Sample Problems

Eq (4) Q_p / Q_c - Reaction Quotients

(1) Write the Q_c expressions for the following rxns.

(a) $2N_2O_{(g)} \rightleftharpoons 2N_{2(g)} + O_{2(g)}$ $\quad Q_c = \frac{[N_2]^2[O_2]}{[N_2O]^2}$

(b) $HF_{(aq)} \rightleftharpoons H^+_{(aq)} + F^-_{(aq)}$ $\quad Q_c = \frac{[H^+][F^-]}{[HF]}$

(c) $CH_{4(g)} + 2H_2S_{(g)} \rightleftharpoons CS_{2(g)} + 4H_{2(g)}$ $\quad Q_c = \frac{[CS_2][H_2]^4}{[CH_4][H_2S]^2}$

$Q_c < K_c$ eq. move right (products) ; $Q_c = K_c$ eq. ; $Q_c > K_c$ eq. move left (reactant)

(2) The K_c for $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ is 1.2 at 375°C. What is the direction if the eq. if the conc. of each component is as follows:
$[H_2] = 0.76M$, $[N_2] = 0.60M$ and $[NH_3] = 0.48M$

Ans $Q_c = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{(0.48)}{(0.60)(0.76)^3} = 0.87$

$Q_c < K_c$; 0.87 < 1.2 → right

(3) For the reaction $H_2S_{(g)} + I_{2(s)} \rightleftharpoons 2HI_{(g)} + S_{(s)}$, $K_p = 1.34 \times 10^{-5}$ at 60°C. Which gas will decrease in pressure if starting pressures are: $H_2S = 0.010$ atm ; $HI = 0.001$ atm:

Ans $Q_p = \frac{(P_{HI})^2}{(P_{H_2S})} = \frac{(0.0010)^2}{(0.010)} = 1.0 \times 10^{-4}$; $K_p = 1.34 \times 10^{-5}$

$K_p < Q_p$; $Q_p > K_p$ ← reactant increases. H_2S ↓