50. At a certain temperature, $K_{eq} = 4$ for the reaction $2HF(g) \rightleftharpoons H_2(g) + F_2(g)$. Predict the direction in which the equilibrium will shift, if any, when the following systems are introduced into a 5.0 L bulb.

(a) 3.0 mol of HF, 2.0 mol of H_2 and 4.0 mol of F_2

(b) 0.20 mol of HF, 0.50 mol of H_2 and 0.60 mol of F_2

(c) 0.30 mol of HF, 1.8 mol of H_2 and 0.20 mol of F_2

51. At a Certain temperature, $K_{eq} = 75$ for the reaction $2O_3(g) \rightleftharpoons 3O_2(g)$. Predict the direction in which the equilibrium will shift, if any, when the following systems are introduced into a 10.0 L bulb.

(a) 0.60 mol of O_3 and 3.0 mol of O_2

(b) 0.050 mol of O_3 and 7.0 mol of O_2

(c) 1.5 mol of O_3 and no O_2

52. $K_{eq} = 5.0$ at a certain temperature for the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$. A certain amount of $SO_3(g)$ was placed in a 2.0 L reaction vessel. At equilibrium the vessel contained 0.30 mol of $O_2(g)$. What concentration of $SO_3(g)$ was originally placed in the vessel?

53. $K_{eq} = 35.0$ for the reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$. If you have $[PCl_5] = 1.34 \times 10^{-3}$ M and $[PCl_3] = 0.205$ M at equilibrium in a certain vessel, what is the equilibrium concentration of $Cl_2(g)$?

54. $K_{eq} = 125$ for $H_2(g) + l_2(g) \rightleftharpoons 2\ Hl(g)$ at a certain temperature. If 0.15 mol of Hl, 0.034 mol of H_2 and 0.096 mol of l_2 are introduced into a 10 L vessel, will the reaction proceed to the reactant side or product side as the reaction attempts to reach equilibrium?

55. A reaction mixture at equilibrium, $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$, contains 1.00 mol of H_2, 2.00 mol of CO_2, 2.00 mol of CO and 2.00 mol of H_2O in a 2.00 L bulb. If 1.00 mol of H_2 is added to the system, calculate the [CO] which will exist when equilibrium is regained.

57. When 0.50 mol of NOCl(g) was put into a 1.0 L flask and allowed to come to equilibrium, 0.10 mol of $Cl_2(g)$ was found. What is K_{eq} for the reaction $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$?

58. $K_{eq} = 7.5$ for $2H_2(g) + S_2(g) \rightleftharpoons 2H_2S(g)$. A certain amount of H_2 was added to a 2.0 L flask and allowed to come to equilibrium. At equilibrium, 0.072 mol of H_2 was found. How many moles of H_2S were originally added to the flask?

59. A reaction mixture at equilibrium, $CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$, contained 4.00 mol of CO_2, 1.50 mol of H_2, 3.00 mol of CO and 2.50 mol of H_2O in a 5.0 L container. How many moles of CO_2 would have to be removed from the system in order to reduce the amount of CO to 2.50 mol?

60. $K_{eq} = 49.5$ for $H_2(g) + l_2(g) \rightleftharpoons 2\ Hl(g)$ at a certain temperature. If 0.250 mol of $H_2(g)$ and 0.250 mol of $l_2(g)$ are placed in a 10.0 L vessel and permitted to react, what will be the concentration of each substance at equilibrium?

61. The equilibrium constant for the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is 3.0 at a certain temperature. Enough $NH_3(g)$ was added to a 5.0 L container such that at equilibrium the container was found to contain 2.5 mol of $N_2(g)$. How many moles of $NH_3(g)$ were put into the container?

62. $K_{eq} = 1.00$ for $N_2O_2(g) + H_2(g) \rightleftharpoons N_2O(g) + H_2O(g)$. If 0.150 mol of $N_2O(g)$ and 0.250 mol of $H_2O(g)$ were introduced into a 1.00 L bulb and allowed to come to equilibrium, what concentration $N_2O_2(g)$ was present at equilibrium?

63. A reaction mixture at equilibrium, $H_2(g) + l_2(g) \rightleftharpoons 2\ Hl(g)$, contains 0.150 mol of $H_2(g)$, 0.150 mol of $l_2(g)$ and 0.870 mol of Hl(g) in a 10.0 L vessel. If 0.400 mol of Hl(g) is added to this system and the system is allowed to come to equilibrium again, what will be the new concentrations of H_2, l_2 and Hl?

64. A reaction mixture, $2\ NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$, contained 0.240 mol of NO(g), 0.0860 mol of $O_2(g)$ and 1.20 mol of $NO_2(g)$ when at equilibrium in a 2.00 L bulb. How many moles of $O_2(g)$ had to be added to the mixture to increase the number of moles of $NO_2(g)$ to 1.28 when equilibrium was re-established?

65. A reaction mixture, 2 lCl(g) + H_2(g) $\rightleftharpoons$ l_2(g) + 2 HCl(g), was found to contain 0.500 mol of lC(g). 0.0560 mol of H_2(g), 1.360 mol of l_2(g) and 0.800 mol of HCl(g) at equilibrium in a 1.00 L bulb. How many moles of lCl(g) would have to be removed in order to reduce the [HCl(g)] to 0.680 M when equilibrium is re-established?

66. (Nasty!) $K_{eq} = 100$ at a certain temperature for CH_4(g) + 2 H_2S(g) $\rightleftharpoons$ CS_2(g) + 4 H_2(g). Some CH_4 and H_2S were introduced into a 1.0 L bulb and at equilibrium 0.10 mol of CH_4 and 0.30 mol of H_2S were found. What was [CS_2] at equilibrium?