CHM 1046 - JOENS WORKSHEET #5 Due date: Monday, October 16th

WORKSHEETS ARE DUE AT THE BEGINNING OF CLASS ON THE DATE GIVEN ON THE WORKSHEET. LATE WORKSHEETS WILL NOT BE ACCEPTED.

NAME ______________________________ Panther ID ____________________________

For problems involving calculations you must show your work for credit.

1) Give the expression for K_C for the following reactions. Also give the expressions for K_p, when appropriate. Otherwise, write K_p = n/a.

a) $NH_4HS(s) \leftrightarrows NH_3(g) + H_2S(g)$

$K_C = [NH_3]\,[H_2S]$ $\quad$ $Kp = (p_{NH3})\,(p_{H2S})$

Everything appearing in K_C is a gas, so you can also write an expression for K_p.

b) $Ag_2SO_4(s) \leftrightarrows 2\,Ag^+(aq) + SO_4^{2-}(aq)$

$K_C = [Ag^+]^2\,[SO_4^{2-}]$ $\quad$ K_p = n/a

K_C expression contains solutes, which do not have a partial pressure, so K_p cannotbe written.

2) For the chemical reaction

$N_2(g) + 3\,H_2(g) \leftrightarrows 2\,NH_3(g)$

the numerical value for the equilibrium constant is $K_C = 3.4 \times 10^8$ at T = 25.0 °C.

A system initially contains approximately 0.1 mol/L of N_2, H_2, and NH_3. At equilibrium, the system

a) will contain close to the maximum possible concentration of N_2 for the given starting conditions
b) will contain close to the maximum possible concentration of H_2 for the given starting conditions
c) will contain close to the maximum possible concentration of NH_3 for the given starting conditions
d) both a and b
e) both a and b and c _____C______

The equilibrium constant is much larger than 1, so products are greatly favored over reactants. Because of this, you will have close to the maximum possible amount of NH_3 in the system (and close to the minimum amounts of N_2 and H_2) for the given initial conditions.

3) The equilibrium constant for the reaction

$$ClF_3(g) \leftrightarrows ClF(g) + F_2(g)$$

is $K_p = 0.14$ at T = 700. K.

A system initially has $p_{ClF3} = p_{ClF} = 0.200$ atm. There is initially no F_2 in the system. Find the values for p_{ClF3}, p_{ClF}, and p_{F2} that will be present when equilibrium is reached.

$$K_p = \frac{(p_{ClF})\,(p_{F2})}{(p_{ClF3})} = 0.14$$

	Initial	Change	Equilibrium
ClF	0.200	x	0.200 + x
F_2	0.	x	x
ClF_3	0.200	- x	0.200 - x

$$\frac{(0.200 + x)\,(x)}{(0.200 - x)} = 0.14$$

$$x^2 + 0.200\,x = 0.028 - 0.14\,x$$

$$x^2 + 0.340\,x - 0.028 = 0$$

$$x = \frac{-\,0.340 \pm [\,(0.340)^2 - 4\,(1)\,(-\,0.028)\,]^{1/2}}{2\,(1)} = \underline{+\,0.069}, -\,0.408$$

The root - 0.408 would give a negative partial pressure for ClFand F_2 and so can be discarded. Using x = 0.069 gives

$p_{ClF} = 0.269$ atm $\quad$ $p_{F2} = 0.069$ atm $\quad$ $p_{ClF3} = 0.131$ atm

As a check, if we insert these values into the expression for K_p, we get

$$K_p = \frac{(0.269)\,(0.069)}{(0.131)} = 0.142$$, within roundoff error of the correct value.

Note that if we assumed $x << 0.200$, we would get $x = 0.14$, which would clearly violate the assumption that x is small. So in this problem we have to solve the quadratic.