The Common Ion Effect
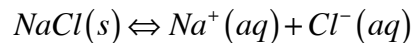
Consider a saturated solution of sodium chloride, in equilibrium with a small amount of undissolved sodium chloride.

$$NaCl(s) \Leftrightarrow Na^+(aq) + Cl^-(aq)$$

If a few drops of concentrated hydrochloric acid is added to the equilibrium mixture, the concentration of the chloride ions will increase. According to Le Chatelier's principle, this will cause the equilibrium to shift to the left. This will cause additional sodium chloride to precipitate out of the solution.

In this example, the chloride ions were common to both solutions that were mixed. The lowering of the solubility of an ionic compound by the addition of a common ion is called the common ion effect.

Example 1
What is the molar solubility of $PbCl_2(s)$ in a $0.2 \ mol/L \ NaCl(aq)$ solution at STP?

Worksheet

1. Calculate the solubility of silver chloride in a 0.10 mol/L solution of sodium chloride at $25°C$.

2. Calculate the solubility of calcium sulfate in 0.01 mol/L calcium nitrate at $25°C$.

3. Calculate the molar solubility of $Ag_2CrO_4(s)$

   a) in pure water.

   b) in a solution of 0.10 mol/L sodium chromate (Na_2CrO_4).

4. Name two compounds that will decrease the solubility of barium sulfate ($BaSO_4$).

5. Name two compounds that will decrease the solubility of copper(II) carbonate ($CuCO_3$).

Answers

1. $1.8 \times 10^{-9} \ mol/L$

2. $4.8 \times 10^{-3} \ mol/L$

3. (a) $6.54 \times 10^{-5} \ mol/L$ (b) $1.7 \times 10^{-6} \ mol/L$

4. Any two soluble compounds containing either Ba^{2+} or SO_4^{2-} ions.

5. Any two soluble compounds containing either Cu^{2+} or CO_3^{2-} ions.