Chapter 8 Example Problem
Using Activities to Calculate the Solubility of a Salt

Find the molar solubility (*S*) for BaF_2 (to two significant figures) in a solution of 0.10 M NaF. Take activities into account.

$$BaF_2(s) \rightleftharpoons Ba^{2+}(aq) + 2\ F^-(aq) \qquad K_{sp} = 1.7 \times 10^{-6}$$

(Forgetting activities for a minute), how would the solubility of BaF_2 compare in (1) pure H_2O *vs*. (2) 0.10 M NaF?

- The Concept: Ions in solution help stabilize the Ba^{2+} and the F^-, which pulls equilibrium to the right—that is, the solubility is increased.

- The Twist: Dissolved Ba^{2+} and F^- contribute to each other's ionic atmospheres—that is, BaF_2 can help itself dissolve!

- The Challenge: How do we calculate the ionic strength (μ) if we don't know $[Ba^{2+}]$ and $[F^-]$?

  Iteration #1

  (a) Make assumptions about $[Ba^{2+}]$ and $[F^-]$
  (b) Compute μ, and activity coefficients $\gamma(Ba^{2+})$ and $\gamma(F^-)$, based on your assumptions
  (c) Compute new values of $[Ba^{2+}]$ and $[F^-]$
  (d) If the calculated $[Ba^{2+}]$ and $[F^-]$ values agree with the assumed values (to the given number of significant figures), you can quit and go home! But if not…

  Iteration #2, #3, …

  (a) Re-compute μ, and activity coefficients $\gamma(Ba^{2+})$ and $\gamma(F^-)$, based on your new values of $[Ba^{2+}]$ and $[F^-]$
  (b) Re-compute $[Ba^{2+}]$ and $[F^-]$
  (c) Repeat Steps (a) and (b) until two successive iterations give the same values of $[Ba^{2+}]$ and $[F^-]$ to a given number of significant figures (that is, until the calculation has converged)