NAME:_____

Lab Section: __1(TuTh@1) __2(TuTh@9)

CHM 103 | Spring 2008
20 points, 30 mins. | **Basic Competency Quiz #1** | week 3
Chemistry, 7th ed., Zumdahl & Zumdahl, chapter 13
Wallace | *revised 4/23/2008*

Unless otherwise specified, each question is worth 4 points.

1. Write the equilibrium constant expression (K=...) for the following reaction.

$$CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g)$$

$$K = \frac{[CH_4][H_2O]}{[CO][H_2]^3}$$

2. Carbon monoxide and hydrogen react according to the reaction shown in question 1, above. When 1.000 mol CO and 3.000 mol H_2 are placed in a 10.00-L vessel at 1200 K and allowed to come to equilibrium, the mixture is found to contain 0.387 mol H_2O.

   a. How many moles of CO remain in the vessel?

	CO	+	$3H_2$	⇌	CH_4	+	H_2O
	1.00		3.00		0		0
	−x		−3x		+x		+x
	1.00 − x		3.00 − 3x		x		0.387 = x

1.00 − 0.387 = 0.613 mol CO

   b. What is the concentration of CO in the vessel at this equilibrium?

$$\frac{0.613 \text{ mol CO}}{10.0 \text{ L}} = 0.0613 \frac{\text{mol CO}}{\text{L}}$$

Unless otherwise specified, each question is worth 4 points.

3. Hydrogen iodide decomposes according to the following equation shown below.

   When 4.00 mol HI was placed in a 5.00-L vessel at 458°C, the equilibrium mixture was found to contain an a concentration of iodine: $[I_2]=0.0884\ ^{mol}/_{L}$. What is the value of K for the decomposition of HI at this temperature?

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

$\frac{4.00}{5.00}$	0	0
$-2x$	$+x$	$+x$
$0.800-2x$	x)	0.0884

$$K = \frac{(0.0884)(0.0884)}{(0.800-2(0.0884))^2} = \boxed{0.0201}$$

4. A 50.0-L reaction vessel contains 1.00 mol N_2, 3.00 mol H_2, and 0.500 mol NH_3. Will more ammonia be formed or will it dissociate when the mixture goes to equilibrium at 400C? Briefly explain your answer. The equilibrium constant for this reaction is $K = 0.500$.

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

$\frac{1.00}{50.0}$	$\frac{3.00}{50.0}$	$\frac{0.500}{50.0}$
$.0200$	$= 0.0600$	$= 0.0100$

$$Q = \frac{(0.0100)^2}{(0.0200)(0.0600)^3} = 23 \quad (> K)$$

SHIFT = ← (DECOMPOSES NH_3)

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5. Predict the direction of the reaction ("equilibrium shift") when H_2 is removed from a mixture in which the following equilibrium has been established:

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