43. Write an equilibrium expression for each chemical equation.

(a) $2\,NO_2(g) \rightleftharpoons N_2O_4(g)$

(b) $2\,BrNO(g) \rightleftharpoons 2\,NO(g) + Br_2(g)$

(c) $H_2O(g) + CO(g) \rightleftharpoons H_2(g) + CO_2(g)$

(d) $CH_4(g) + 2\,H_2S(g) \rightleftharpoons CS_2(g) + 4\,H_2(g)$

45. Write an equilibrium expression for each chemical equation involving one or more solid or liquid reactants or products.

(a) $PCl_5(g) \rightleftharpoons PCl_3(l) + Cl_2(g)$

(b) $2\,KClO_3(s) \rightleftharpoons 2\,KCl(s) + 3\,O_2(g)$

(c) $HF(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + F^-(aq)$

(d) $NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

49. For each equilibrium constant, indicate if you would expect an equilibrium reaction mixture to be dominated by reactants or by products, or to contain significant amounts of both.

(a) $K_{eq} = 5.2 \times 10^{17}$

(b) $K_{eq} = 1.24$

(c) $K_{eq} = 3.22 \times 10^{-21}$

(d) $K_{eq} = 0.47$

51. Consider the reaction.

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

An equilibrium mixture of this reaction at a certain temperature has $[COCl_2] = 0.225$ M, $[CO] = 0.105$ M, and $[Cl_2] = 0.0844$ M. What is the value of the equilibrium constant at this temperature?

55. Consider the reaction.

$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$$

An equilibrium mixture of this reaction at a certain temperature has $[NH_3] = 0.278$ M and $[H_2S] = 0.355$ M. What is the value of the equilibrium constant at this temperature?

61. Consider the reaction:

$$N_2(g) + 3\,H_2(g) \rightleftharpoons 2\,NH_3(g)$$

Complete the table. Assume that all concentrations are equilibrium concentrations in moles per liter, M.

T(K)	$[N_2]$	$[H_2]$	$[NH_3]$	K_{eq}
500	0.115	0.105	0.439	____
575	0.110	____	0.128	9.6
775	0.120	0.140	____	0.0584

63. Consider this reaction at equilibrium.

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

Predict the effect (shift right, shift left, or no effect) of these changes.

(a) adding Cl_2 to the reaction mixture

(b) adding $COCl_2$ to the reaction mixture

(c) adding CO to the reaction mixture

65. Consider this reaction at equilibrium.

$$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$$

Predict the effect (shift right, shift left, or no effect) of these changes.

(a) adding C to the reaction mixture

(b) condensing H_2O and removing it from the reaction mixture

(c) adding CO to the reaction mixture

(d) removing H_2 from the reaction mixture

67. Consider the effect of a volume change on this reaction at equilibrium.

$$I_2(g) \rightleftharpoons 2\,I(g)$$

Predict the effect (shift right, shift left, or no effect) of these changes.

(a) increasing the reaction volume

(b) decreasing the reaction volume

69. Consider the effect of a volume change on this reaction at equilibrium.

$$I_2(g) + Cl_2(g) \rightleftharpoons 2\,ICl(g)$$

Predict the effect (shift right, shift left, or no effect) of these changes.

(a) increasing the reaction volume

(b) decreasing the reaction volume

71. This reaction is endothermic.

$$C(s) + CO_2(g) \rightleftharpoons 2\,CO(g)$$

Predict the effect (shift right, shift left, or no effect) of these changes.

(a) increasing the reaction temperature

(b) decreasing the reaction temperature

73. This reaction is exothermic.

$$C_6H_{12}O_6(s) + 6\,O_2(g) \rightleftharpoons 6\,CO_2(g) + 6\,H_2O(g)$$

Predict the effect (shift right, shift left, or no effect) of these changes.

(a) increasing the reaction temperature

(b) decreasing the reaction temperature

75. Coal, which is primarily carbon, can be converted to natural gas, primarily CH_4, by this exothermic reaction.

$$C(s) + 2\,H_2(g) \rightleftharpoons CH_4(g)$$

If this reaction mixture is at equilibrium, predict the effect (shift right, shift left, or no effect) of these changes.

(a) adding more C to the reaction mixture

(b) adding more H_2 to the reaction mixture

(c) raising the temperature of the reaction mixture

(d) lowering the volume of the reaction mixture

(e) adding a catalyst to the reaction mixture