Ch.12

I. Chemical quotient:

$aA + bB \rightarrow cC + dD$

$$Q = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

$Q>K$, move to reactant
$Q<K$, move to product

K_c (use mole/L for [A], [B], [C], and [D])
K_p (use atm for P_A, P_B, P_C, and P_d) $K_p = K_c * (RT)^{\Delta n}$, $\Delta n = (c+d)-(a+b)$, $R = 0.08206$ L*atm/(K*mol)

II. Equilibrium constant calculation:

$aA + bB \rightarrow cC + dD$ K_1

$cC + dD \rightarrow aA + bB$ $K_2 = K_1^{-1}$

$ncC + ndD \rightarrow naA + nbB$ $K_3 = K_1^{-n}$

Combine two equations (K_1 and K_2), $K_{new} = K_1 \times K_2$

III. ICE table (small x approximation):

$K>10^4$ or $K<10^{-4}$, small x approximation, otherwise $x = (-b +/- \sqrt{(b^2-4ac)})/2a$

IV. Le Chatelier's principle: predict how the reaction direction is affected by
1. Concentration, 2.pressure, and 3. Temperature (~~catalyst~~)

Ch 12

12.I

1. Consider the gas-phase reaction, $Cl_2(g) + Br_2(g) <=> 2\ BrCl(g)$, for which $K_p = 32$ at 500 K. If the mixture is analyzed and found to contain 0.49 bar of Cl_2, 0.29 bar of Br_2 and 2.1 bar of BrCl, describe the situation: [***Q* < *K* and more products will be made to reach equilibrium**]

12.II

2. At a certain temperature, K_p is 0.25 for the reaction,
   $H_2(g) + Br_2(g) <=> 2\ HBr(g)$.
   Calculate the value of K_p for the reaction,
   $HBr(g) <=> 1/2\ H_2(g) + 1/2\ Br_2(g)$
   [**2**]
3. Given the values of *K* shown below, determine the value of *K* for the reaction,
   $N_2(g) + 2\ O_2(g) <=> 2\ NO_2(g)$.
   $N_2(g) + O_2(g) <=> 2\ NO(g)$ $K_1 = 2$
   $NO_2(g) <=> NO + 1/2\ O_2(g)$ $K_2 = 3$
   Give your answer to the 4 decimal places.
   [**0.2222**]

12.III

4. At 700 K, the reaction below has a K_p value of 54. An equilibrium mixture at this temperature was found to contain 0.5 atm each of H_2 and I_2. Calculate the pressure of HI at equilibrium.
   $H_2(g) + I_2(g) <=> 2\ HI(g)$. Use 2 decimal places. [**3.68**]
5. At a given temperature, 2 atm of H_2 and 1 atm of I_2 are mixed and allowed to come to equilibrium. The equilibrium pressure of HI is found to be 1 atm. Calculate K_p for the reaction at this temperature.
   $H_2(g) + I_2(g) <=> 2\ HI(g)$. Give your answer to 3 decimal places. [**1.333**]
6. In the reaction below, 0.5 atm each of H_2 and Br_2 were placed into a 1.00 L flask and allowed to react:
   $H_2(g) + Br_2(g) <=> 2\ HBr(g)$
   Given that $K_c = 4$, calculate the equilibrium pressure of HBr.[**0.5**]

12.IV

7. Consider the reaction $N_2(g) + 3\ H_2(g) <=> 2\ NH_3(g)$, which is exothermic as written. What would be the effect on the equilibrium position of removing $N_2(g)$? [**Reaction would go to the left, making more "reactants"**]

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