

Name: _____
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 using the GIVEN ion concentrations

Ksp = The value obtained when using ion concentrations 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

∴ a possible ppt may form

• "just start"
• "max amount added w/out forming a ppt"

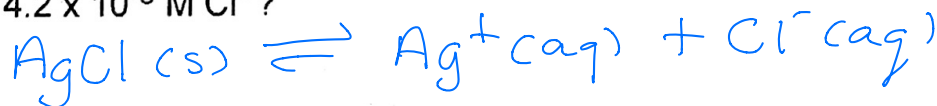
C. $Q > K_{sp}$

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 $6.0 \times 10^{-5} \text{ M Ag}^+$ mixes with 10.0 mL of $4.2 \times 10^{-6} \text{ M Cl}^-$?

1st:



2nd:

$$K_{sp} = [\text{Ag}^+][\text{Cl}^-] = \underline{1.8 \cdot 10^{-10}}, \quad "Q" = [\text{Ag}^+]_G [\text{Cl}^-]_G$$

3rd:

Calculate $[\text{Ag}^+]_G$

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

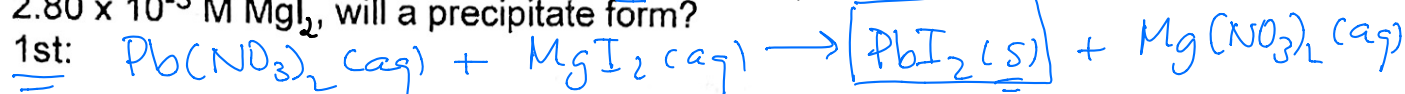
$$[\text{Cl}^-]_G = \frac{4.2 \cdot 10^{-6} \text{ M} \cdot 0.0100 \text{ L}}{0.0150 \text{ L}} = \underline{2.8 \cdot 10^{-6} \text{ M Cl}^-}$$

4th:

$$"Q" = [2.0 \cdot 10^{-5}][2.8 \cdot 10^{-6}] = 5.6 \cdot 10^{-11} < 1.8 \cdot 10^{-10} \quad \text{no ppt}$$



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:

$$K_{sp} = [\text{Pb}^{2+}][\text{I}^-]^2 = 8.5 \cdot 10^{-9} \quad \text{table}$$

$$Q = [\text{Pb}^{2+}]_G [\text{I}^-]_G^2 \quad [\text{I}^-]_G = 2 \cdot \frac{2.80 \cdot 10^{-3} \text{ M} \cdot 0.0350 \text{ L}}{0.0600 \text{ L}} = 3.27 \cdot 10^{-3} \text{ M I}^-$$

3rd:

$$[\text{Pb}^{2+}]_G = \frac{4.50 \cdot 10^{-3} \cdot 0.0250 \text{ L}}{0.0600 \text{ L}} \approx 1.88 \cdot 10^{-3} \text{ M Pb}^{2+}$$

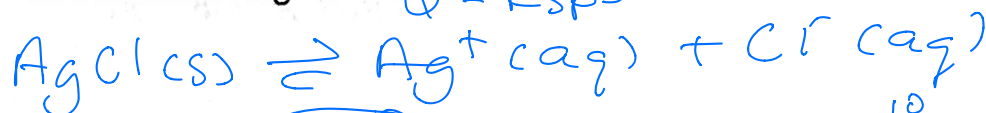
4th:

$$Q = [1.88 \cdot 10^{-3}][3.27 \cdot 10^{-3}]^2 = 2.00 \cdot 10^{-8} > 8.5 \cdot 10^{-9}$$

yes a ppt will form

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

1st:



2nd:

$$K_{sp} = [\text{Ag}^+][\text{Cl}^-] = 1.8 \cdot 10^{-10}$$

3rd:

$$Q = K_{sp} \quad \frac{1.8 \cdot 10^{-10}}{3.6 \cdot 10^{-3}} = \frac{[3.6 \cdot 10^{-3}][x]}{3.6 \cdot 10^{-3}}$$

4th:

$$5.0 \cdot 10^{-8} = [x]$$

$\therefore 5.0 \cdot 10^{-8} \text{ M Cl}^-$ will just start a ppt