AP Worksheet 7b (Manipulating and Calculating K)

Part 3 – Manipulating K

1. The equilibrium constant, K_c, for the reaction: 2 NOCl(g) $\rightleftharpoons$ 2 NO(g) + Cl_2(g) is 2.4×10^{-7}. What is the equilibrium constant, K_c, for the reaction: ⅓ Cl_2(g) + ⅔ NO(g) $\rightleftharpoons$ ⅔ NOCl(g) *(1.6×10^{2})*

2. If K = 0.145 for A_2 + 2B $\rightleftharpoons$ 2AB, what would K equal for AB $\rightleftharpoons$ B + ½ A_2? *(2.63)*

3. Given the following equilibrium equations and their corresponding equilibrium constants:
   2 CO_2(g) + H_2O(g) $\rightleftharpoons$ 2 O_2(g) + CH_2CO(g) Kc = 6.1×10^{8}
   CH_4(g) + 2 O_2(g) $\rightleftharpoons$ CO_2(g) + 2 H_2O(g) Kc = 1.2×10^{14}
   Find K_c for the reaction: CH_4(g) + CO_2(g) $\rightleftharpoons$ CH_2CO(g) + H_2O(g) *(7.3×10^{22})*

Part 4 – Solving equilibrium problems

4. Calculate the equilibrium amounts of each substance in the reaction below if an initial amount of 0.100 moles of H_2 are brought together with an initial amount of 0.200 moles of I_2 and then equilibrium is established at 300 K. K_c at this temperature is 70.

$$H_2 + I_2 \rightleftharpoons 2HI$$

5. Determine the equilibrium amounts of each substance in the reaction below if an initial amount of 0.400 moles of CO are brought together with an initial amount of 2.20 moles of Cl_2 in a 1.00 L vessel and then equilibrium is established at 900 K. K_c at this temperature is 0.800.

$$COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$$

6. A mixture of 9.22 moles of A, 10.11 moles of B, and 27.83 moles of C is placed in a one-liter container at a certain temperature. The reaction is allowed to reach equilibrium. At equilibrium the number of moles of B is 18.32. Calculate the equilibrium constant for the reaction: A(g) + 2 B(g) $\rightleftharpoons$ 3 C(g) *(0.832)*

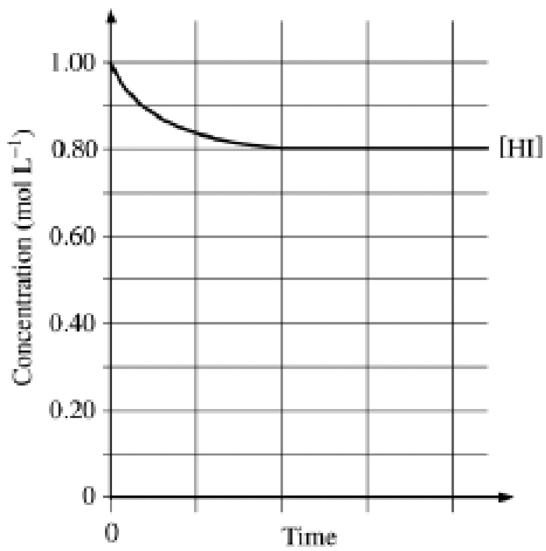
7. At a certain temperature, K_c is 4.13×10^{-2} for the equilibrium: 2 IBr(g) $\rightleftharpoons$ I_2(g) + Br_2(g) Assume that equilibrium is established at the above temperature by adding only IBr(g) to the reaction flask.
   a. What are the concentrations of I_2(g) and Br_2(g) in equilibrium with 0.0124 moles/liter of IBr(g) ? *(2.52×10^{-3} M)*
   b. What was the initial concentration of IBr before equilibrium was established *(0.0174 M)*

AP problem

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

After a 1.0 mole sample of HI(*g*) is placed into an evacuated 1.0 L container at 700. K, the reaction represented above occurs. The concentration of HI(*g*) as a function of time is shown below.

(a) Write the expression for the equilibrium constant, K_c, for the reaction.



(b) What is [HI] at equilibrium?

(c) Determine the equilibrium concentrations of $H_2(g)$ and $I_2(g)$.

(d) On the graph above, make a sketch that shows how the concentration of $H_2(g)$ changes as a function of time.

(e) Calculate the value of the following equilibrium constants at 700. K.

(i) K_c

(ii) K_p

(f) At 1,000 K, the value of K_c for the reaction is 2.6×10^{-2}. In an experiment, 0.75 mole of HI(*g*), 0.10 mole of $H_2(g)$, and 0.50 mole of $I_2(g)$ are placed in a 1.0 L container and allowed to reach equilibrium at 1,000 K. Determine whether the equilibrium concentration of HI(*g*) will be greater than, equal to, or less than the initial concentration of HI(*g*). Justify your answer.