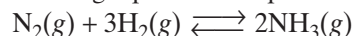**31.** Use the $K_{sp}$ values given in **Table 3** to evaluate the solubility of each of the following in moles per liter.
a. AgBr
b. CoS

**32.** Complete each of the following relative to the reaction that occurs when 25.0 mL of 0.0500 M $Pb(NO_3)_2$ is combined with 25.0 mL of 0.0400 M $Na_2SO_4$ if equilibrium is reached at 25°C.
a. Write the solubility equilibrium equation at 25°C.
b. Write the solubility equilibrium expression for the net reaction.

**33.** The ionic substance $T_3U_2$ ionizes to form $T^{2+}$ and $U^{3-}$ ions. The solubility of $T_3U_2$ is $3.8 \times 10^{-10}$ mol/L. What is the value of the solubility product constant?

**34.** A solution of AgI contains $2.7 \times 10^{-10}$ mol/L $Ag^+$. What is the maximum $I^-$ concentration that can exist in this solution?

**35.** Calculate whether a precipitate will form if 0.35 L of 0.0044 M $Ca(NO_3)_2$ and 0.17 L of 0.000 39 M NaOH are mixed at 25°C. (See **Table 3** for $K_{sp}$ values.) (Hint: See Sample Problem D.)

**36.** Determine whether a precipitate will form if 1.70 g of solid $AgNO_3$ and 14.5 g of solid NaCl are dissolved in 200. mL of water to form a solution at 25°C.

**37.** If $2.50 \times 10^{-2}$ g of solid $Fe(NO_3)_3$ is added to 100. mL of a $1.0 \times 10^{-4}$ M NaOH solution, will a precipitate form?

## MIXED REVIEW

**38.** Calcium carbonate is only slightly soluble in water.
a. Write the equilibrium equation for calcium carbonate in solution.
b. Write the solubility product constant expression, $K_{sp}$, for the equilibrium in a saturated solution of $CaCO_3$.

**39.** Calculate the concentration of $Hg^{2+}$ ions in a saturated solution of $HgS(s)$. How many $Hg^{2+}$ ions are in 1000 L of the solution?

**40.** Calculate the equilibrium constant, $K$, for the following reaction at 900°C.
$$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$$
The components were analyzed, and it was found that $[H_2] = 0.061$ mol/L, $[CO_2] = 0.16$ mol/L, $[H_2O] = 0.11$ mol/L, and $[CO] = 0.14$ mol/L.

**41.** A solution in equilibrium with solid barium phosphate is found to have a barium ion concentration of $5.0 \times 10^{-4}$ M and a $K_{sp}$ of $3.4 \times 10^{-23}$. Calculate the concentration of phosphate ion.

**42.** At 25°C, the value of $K$ is $1.7 \times 10^{-13}$ for the following reaction.
$$2N_2O(g) + O_2(g) \rightleftharpoons 4NO(g)$$
It is determined that $[N_2O] = 0.0035$ mol/L and $[O_2] = 0.0027$ mol/L. Using this information, what is the concentration of $NO(g)$ at equilibrium?

**43.** Tooth enamel is composed of the mineral hydroxyapatite, $Ca_5(PO_4)_3OH$, which has a $K_{sp}$ of $6.8 \times 10^{-37}$. The molar solubility of hydroxyapatite is $2.7 \times 10^{-5}$ mol/L. When hydroxyapatite is reacted with fluoride, the $OH^-$ is replaced with the $F^-$ ion on the mineral, forming fluorapatite, $Ca_5(PO_4)_3F$. (The latter is harder and less susceptible to cavities.) The $K_{sp}$ of fluorapatite is $1 \times 10^{-60}$. Calculate the molar solubility of fluorapatite in water. Given your calculations, can you support the fluoridation of drinking water?

**44.** Determine if a precipitate will form when 0.96 g $Na_2CO_3$ is combined with 0.20 g $BaBr_2$ in a 10. L solution ($K_{sp} = 2.8 \times 10^{-9}$).

**45.** For the formation of ammonia, the equilibrium constant is calculated to be $5.2 \times 10^{-5}$ at 25°C. After analysis, it is determined that $[N_2] = 2.00$ M and $[H_2] = 0.80$ M. How many grams of ammonia are in the 10. L reaction vessel at equilibrium? Use the following equilibrium equation.
$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

## CRITICAL THINKING

**46. Relating Ideas** Let $s$ equal the solubility, in mol/L, of $AB_2$. In terms of $s$, what is the molar concentration of A? of B? What is the $K_{sp}$ of $AB_2$?