Quiz 7.3 – Equilibrium Reactions

Name: Key

Question 1

Consider the reaction: heat + $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$ (1 mole (g) ⇌ 2 moles (g)) $\Delta H_{rxn} = 131.3 \frac{kJ}{mol}$ $K_C = 5.63 \times 10^{-4}$

- Give the equilibrium expression for this reaction

$K = \frac{[CO][H_2]}{[H_2O]}$

- Is this reaction reactant-favored, or product-favored?

reactant-favored

- What is $[CO]$ if $[H_2O] = 0.100\ M$ and $[H_2] = 2.50 \times 10^{-3}$

$5.63 \cdot 10^{-4} = \frac{[CO]\,2.5 \cdot 10^{-3}}{0.100} \rightarrow [CO] = 0.0225\ M$

- Which way will the reaction shift to restore equilibrium after each of the following changes:
  - Remove $H_2O(g)$ ←
  - Add excess C(s) No change
  - Increase the pressure (reduce system volume) ←
  - Increase the temperature →

Question 2

Consider the reaction: $H_2(g) + Br_2(g) \rightleftharpoons 2\,HBr(g)$ (2 moles (g) ⇌ 2 moles (g)) + heat $\Delta H_{rxn} = -72.6 \frac{kJ}{mol}$ $K_C = 62.5$

- Give the equilibrium expression for this reaction

$K = \frac{[HBr]^2}{[H_2][Br_2]}$

- Is this reaction reactant-favored, or product-favored?

product-favored

- What is $[HBr]$ if $[H_2] = 0.0200\ M$ and $[Br_2] = 5.00 \times 10^{-3}$

$K = \frac{[HBr]^2}{[H_2][Br_2]} \rightarrow 62.5 = \frac{x^2}{0.02 \cdot 5 \cdot 10^{-3}} \rightarrow x = 0.0791\ M$

- Which way will the reaction shift to restore equilibrium after each of the following changes:
  - Add HBr(g) ←
  - Add a catalyst No change
  - Increase the pressure (reduce system volume) No change
  - Increase the temperature ←