

Name: Key
Blk: _____ Date: _____

Chemistry 12
Solubility Lesson #7
PREDICTING WHETHER A PRECIPITATE WILL FORM

In this section you are asked to determine if when you mix two solutions containing ions whether or not a precipitate will form. This is commonly called the **TRIAL ION PRODUCT** Calculation or "TIP" (LIKE A TRIAL Keq)

Q = The value obtained when you multiply given ion concentrations

K_{sp} = The value obtained when you multiply the concentrations of ions in a SATURATED SOLUTION

There are **THREE POSSIBLE OUTCOMES** once you have calculated the Trial Ion Product:

A. Q < K_{sp}

Here we have less than what is needed for a saturated solution so the result is:
NO A PPT WILL NOT FORM

B. Q = K_{sp}

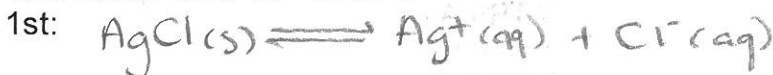
Here we have just enough for a saturated solution so the result is:
A MINIMUM AMOUNT OF PPT WILL FORM

C. Q > K_{sp}

Here we have more than what is needed for a saturated solution so the result is:

YES A PPT WILL FORM

Example 1: Will a precipitate form when 5.0 mL of 6.0×10^{-5} M Ag^+ mixes with 10.0 mL of 4.2×10^{-6} M Cl^- ?



2nd: $K_{sp} = [\text{Ag}^+][\text{Cl}^-] = 1.8 \times 10^{-10}$

$Q = [\text{Ag}^+]_{dil} [\text{Cl}^-]_{dil}$

3rd: calculate the diluted ion []'s

$[\text{Ag}^+]_{dil} = \frac{6.0 \times 10^{-5} \text{ M} \times 0.0050 \text{ L}}{0.0150 \text{ L}} = 2.0 \times 10^{-5} \text{ M Ag}^+$

4th: $[\text{Cl}^-]_{dil} = \frac{4.2 \times 10^{-6} \text{ M} \times 0.0100 \text{ L}}{0.0150 \text{ L}} = 2.8 \times 10^{-6} \text{ M Cl}^-$

"Q" = $[2.0 \times 10^{-5}][2.8 \times 10^{-6}]$

= $5.6 \times 10^{-11} < 1.8 \times 10^{-10}$

∴ No PPT Forms!

Example 2: If 25.0 mL of $4.50 \times 10^{-3} \text{ M Pb(NO}_3)_2$ is mixed with 35.0 mL of $2.80 \times 10^{-3} \text{ M MgI}_2$, will a precipitate form?



2nd: $K_{sp} = [\text{Pb}^{2+}][\text{I}^{-}]^2 = 8.5 \times 10^{-9}$

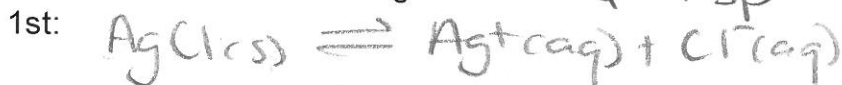
Calculate the dilution $[\text{Pb(NO}_3)_2] + [\text{MgI}_2]$ 1.875×10^{-3}

3rd: $[\text{Pb(NO}_3)_2] = \frac{4.50 \times 10^{-3} \text{ M} \times 0.0250 \text{ L}}{0.0600 \text{ L}} = 1.88 \times 10^{-3} \text{ M Pb(NO}_3)_2$
 $\therefore 1.88 \times 10^{-3} \text{ M Pb}^{2+}$

4th: $[\text{MgI}_2] = \frac{2.80 \times 10^{-3} \text{ M} \times 0.0350 \text{ L}}{0.0600 \text{ L}} = 1.63 \times 10^{-3} \text{ M MgI}_2$

$Q = [\text{Pb}^{2+}][\text{I}^{-}]^2 = [1.88 \times 10^{-3}][3.27 \times 10^{-3}]^2 \therefore 3.27 \times 10^{-3} \text{ M I}^{-}$
 $= 2.00 \times 10^{-8} > 8.5 \times 10^{-9} \therefore \text{yes a ppt will form!}$

Example 3. What $[\text{Cl}^{-}]$ is required to JUST START precipitation of $\text{AgCl}(\text{s})$ from a $3.6 \times 10^{-3} \text{ M}$ solution of Ag^{+} ?



2nd: $K_{sp} = [\text{Ag}^{+}][\text{Cl}^{-}] = 1.8 \times 10^{-10} \therefore Q = 1.8 \times 10^{-10}$

3rd: using the K_{sp} value and $[\text{Ag}^{+}]$; solve for $[\text{Cl}^{-}]$

$$\frac{1.8 \times 10^{-10}}{3.6 \times 10^{-3}} = \frac{[3.6 \times 10^{-3}][x]}{3.6 \times 10^{-3}}$$

4th: $5.0 \times 10^{-8} = x$

$\therefore 5.0 \times 10^{-8} \text{ M Cl}^{-}$ is required to JUST START the ppt of AgCl !