calculation for K yields a different result, there must be a reason. Either the H_2, I_2, and HI system has not reached equilibrium or the system is not at 425°C.

The balanced chemical equation for an equilibrium system is necessary to write the expression for the equilibrium constant. The data in **Table 1** show that the validity of this expression is confirmed when the actual values of the equilibrium concentrations of reactants and products are determined experimentally. The values of K are calculated from these concentrations. No information concerning the kinetics of the reacting systems is required.

Once the value of the equilibrium constant is known, the equilibrium-constant expression can be used to calculate concentrations of reactants or products at equilibrium. Suppose an equilibrium system at 425°C is found to contain 0.015 mol/L each of H_2 and I_2. To find the concentration of HI in this system, rearrange the chemical equilibrium expression as shown in the two equations that follow.

$$K = \frac{[HI]^2}{[H_2][I_2]}$$

$$[HI] = \sqrt{K[H_2][I_2]}$$

Using the known K value and the given concentrations for H_2 and I_2, solve the equation for [HI].

$$[HI] = \sqrt{0.015 \times 0.015 \times 54.34}$$

$$[HI] = 0.11 \text{ mol/L}$$

SAMPLE PROBLEM A

For more help, go to the Math Tutor at the end of this chapter.

An equilibrium mixture of N_2, O_2, and NO gases at 1500 K is determined to consist of 6.4×10^{-3} mol/L of N_2, 1.7×10^{-3} mol/L of O_2, and 1.1×10^{-5} mol/L of NO. What is the equilibrium constant for the system at this temperature?

SOLUTION

1 ANALYZE

Given: $[N_2] = 6.4 \times 10^{-3}$ mol/L
$[O_2] = 1.7 \times 10^{-3}$ mol/L
$[NO] = 1.1 \times 10^{-5}$ mol/L

Unknown: K

2 PLAN

The balanced chemical equation is $N_2(g) + O_2(g) \rightleftarrows 2NO(g)$.

The chemical equilibrium expression is $K = \dfrac{[NO]^2}{[N_2][O_2]}$.

3 COMPUTE

Substitute the given values for the concentrations into the equilibrium expression.

$$K = \frac{(1.1 \times 10^{-5} \text{ mol/L})^2}{(6.4 \times 10^{-3} \text{ mol/L})(1.7 \times 10^{-3} \text{ mol/L})} = 1.1 \times 10^{-5}$$