Last Name: ___________________________________ Chapter 13-2 QUIZ – Equilibrium

SHOW YOUR WORK FOR CREDIT!!!!!!!!!!

1. Given the reaction $N_2O_4 \rightarrow 2NO_2$ at 24.85°C. The reaction occurs in a 2.25L flask which contains 0.055 mol NO_2 and 0.082 mol N_2O_4 and a $K_p = 6.7$

a. Calculate Q and determine if the reaction is at equilibrium.

$Q = [NO_2]^2/[N_2O_4] = (.055\,mol/2.25L)^2/(.082\,mol/2.25L) = .024^2/.036 = 0.016$

$K_p = K_c(RT)^{\Delta n} = 6.7 = K_c(.08206\,L\,atm/mol\,K \cdot 298K)^1 \quad K_c = 0.273 > Q$

$n = 2-1 = 1$

b. If the reaction is not at equilibrium, tell which direction the reaction is going. Circle one:

FORWARD BACKWARD

c. Prepare an ICE table and determine the equilibrium concentrations of the reactant and product. Note: for an expression $ax^2+bx+c=0$, the equation $x=[-b\pm\sqrt{b^2-4ac}\,]/2a$ should be used.

	N_2O_4 ⇔	$2NO_2$
I	.036	.024
C	−x	+2x
E	.036−x	.024+2x
	.0156	.0648

$K_c = 0.273 = \frac{(.024+2x)^2}{(.036-x)}$

$0.273(.036-x) = (.024+2x)^2$

$.0098 - .273x = 5.76E^{-4} + 4x^2 + .096x$

$0 = 4x^2 + .369x - .0092$

$x = \frac{-.369 + \sqrt{.369^2 - 4(4)(-.0092)}}{2(4)} = \frac{-.369 + \sqrt{.283}}{8} = \frac{-.369 + .532}{8} = .0204$

$K_c = 0.273 = \frac{(.0648)^2}{.0156} = .269$ ✓

2. Consider the following exothermic reaction: $CO(g) + Cl_2(g) \Leftrightarrow COCl_2(g)$ + heat tell what would happen if the following change was made:

a. Pressure is increased. Answer = number 1

b. $COCl_2$ is removed from the system. Answer = number 1

c. Cl_2 is added to the system. Answer = number 1

d. Temperature is increased. Answer = number 3

Your choices are:

1. = the reaction will proceed to the right
2. = the equilibrium will remain undisturbed
3. = the reaction will proceed to the left

3. Given the reaction A(g) <-> B(g) + 2C(g) with an initial [A]=2.1M, [B]=0.0040M, [C]=0.0090M; and a Kc=9.6×10^{-15}.

   a. Determine the value for Q.

$$Q = \frac{[B][C]^2}{[A]} = \frac{(.004)(.009^2)}{2.1} = 1.54 \times 10^{-7} > K_c$$

   b. Tell what direction the reaction is proceeding. Circle one:

   FORWARD BACKWARD

   c. Prepare and ICE table and determine the equilibrium concentrations of A, B, and C. Use any appropriate simplifying assumptions and, if you use them, verify that your assumptions are valid.

A ⟷ B + 2C

$K_c = 9.6 \times 10^{-15}$

	A	B	2C
I	2.1	.004	.009
C	+x	−x	−2x
E	2.1+x	.004−x	.009−2x
	2.1+.004	.004−.004	.009−.008
best guess ⇒	2.1004	0	.001

assumption Kc is so small that the reaction substantially goes in the reverse direction to reactant

$$\frac{1}{K_{forward}} = K_{reverse} = 1.04 \times 10^{14}$$

= 100 trillion