Name Key

Class ____________ Date ____________

1. 0.0040 mol of NO and 0.0030 mol of O_2 are introduced into a 1.0 L flask, and the reaction $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$ occurs. At equilibrium, it is determined that $[NO_2] = 0.0035$ mol/L. What is the value of K_{eq} for the reaction?

$2NO + O_2 \leftrightarrow 2NO_2$

$K_{eq} = \frac{[NO_2]^2}{[NO]^2[O_2]}$

$K_{eq} = \frac{(0.0035)^2}{(0.0005)^2(0.00125)} = 3.9 \times 10^4$

$= 4 \times 10^4$

	NO	O_2	NO_2
[Initial]	0.0040	0.0030	0
change	−0.0035	−0.00175	+0.0035
[Eqm]	0.0005	0.00125	0.0035

2. 0.020 mol of each of SO_2, O_2, and SO_3 is placed in a 1.0 L flask and allowed to come to equilibrium. The equilibrium $[SO_2]$ is found to be 0.0080 mol/L. What is the value of K_{eq} for the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$?

$2SO_{2(g)} + O_{2(g)} \leftrightarrow 2SO_{3(g)}$

$K_{eq} = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$

$K_{eq} = \frac{(0.032)^2}{(0.0080)^2(0.014)} = 1.1 \times 10^3$

	SO_2 (2)	O_2 (1)	SO_3 (2)
[Initial]	0.020	0.020	0.020
change	−0.012	+0.0060	+0.012
[Eqm]	0.0080	0.014	0.032

3. A solution initially contains 0.35*M* of A and 0.75*M* of B. A reaction occurs according to the equation $2A + B \rightleftharpoons 3C + D$. At equilibrium, [D] is found to be 0.10*M*. What is the value of K_{eq}?

$2A + B \leftrightarrow 3C + D$

$K_{eq} = \frac{[C]^3[D]}{[A]^2[B]}$

$K_{eq} = \frac{(0.30)^3(0.10)}{(0.15)^2(0.65)} = 0.18$

	A	B	C	D
[Initial]	0.35	0.75	0	0
change	−0.20	−0.10	+0.30	+0.10
[Eqm]	0.15	0.65	0.30	0.10

4. **For the equilibrium reaction $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$, the K_{eq} value at 690°C is 10.0. A mixture of 0.300 mol of CO, 0.300 mol of H_2O, 0.500 mol of CO_2, and 0.500 mol of H_2 is placed in a 1.0 L flask.**
   a. **Show that the reaction is not at equilibrium.**
   b. **Determine the direction in which the reaction will shift to reach equilibrium.**
   c. **Calculate the equilibrium concentrations of all four species.**

Key.

a) trial product $= \frac{[CO_2][H_2]}{[CO][H_2O]} = \frac{(0.500)(0.500)}{(0.300)(0.300)} = 2.8 \neq 10.0$ ∴ not at eq=

b) trial product < Keq ∴ shifts to products

c) $K_{eq} = \frac{[CO_2][H_2]}{[CO][H_2O]} = 10.0$

$K_{eq} = \frac{(0.500+x)^2}{(0.300-x)^2} = 10.0$ √ both sides

$x = 0.108\ M$

	CO	H_2O	CO_2	H_2
[Initial]	0.300	0.300	0.500	0.500
Change	−x	−x	+x	+x
[Eq=]	0.300−x	0.300−x	0.500+x	0.500+x

$[CO] = [H_2O] = 0.300 - 0.108 = 0.192\ M$ $[CO_2] = [H_2] = 0.500 + 0.108 = 0.608\ M$

5. **The K_{eq} for the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ has a value of 1.85×10^{-2} at 425°C. If 0.18 mol of HI is placed in a 2.0 L flask and allowed to come to equilibrium at this temperature, what will be the equilibrium $[I_2]$?**

$K_{eq} = \frac{[H_2][I_2]}{[HI]^2} = 1.85 \times 10^{-2}$

$= \frac{x^2}{(0.090-2x)^2} = 1.85 \times 10^{-2}$

√ both sides

$x = 9.6 \times 10^{-3}\ M$

	HI	H_2	I_2
[Initial]	0.18 mol / 2.0 L	0	0
change	−2x	+x	+x
[Eq=]	0.090−2x	x	x

$[I_2] = 9.6 \times 10^{-3}\ M$

6. **For the reaction $2A(g) \rightleftharpoons 2B(g) + C(s)$, the value of K_{eq} is known to be 6.8×10^2. If 0.42 mol of A is placed in a 3.0 L container and allowed to reach equilibrium, what is the equilibrium [B]?**

$K_{eq} = [B]^2 / [A]^2 = 6.8 \times 10^2$

$K_{eq} = \frac{x^2}{(0.14-x)^2} = 6.8 \times 10^2$ √ both sides

$x = .13\ M$

	A	B
Initial	0.42 / 3.0	0
Change	−x	+x
Eq	0.14−x	x

$[B]_{eq} = 0.13\ M$