Calculate the ion product.

$$[Ba^{2+}][SO_4^{2-}] = (5.0 \times 10^{-3})(2.5 \times 10^{-3})$$
$$= 1.2 \times 10^{-5}$$

The ion product, 1.2×10^{-5}, is greater than the value of K_{sp}, 1.1×10^{-10}, so precipitation occurs.

4 EVALUATE The answer contains the appropriate number of significant figures and is close to an estimated value of 1×10^{-5}, calculated as $(5 \times 10^{-3})(2 \times 10^{-3})$; because $10^{-5} > 10^{-10}$, precipitation should occur.

PRACTICE *Answers in Appendix E*

1. Does a precipitate form when 100. mL of 0.0025 M $AgNO_3$ and 150. mL of 0.0020 M NaBr solutions are mixed?
2. Does a precipitate form when 20. mL of 0.038 M $Pb(NO_3)_2$ and 30. mL of 0.018 M KCl solutions are mixed?

extension
Go to **go.hrw.com** for more practice problems that ask you to perform precipitation calculations.
Keyword: HC6EQUX

Limitations on the Use of K_{sp}

The solubility product principle can be very useful when applied to solutions of sparingly soluble substances. It *cannot* be applied very successfully to solutions of moderately soluble or very soluble substances. This is because the positive and negative ions attract each other, and this attraction becomes appreciable when the ions are close together. Sometimes it is necessary to consider two equilibria simultaneously. For example, if either ion hydrolyzes, the salt will be more soluble than predicted when only the solubility product constant is used. The solubility product is also sensitive to changes in solution temperature to the extent that the solubility of the dissolved substance is affected by such changes. All of these factors limit the conditions under which the solubility product principle can be applied.

SECTION REVIEW

1. What is a solubility product constant? How are such constants determined?
2. How are solubility product constants used to calculate solubilities?
3. What is an ion product?
4. How are calculations to predict possible precipitation carried out?
5. What is the value of K_{sp} for Ag_2SO_4 if 5.40 g is soluble in 1.00 L of water?
6. Determine whether a precipitate will form if 20.0 mL of 1.00×10^{-7} M $AgNO_3$ is mixed with 20.0 mL of 2.00×10^{-9} M NaCl at 25°C.

Critical Thinking

7. **ANALYZING DATA** A solution is 0.20 M in each of the following: $Ca(NO_3)_2$, $Cr(NO_3)_3$, and $La(NO_3)_3$. Solid NaF is added to the solution until the $[F^-]$ of the solution is 1.0×10^{-4} M. Given the values of K_{sp} below, describe what will happen.
$CaF_2 = 3.9 \times 10^{-11}$; $CrF_3 = 6.6 \times 10^{-11}$; and $LaF_3 = 4.0 \times 10^{-17}$