CHM152 Quiz3 25 Pts Fall 2017 Name: Key

1. (2 Pts) Consider the reaction $N_2(g) + 3H_2(g) \leftrightharpoons 2NH_3(g)$. If hydrogen gas is added to this system at equilibrium, will the reaction shift towards *reactants* or *products*?

$\rightarrow$

2. (2 Pts) Consider the reaction $N_2(g) + 3H_2(g) \leftrightharpoons 2NH_3(g)$. The production of ammonia is an exothermic reaction. Will heating the equilibrium system *increase* or *decrease* the amount of ammonia produced?

$\leftarrow$

3. (2 Pts) Consider the reaction $N_2(g) + 3H_2(g) \leftrightharpoons 2NH_3(g)$. If we use a catalyst, which way will the reaction shift?

It won't shift (only reaches equilibrium faster).

4. (3 Pts) Given the following data for the reaction: $A(g) + 2B(s) \leftrightharpoons AB_2(g)$

Temperature (K)	K_c
300	1.5×10^4
600	55
900	3.4×10^{-3}

$K_c \approx \frac{\text{products}}{\text{reactants}}$

Is the reaction *endothermic* or *exothermic (explain your answer)*?

Raising the temperature gives less product, therefore it is an exothermic reaction.

5. (4 Pts) Consider the reaction, $N_2(g) + 3H_2(g) \leftrightharpoons 2NH_3(g)$. $K_c = 4.2$ at 600 K. What is the value of K_c for $4\,NH_3(g) \leftrightharpoons 2N_2(g) + 6H_2(g)$

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad K_{c_1} = \frac{[NH_3]^2}{[N_2][H_2]^3} = 4.2$$

$$4NH_3(g) \rightleftharpoons 2N_2(g) + 6H_2(g) \quad K_{c_2} = \frac{[N_2]^2[H_2]^6}{[NH_3]^4}$$

By inspection $K_{c_2} = \frac{1}{K_{c_1}^2} = \frac{1}{4.2^2} = 0.057$

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6. (4 Pts) 5.00 mol of ammonia are introduced into a 5.00 L reactor vessel in which it partially dissociates at high temperatures.

$$2NH_3(g) \rightleftharpoons 3H_2(g) + N_2(g)$$

At equilibrium at a particular temperature, 1.00 mole of ammonia remains. Calculate K_c for the reaction.

$2NH_3(g) \rightleftharpoons 3H_2(g) + N_2(g)$ $\quad K_c = \frac{[H_2]^3[N_2]}{[NH_3]^2}$

I. $\frac{5}{5} = 1.00\ M$ $\quad 0 \quad 0$

C. $-2x$ $\quad 3x \quad x$

E. $1.00-2x$ $\quad 3x \quad x$ $\quad K_c = \frac{[1.2]^3[0.4]}{[0.200]^2} = 17.3$

@ Eq $1.00-2x = \frac{1.00}{5.00} = 0.200$

$x = 0.400\ M$

So: E $0.200 \quad 1.2 \quad 0.4$

7. (4 Pts) 4.21 moles of S_2Cl_4 are introduced into a 2.0 L vessel.

$$S_2Cl_4(g) \rightleftharpoons 2SCl_2(g)$$

At equilibrium, 1.25 moles of S_2Cl_4 are found to remain in the container. Calculate K_c for this reaction.

$S_2Cl_4(g) \rightleftharpoons 2SCl_2(g)$ $\quad K_c = \frac{[SCl_2]^2}{[S_2Cl_4]}$

I, 4.21 moles $\quad 0$

C, $-x$ $\quad +2x$

E. $4.21-x = 1.25$ moles $\quad 2x$ $\quad K_c = \frac{\left[\frac{5.92}{2.0}\right]^2}{\left(\frac{1.25}{2.0}\right)} = 14$

$x = 2.96$

E. $\frac{1.25}{2.0} \quad \frac{5.92}{2.0}$

8. (2 Pts) Consider the equilibrium equation $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$, $\Delta H = 2296$ J. Which way will the reaction shift if the volume of the container is decreased?

$\leftarrow$ (Decreasing volume increase pressure so equilibrim shifts toward less moles of gas.)

9. (2 Pts) What is the correct equilibrium constant expression for this reaction?

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

$$K_c = \frac{[H_2][I_2]}{[HI]^2}$$