Quiz 18.3 – Gibbs Energy and Equilibrium

Name: Key

Question 1

Consider the reaction at 25.0 °C: $N_2(g) + O_2(g) \rightleftharpoons 2\,NO(g)$ $\quad \Delta G^\circ = 175.2 \frac{kJ}{mol}$

- Find ΔG if $P_{N_2} = 0.250\ atm$, $P_{O_2} = 0.100\ atm$, and $P_{NO} = 3.50\ atm$

$\Delta G = \Delta G^\circ + RT \ln Q$ $\qquad Q = \frac{3.50^2}{0.250 \cdot 0.100} = 490$

$\Delta G = 175.2\ kJ/mol + 0.008314\ kJ/mol\cdot K \cdot 298\ K \cdot \ln 490 = 190.5\ kJ/mol$

- Find the equilibrium constant for this reaction

$\Delta G^\circ = -RT \ln K$

$K = e^{-\frac{\Delta G^\circ}{RT}} = 1.95 \cdot 10^{-31}$

Question 2

Consider the reaction at 25.0 °C: $2\,NO(g) + O_2(g) \rightleftharpoons 2\,NO_2(g)$ $\quad K = 6.4 \times 10^9$

- Find ΔG° for this reaction

$\Delta G^\circ = -RT \ln K = -0.008314\ kJ/mol\cdot K \cdot 298\ K \cdot \ln(6.4 \cdot 10^9)$

$\Delta G^\circ = -56\ kJ/mol$

- Find the value of Q for this reaction which gives $\Delta G = 3.14 \frac{kJ}{mol}$

$\Delta G = \Delta G^\circ + RT \ln Q$

$Q = e^{\frac{\Delta G - \Delta G^\circ}{RT}} = e^{\frac{3.14\ kJ/mol + 56\ kJ/mol}{0.008314\ kJ/mol\cdot K \cdot 298\ K}} = 2.3 \cdot 10^{10}$