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## CHEM 101B Chapter 12 Equilibrium – The Equilibrium Constant

29. The following equilibrium pressures at a certain temperature were observed for the reaction



$$P_{\text{NO}_2} = 0.55 \text{ atm}$$

$$P_{\text{NO}} = 6.5 \times 10^{-5} \text{ atm}$$

$$P_{\text{O}_2} = 4.5 \times 10^{-5} \text{ atm}$$

Calculate the value for the equilibrium constant  $K_p$  at this temperature.

$$K_p = \frac{(6.5 \times 10^{-5})^2 (4.5 \times 10^{-5})}{(0.55)^2} = \boxed{6.3 \times 10^{-13}}$$

31. At 327°C, the equilibrium concentrations are  $[\text{CH}_3\text{OH}] = 0.15 \text{ M}$ ,  $[\text{CO}] = 0.24 \text{ M}$ , and  $[\text{H}_2] = 1.1 \text{ M}$  for the reaction



Calculate  $K_p$  at this temperature.

$$K_c = \frac{[\text{CO}][\text{H}_2]^2}{[\text{CH}_3\text{OH}]} = \frac{(0.24)(1.1)^2}{(0.15)} = 1.936$$

$$\Delta n = 3 - 1 = 2$$

$$K_p = K_c (RT)^{\Delta n}$$

$$= (1.936)(0.08206 \cdot 600)^2$$

$$= 4693.2 = \boxed{4700}$$

$$\hookrightarrow 4.7 \times 10^3$$

38. In a study of the reaction



$$K_p = \underline{\hspace{2cm}}$$

(atm)

at 1200 K it was observed that when the equilibrium partial pressure of water vapor is 15.0 torr, the total pressure at equilibrium is 36.3 torr. Calculate the value of  $K_p$  for this reaction at 1200 K. (Hint: Apply Dalton's law of partial pressures.)

$$\begin{array}{r} 36.3 = P_{\text{tot}} \\ - 15.0 = P_{\text{H}_2\text{O}} \\ \hline 21.3 = P_{\text{H}_2} \end{array}$$

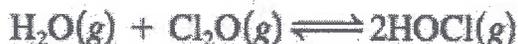
$$P_{\text{H}_2\text{O}} = 0.0197 \text{ atm}$$

$$P_{\text{H}_2} = 0.0280 \text{ atm}$$

$$K_p = \frac{P_{\text{H}_2}^4}{P_{\text{H}_2\text{O}}^4} = \frac{(0.0280)^4}{(0.0197)^4} = 4.08$$

$K_c$

39. The equilibrium constant is 0.0900 at 25°C for the reaction



For which of the following sets of conditions is the system at equilibrium? For those that are not at equilibrium, in which direction will the system shift?

- A 1.0-L flask contains 1.0 mole of HOCl, 0.10 mole of  $\text{Cl}_2\text{O}$ , and 0.10 mole of  $\text{H}_2\text{O}$ .
- A 2.0-L flask contains 0.084 mole of HOCl, 0.080 mole of  $\text{Cl}_2\text{O}$ , and 0.98 mole of  $\text{H}_2\text{O}$ .
- A 3.0-L flask contains 0.25 mole of HOCl, 0.0010 mole of  $\text{Cl}_2\text{O}$ , and 0.56 mole of  $\text{H}_2\text{O}$ .

$$K = \frac{[\text{HOCl}]^2}{[\text{H}_2\text{O}][\text{Cl}_2\text{O}]}$$

(only eq. conc.)

$$Q = \frac{[\text{HOCl}]^2}{[\text{H}_2\text{O}][\text{Cl}_2\text{O}]}$$

any #s

a)  $Q = 100$  (not eq.)

shift left

b)  $Q = 0.090$  (EQ)

(No shift)

c)  $Q = 110$  (not eq.)

shift left