**18.1** 52. Write equilibrium constant expressions for these homogenous equilibria.

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau Ta. 2N2H4(g) + 2NO2(g) 3N2(g) + 4H2O(g)

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau Tb. 2NbCl4(g) NbCl3(g) + NbCl5(g)

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau Tc. I2(g) 2I(g)

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau Td. 2SO3(g) + CO2(g) CS2(g) + 4O2(g)

53. Write equilibrium constant expressions for these heterogeneous equilibria.

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau Ta. 2NaHCO3(s) Na2CO3(s) + H2O(g) + CO2(g)

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau Tb. C6H6(l) C6H6(g)

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau Tc. Fe3O4(s) + 4H2(g) 3Fe(s) + 4H2O(g)

55. Calculate *Keq* for the following equilibrium when [SO3] = 0.0160 mol/L, [SO2] = 0.00560 mol/L, and [O2] = 0.00210 mol/L

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau T2SO3(g) 2SO2(g) + O2(g)

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau T57. When solid ammonium chloride is put in a reaction vessel at 323 K, the equilibrium concentrations of both ammonia and hydrogen chloride are found to be 0.0660 mol/L. NH4Cl(s) NH3(g) + HCl(g). Calculate *Keq*.

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau T56. *Keq* for the reaction A + 2B C is 3.63. The data in the table shows the concentrations of the reactants and product in the two different reactions mixtures at the same temperature. Compare both Keq to prove that they are each at equilibrium.

|  |  |  |
| --- | --- | --- |
| **Concentrations of A, B, C** | | |
| A (mol/L) | B (mol/L) | C (mol/L) |
| 0.500 | 0.621 | 0.700 |
| 0.250 | 0.702 | 0.250 |

71. A 6.00 L vessel contains an equilibrium mixture of 0.0222 mol PCl3, 0.0189 mol PCl5, and 0.1044 mol Cl2. Calculate Keq for the following reaction.

** \alpha A + \beta B \rightleftharpoons \sigma S + \tau T** PCl5(g) PCl3(g) + Cl2(g)

**18.3** 65. *Keq* is 1.60 at 933 K for this reaction. Calculate the equilibrium concentration for hydrogen when [CO2] = 0.320 mol/L, [H2O] = 0.240 mol/L, and [CO] = 0.280 mol/L

** \alpha A + \beta B \rightleftharpoons \sigma S + \tau T** H2(g) + CO2(g) H2O(g) + CO(g)

66. At 2273K, *Keq* = 6.2x10-4for this reaction. If [N2] = 0.05200 mol/L and [O2] = 0.00120 mol/L, what is the concentration of NO at equilibrium?

** \alpha A + \beta B \rightleftharpoons \sigma S + \tau T** N2(g) + O2(g) 2NO(g)

**Keq practice KEY**

**18.1** 52. Write the equilibrium constant for these homogenous equilibria

**a. Keq= [N2]3 [H2O]4**

**[N2H4]2 [NO2]2**

1. 2N2H4(g) +2NO2(g) ↔ 3N2(g) +4H2O(g)

**b. Keq= [NbCl3][NbCl5]**

**[NbCl]2**

1. 2NbCl4(g) ↔ NbCl3(g) +NbCl5(g)
2. I2(g) ↔ 2I(g)

**c. Keq= [I]2**

**[I2]**

1. 2SO3(g) + CO2(g) ↔ CS2(g) + 4O2(g)

**d. Keq= [CS2][O2]4**

**[SO3]2 [CO2]**

53. Write the equilibrium constant for these heterogeneous equilibria

**a. Keq= [H2O][CO2]**

**c. Keq= [H2O]4**

**[H2]4**

1. 2NaHCO3(s) ↔ Na2CO3(s) + H2O(g) + CO2(g)
2. C6H6(l) ↔ C6H6(g)

**b. Keq= [C6H6]**

1. Fe3O4(s) +4H2(g) ↔ 3Fe(s) +4H2O(g)

55. Calculate *K*eq for the following equilibrium when [SO3] = 0.0160 mol/L, [SO2] = .00560 mol/L, and [O2] = .00210 mol/L

**Keq = 2.57 x 10-4**

2SO3(g) ↔ 2SO2(g) + O2(g)

57. When solid ammonium chloride is put in a reaction vessel at 323 K, the equilibrium concentrations of both ammonia and hydrogen chloride are found to be .066 mol/L. NH4Cl(s) ↔ NH3(g) + HCl(g). Calclulate *Keq*.

**Keq = 0.00436**

 \alpha A + \beta B \rightleftharpoons \sigma S + \tau T56. *Keq* for the reaction A + 2B C is 3.63. The data in the table shows the concentrations of the reactants and product in the two different reactions mixtures at the same temperature. Does the data provide evidence that both reactions are at equilibrium?

|  |  |  |
| --- | --- | --- |
| **Concentrations of A, B, C** | | |
| A (mol/L) | B (mol/L) | C (mol/L) |
| 0.500 | 0.621 | 0.700 |
| 0.250 | 0.525 | 0.250 |

**Both reactions are at equilibrium**

71. A 6.00 L vessel contains an equilibrium mixture of 0.0222 mol PCl3, 0.0189 mol PCl5, and 0.1044 mol Cl2. Calculate Keq for the following reaction.

** \alpha A + \beta B \rightleftharpoons \sigma S + \tau T** PCl5(g) PCl3(g) + Cl2(g)

**Keq = 2.04x10-2**

**18.3** 65. *Keq* is 1.60 at 933 K for this reaction. Calculate the equilibrium concentration for hydrogen when [CO2] = 0.320 mol/L, [H2O] = 0.240 mol/L, and [CO] = 0.280 mol/L

** \alpha A + \beta B \rightleftharpoons \sigma S + \tau T** H2(g) + CO2(g) H2O(g) + CO(g)

**[H2] = 0.131 *M***

66. At 2273K, *Keq* = 6.2x10-4for this reaction. If [N2] = 0.05200 mol/L and [O2] = 0.00120 mol/L, what is the concentration of NO at equilibrium?

** \alpha A + \beta B \rightleftharpoons \sigma S + \tau T** N2(g) + O2(g) 2NO(g)

**[NO] = 2.0x10-4 *M***