

April 5, 2002

➤ Quiz and Demo (sorta) today!

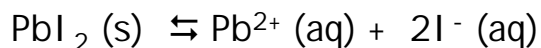
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When Precipitation Happens

➤ Will a *precipitate* form when we mix two solutions?

Example:

If we mix 50.0 mL 0.010 M $\text{Pb}(\text{NO}_3)_2$ and 50.0 mL 0.010 M KI, will **PbI_2** ($K_{sp} = 1.4 \times 10^{-8}$) precipitate?



50.0 mL 0.010 M = 0.50 mmol Pb^{2+} and I^-

$$C_{\text{Pb}^{2+}} = C_{\text{I}^-} = 0.50 \text{ mmol}/100.0 \text{ mL} = 5.0 \times 10^{-3} \text{ M}$$

$$Q = (C_{\text{Pb}^{2+}})(C_{\text{I}^-})^2 = (5.0 \times 10^{-3})(5.0 \times 10^{-3})^2 = 1.25 \times 10^{-7}$$

$Q > K_{sp}$ so **PbI_2 will precipitate**

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Differential Solubility

- Suppose *two* cations are in solution; which will precipitate first?

Example:

Suppose we add CrO_4^{2-} to a solution containing *both* Ba^{2+} and Sr^{2+} at $1.0 \times 10^{-3} \text{ M}$. Which ion will precipitate first?

$$K_{\text{sp}} (\text{BaCrO}_4) = 2.4 \times 10^{-10}$$

$$K_{\text{sp}} (\text{SrCrO}_4) = 3.6 \times 10^{-5}$$

•With identical amounts of both ions, cmpd with the *smallest* K_{sp} will precipitate first: Ba^{2+}

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Quantitatively!

- BaCrO_4 will begin to precipitate when:

$$[\text{CrO}_4^{2-}] = \frac{K_{\text{sp}}}{[\text{Ba}^{2+}]} = \frac{2.4 \times 10^{-10}}{1.0 \times 10^{-3}} = 2.4 \times 10^{-7} \text{ M}$$

[CrO₄²⁻] when precipitation *begins*

- SrCrO_4 will begin to precipitate when:

$$[\text{CrO}_4^{2-}] = \frac{K_{\text{sp}}}{[\text{Sr}^{2+}]} = \frac{3.6 \times 10^{-5}}{1.0 \times 10^{-3}} = 3.6 \times 10^{-2} \text{ M}$$

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Leftovers?

➤ How much Ba^{2+} **remains** when SrCrO_4 begins to precipitate?

When SrCrO_4 begins to precipitate:

$$[\text{CrO}_4^{2-}] = 3.6 \times 10^{-2} \text{ M}$$

So: $[\text{Ba}^{2+}] = \frac{K_{\text{sp}}}{[\text{CrO}_4^{2-}]} = \frac{2.4 \times 10^{-10}}{3.6 \times 10^{-2}} = \mathbf{6.7 \times 10^{-9} \text{ M}}$

% Ba^{2+} remaining:

$$\frac{[\text{Ba}^{2+}]}{C_{\text{Ba}^{2+}}} = \frac{6.7 \times 10^{-9}}{1.0 \times 10^{-3}} \times 100 = \mathbf{6.7 \times 10^{-4} \%}$$

Ba^{2+} remaining