D \quad K_1 \times \frac{1}{K_2} \times K_3$

$D \rightleftharpoons A \quad K = \frac{1}{K_1 \times \frac{1}{K_2} \times K_3} = \frac{K_2}{K_1 K_2}$

Ques $A \rightleftharpoons B$ K_1

$2C \rightleftharpoons 2B$ K_2

$D/2 \rightleftharpoons C/2$ K_3

① - ② / 2 - ③ ×2

$A \rightleftharpoons D$ $K = ?$

① $-\frac{1}{2}$ ② $-2 \times$ ③

$K_1 \times \frac{1}{K_2^{1/2}} \times \frac{1}{K_3^2}$

Ques

$3B \rightleftharpoons 3A$ K_1

$2C \rightleftharpoons 2B$ K_2

$C \rightleftharpoons D$ K_3

$D \rightleftharpoons A$ $K = ?$

$\frac{1}{3}$ ① $+ \frac{1}{2}$ ② $-$ ③

$K = K_1^{\frac{1}{3}} \; K_2^{\frac{1}{2}} \; \frac{1}{K_3}$

4. Temperature!

$$\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

Vant Hoff Eqn

K_1 is eqm Const. at Temp T_1

K_2 is eqm Const. at Temp T_2

$\Delta H \rightarrow$ Heat of reac^n

$$\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303R}\left[\frac{T_2 - T_1}{T_1 \cdot T_2}\right]$$

Let $T_2 > T_1$

Case 1 If process is exothermic $\Delta H = -ve$

$$\log \frac{K_2}{K_1} < 0$$

$$\log K_2 - \log K_1 < 0$$

$$\log K_2 < \log K_1$$

$$\boxed{K_2 < K_1}$$ → in an exothermic process as T ↑ value of eqm Const. ↓

Case 2 If process is endothermic $\Delta H = +ve$

$$\log K_2/K_1 > 0$$

$$\log K_2 - \log K_1 >$$

$$\log K_2 > \log K_1$$

$$\boxed{K_2 > K_1}$$ → in an endothermic process as T ↑ value of eqm Const. ↑

$\Delta H = 0 \quad K_1 = K_2$