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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

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

$$P_{NO_2} = 0.55 \text{ atm}$$

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

$$P_{O_2} = 4.5 \times 10^{-5} \text{ atm}$$

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

$$K_p = \frac{(6.5\times10^{-5})^2(4.5\times10^{-5})}{(.55)^2} = \boxed{6.3\times10^{-13}}$$

31. At 327°C, the equilibrium concentrations are $[CH_3OH] = 0.15\ M$, $[CO] = 0.24\ M$, and $[H_2] = 1.1\ M$ for the reaction

$$CH_3OH(g) \rightleftharpoons CO(g) + 2H_2(g)$$

Calculate K_p at this temperature.

$$K_c = \frac{[CO][H_2]^2}{[CH_3OH]} = \frac{(.24)(1.1)^2}{(.15)} = 1.936$$

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

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

$$= (1.936)(.08206 \cdot 600)^2$$

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

$$\hookrightarrow 4.7\times10^{3}$$

38. In a study of the reaction

$$3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$$

$K_p =$ ——

(1 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.)

$36.3 = P_{tot}$
$-15.0 = P_{H_2O}$
$21.3 = P_{H_2}$

$P_{H_2O} = 0.0197$ atm
$P_{H_2} = 0.0280$ atm

$$K_p = \frac{P_{H_2}^4}{P_{H_2O}^4} = \frac{(.0280)^4}{(.0197)^4} = 4.08$$

K_c

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

$$H_2O(g) + Cl_2O(g) \rightleftharpoons 2HOCl(g)$$

$K = \frac{[HOCl]^2}{[H_2O][Cl_2O]}$ (only eq conc.)

$Q = \frac{[HOCl]^2}{[H_2O][Cl_2O]}$ any #s

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. A 1.0-L flask contains 1.0 mole of HOCl, 0.10 mole of Cl_2O, and 0.10 mole of H_2O.

b. A 2.0-L flask contains 0.084 mole of HOCl, 0.080 mole of Cl_2O, and 0.98 mole of H_2O.

c. A 3.0-L flask contains 0.25 mole of HOCl, 0.0010 mole of Cl_2O, and 0.56 mole of H_2O.

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

b) $Q = 0.090$ EQ (No shift)

c) $Q = 110$ (not eq) shift left