CHM152 QUIZ 3 25 Pts SPRING 2012 NAME: Key

SHOW ALL WORK TO RECEIVE CREDIT

1. (4 Pts) Consider the reaction: $2SO_2 + O_2 \rightleftarrows 2SO_3 + \text{heat}$. Under which conditions is SO_3 most stable?

(A) high pressure and high temperature (B) high pressure and low temperature

(C) low pressure and high temperature (D) low pressure and low temperature

(E) Must be determined experimentally

2. (4 Pts) The equilibrium constant for the gaseous reaction **C + D** $\rightleftarrows$ **E + 2F** is 3.0 at 50 °C. In a 2.0 L flask at 50 °C are placed 1.0 mol of **C**, 1.0 mol of **D**, 1.0 mol of **E**, and 3.0 mol of **F**. What changes in concentration will occur (Hint: if the system is not at equilibrium, in which direction will it shift)? You must show work to support your answer.

$C + D \rightleftarrows E + 2F$

1.0 1.0 1.0 3.0

$$Q = \frac{\left[\frac{1.0}{2.0}\right]\left[\frac{3.0}{2.0}\right]^2}{\left[\frac{1.0}{2.0}\right]\left[\frac{1.0}{2.0}\right]} = 4.5$$

Since Q > K, the equilibrium will shift ← (to make it smaller)

3. (4 Pts) The reversible reaction. $2H_2 + CO \rightleftarrows CH_3OH(g) + \text{heat}$ is carried out by mixing carbon monoxide and hydrogen gases in a closed vessel under high pressure with a suitable catalyst. After equilibrium is established at high temperature and pressure, all three substances are present. If the pressure on the system is lowered, with the temperature kept constant, what will be the result?

(A) The amount of CH_3OH will be increased. (B) The amount of CH_3OH will be decreased.

(C) The amount of each substance will be unchanged. (D) The amount of each substance will be increased.

(E) The result cannot be predicted from the information given.

4. (4 Pts) Calculate K_{eq} in terms of molar concentration for the reaction $N_2(g) + 3H_2(g) \rightleftarrows 2NH_3(g)$ when the equilibrium concentration moles per liter are: $N_2 = 0.02$, $H_2 = 0.01$, $NH_3 = 0.10$.

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{[0.10]^2}{[0.02][0.01]^3} = \boxed{500{,}000 \text{ or } 5 \times 10^5}$$

5. (4 Pts) A mixture of 2.0 mol of $CO(g)$ and 2.0 mol of $H_2O(g)$ was allowed to come to equilibrium in a 1 L flask at a high temperature. If $K_c = 4.0$, what is the molar concentration of $H_2(g)$ in the equilibrium mixture?

	$CO(g)$ +	$H_2O(g) \rightleftarrows$	$CO_2(g)$ +	$H_2(g)$
I	2.0	2.0	0	0
C	−x	−x	+x	+x
E	2.0 − x	2.0 − x	x	x

$$K_c = \frac{[CO_2][H_2]}{[CO][H_2O]}$$

$$4.0 = \frac{x^2}{(2.0-x)^2} \Leftarrow \text{perfect square}$$

$$2.0 = \frac{x}{2.0-x} \qquad x = \frac{4}{3} = 1.3\underline{3}$$

6. (4 Pts) A 1.20-L flask contains an equilibrium mixture of 0.0168 mol of N_2, 0.2064 mol of H_2, and 0.0143 mol of NH_3. Calculate the equilibrium constant, K_c for the reaction: $N_2(g) + 3H_2(g) \rightleftarrows 2NH_3(g)$

E (moles) 0.0168 0.2064 0.0143

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$K_c = \frac{\left[\frac{0.0143}{1.20}\right]^2}{\left[\frac{0.0168}{1.20}\right]\left[\frac{0.2064}{1.20}\right]^3} = 1.99$$