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* $Pb(NO_3)_2$ and 50.0 mL 0.010 *M* KI, will ***PbI_2 (K_{sp} = 1.4 x 10^{-8})*** precipitate?

$$PbI_2 (s) \leftrightarrows Pb^{2+} (aq) + 2I^- (aq)$$

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

$C_{Pb2+} = C_{I-}$ = 0.50 mmol/100.0 mL = *5.0 x 10^{-3} M*

$Q = (C_{Pb2+})(C_{I-})^2 = (5.0 \times 10^{-3})(5.0 \times 10^{-3})^2 =$ ***1.25 x 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?

<u>Example:</u>

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

K_{sp} ($BaCrO_4$) = 2.4×10^{-10}

K_{sp} ($SrCrO_4$) = 3.6×10^{-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:

$$[CrO_4^{2-}] = \frac{K_{sp}}{[Ba^{2+}]} = \frac{2.4 \times 10^{-10}}{1.0 \times 10^{-3}} = \mathbf{2.4 \times 10^{-7}\ \mathit{M}}$$

$[CrO_4^{2-}]$ when precipitation *begins*

- $SrCrO_4$ will begin to precipitate when:

$$[CrO_4^{2-}] = \frac{K_{sp}}{[Sr^{2+}]} = \frac{3.6 \times 10^{-5}}{1.0 \times 10^{-3}} = \mathbf{3.6 \times 10^{-2}\ \mathit{M}}$$

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Leftovers?

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

When $SrCrO_4$ begins to precipitate:

$$[CrO_4^{2-}] = 3.6 \times 10^{-2}\ M$$

So: $[Ba^{2+}] = \frac{K_{sp}}{[CrO_4^{2-}]} = \frac{2.4 \times 10^{-10}}{3.6 \times 10^{-2}} = \mathbf{6.7 \times 10^{-9}}\ \boldsymbol{M}$

Ba^{2+} remaining

% Ba^{2+} remaining:

$\frac{[Ba^{2+}]}{C_{Ba2+}} = \frac{6.7 \times 10^{-9}}{1.0 \times 10^{-3}} \times 100 =$ ***6.7×10^{-4} %***

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