

43. Write an equilibrium expression for each chemical equation.

- (a) $2 \text{NO}_2(g) \rightleftharpoons \text{N}_2\text{O}_4(g)$
 (b) $2 \text{BrNO}(g) \rightleftharpoons 2 \text{NO}(g) + \text{Br}_2(g)$
 (c) $\text{H}_2\text{O}(g) + \text{CO}(g) \rightleftharpoons \text{H}_2(g) + \text{CO}_2(g)$
 (d) $\text{CH}_4(g) + 2 \text{H}_2\text{S}(g) \rightleftharpoons \text{CS}_2(g) + 4 \text{H}_2(g)$

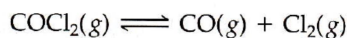
45. Write an equilibrium expression for each chemical equation involving one or more solid or liquid reactants or products.

- (a) $\text{PCl}_5(g) \rightleftharpoons \text{PCl}_3(l) + \text{Cl}_2(g)$
 (b) $2 \text{KClO}_3(s) \rightleftharpoons 2 \text{KCl}(s) + 3 \text{O}_2(g)$
 (c) $\text{HF}(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{F}^-(aq)$
 (d) $\text{NH}_3(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{NH}_4^+(aq) + \text{OH}^-(aq)$

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) $K_{\text{eq}} = 5.2 \times 10^{17}$
 (b) $K_{\text{eq}} = 1.24$
 (c) $K_{\text{eq}} = 3.22 \times 10^{-21}$
 (d) $K_{\text{eq}} = 0.47$

51. Consider the reaction.



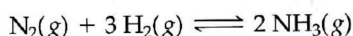
An equilibrium mixture of this reaction at a certain temperature has $[\text{COCl}_2] = 0.225 \text{ M}$, $[\text{CO}] = 0.105 \text{ M}$, and $[\text{Cl}_2] = 0.0844 \text{ M}$. What is the value of the equilibrium constant at this temperature?

55. Consider the reaction.



An equilibrium mixture of this reaction at a certain temperature has $[\text{NH}_3] = 0.278 \text{ M}$ and $[\text{H}_2\text{S}] = 0.355 \text{ M}$. What is the value of the equilibrium constant at this temperature?

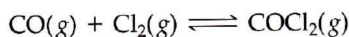
61. Consider the reaction:



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.



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.



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

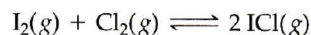
67. Consider the effect of a volume change on this reaction at equilibrium.



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

- (a) increasing the reaction volume
 (b) decreasing the reaction volume

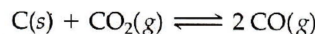
69. Consider the effect of a volume change on this reaction at equilibrium.



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.



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

- (a) increasing the reaction temperature
 (b) decreasing the reaction temperature

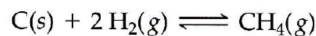
73. This reaction is exothermic.



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.



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