CHM152 Quiz 2b 25 Pts Fall 2016 Name: Key

***SHOW ALL WORK TO RECEIVE CREDIT***

1. (4 Pts) Calculate $K_c$ for the reaction $2HI(g) \leftrightharpoons H_2(g) + I_2(g)$ given that the concentrations of each species at equilibrium are as follows: $[HI] = 0.85$ mol/L, $[I_2] = 0.60$ mol/L, $[H_2] = 0.27$ mol/L.

$$K_c = \frac{[H_2][I_2]}{[HI]^2} = \frac{[0.27][0.60]}{[0.85]^2} = 0.224$$

2. (4 Pts) The brown gas $NO_2$ and the colorless gas $N_2O_4$ exist in equilibrium, $2NO_2 \leftrightharpoons N_2O_4$. In an experiment, 0.625 mole of $N_2O_4$ was introduced into a 5.00 L vessel and was allowed to decompose until equilibrium was reached. The concentration of $N_2O_4$ at equilibrium was 0.0750 M. Calculate $K_c$ for the reaction.

| | $2NO_2$ | $\rightleftharpoons N_2O_4$ |
|---|---|---|
| I | 0 | $\frac{0.625}{5.00} = 0.125$ |
| C | +2X | −X |
| E | 2X | $0.125 - X = 0.0750$ |

$X = 0.5$

$2X = 1.0$

$$K_c = \frac{[N_2O_4]}{[NO_2]^2}$$

$$K_c = \frac{[0.0750]}{[0.1]^2} = 7.5$$

3. ~~(3 Pts) The solubility of silver chloride can be increased by dissolving it in a solution containing~~ ammonia.

① $AgCl(s) \leftrightharpoons Ag^+(aq) + Cl^-(aq)$ $K_1 = 1.6 \times 10^{-10}$

② $Ag^+(aq) + 2NH_3(aq) \leftrightharpoons Ag(NH_3)_2^+(aq)$ $K_2 = 1.5 \times 10^7$

What is the value of the equilibrium constant for the overall reaction?

③ $AgCl(s) + 2NH_3(aq) \leftrightharpoons Ag(NH_3)_2^+(aq) + Cl^-(aq)$ $K_{net} = ?$

The top 2 equations add up to Equation ③

SO: $K_{net} = K_1 \times K_2 = 2.4 \times 10^{-3}$

4. (3 Pts) Write correct equilibrium constant expression for the following reaction?

$Fe_2O_3(s) + 3H_2(g) \leftrightharpoons 2Fe(s) + 3H_2O(g)$

$$K_c = \frac{[H_2O]^3}{[H_2]^3}$$

— more on back —

Key

5. (4 Pts) At 700 K, the reaction $2SO_2(g) + O_2(g) \leftrightharpoons 2SO_3(g)$ has the equilibrium constant $K_c = 4.3 \times 10$, and the following concentrations are present: $[SO_2] = 0.10$ M; $[SO_3] = 10.$ M; $[O_2] = 0.10$ M. Which of the following is true based on the above?
   A) $Q_c > K_c$, the reaction proceeds from left to right to reach equilibrium
   B) $Q_c > K_c$, the reaction proceeds from right to left to reach equilibrium
   C) $Q_c < K_c$, the reaction proceeds from left to right to reach equilibrium
   D) $Q_c < K_c$, the reaction proceeds from right to left to reach equilibrium
   E) $Q_c = K_c$, the reaction is currently at equilibrium

$$Q_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{(10.)^2}{[0.10]^2[0.10]} = 1.0 \times 10^5 \quad Q_c < K_c$$

(needs more product)

6. (3 Pts) The equilibrium constant for the reaction $Ni(s) + 4CO(g) \leftrightharpoons Ni(CO)_4(g)$ is $5.0 \times 10^4$ at 25°C. What is the equilibrium constant for the reaction $Ni(CO)_4(g) \leftrightharpoons Ni(s) + 4CO(g)$?

since: $K_{c_1} = \frac{[Ni(CO)_4]}{[CO]^4} = 5.0 \times 10^4$

and $K_{c_2} = \frac{[CO]^4}{[Ni(CO)_4]}$

$$K_{c_2} = \frac{1}{5.0 \times 10^4} = 2 \times 10^{-5}$$

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7. (4 Pts) The reaction $A(g) + 2B(g) \leftrightharpoons C(g)$ was allowed to come to equilibrium. The initial amounts of reactants placed into a 5.00 L vessel were 1.0 mol A and 1.8 mol B. After the reaction reached equilibrium, 1.0 mol of B was found. Calculate $K_c$ for this reaction.

| | $A(g)$ moles | $2B(g)$ moles | $C(g)$ moles |
|---|---|---|---|
| I | 1.0 | 1.8 | 0 |
| C | $-x$ | $-2x$ | $x$ |
| E | $1.0-x$ | $1.8-2x$ | $x$ |

@ E: $1.8 - 2x = 1.0$

$2x = 0.8$

$x = 0.4$

| | $A(g)$ | $2B(g)$ | $C(g)$ |
|---|---|---|---|
| So E | $\frac{0.6}{5.00}$ | $\frac{1.0}{5.00}$ | $\frac{0.4}{5.00}$ |

$$K_c = \frac{\left[\frac{0.4}{5.00}\right]}{\left[\frac{0.6}{5.00}\right]\left[\frac{1.0}{5.00}\right]^2}$$

$K_c = 16.7$ or $17$