Name: Key
Blk:_____ Date:_____

Chemistry 12
Solubililty 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

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

B. **Q =Ksp**
Here we have just enough for a saturated solution so the result is:
A MINIMUM AMOUNT OF PPT WILL FORM

C. **Q > Ksp**
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^- ?

1st: $AgCl_{(s)} \rightleftharpoons Ag^+_{(aq)} + Cl^-_{(aq)}$

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

3rd: Calculate the diluted ion [ ]'s

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

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

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

$= 5.6 \times 10^{-11} < 1.8 \times 10^{-10}$ $\therefore$ No PPT Forms!

Example 2: If 25.0 mL of 4.50×10^{-3} N $Pb(NO_3)_2$ is mixed with 35.0 mL if 2.80×10^{-3} M MgI_2, will a precipitate form?

1st: $Pb(NO_3)_2 + MgI_2 \longrightarrow PbI_2(s) + Mg(NO_3)_2$

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

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

3rd: Calculate the dilution $[Pb(NO_3)_2] + [MgI_2]$ 1.875×10^{-3}

$[Pb(NO_3)_2] = \dfrac{4.50 \times 10^{-3}\ M \times 0.0250\ L}{0.0600\ L} = 1.88 \times 10^{-3}\ M\ Pb(NO_3)_2$

$\therefore \boxed{1.88 \times 10^{-3}\ M\ Pb^{2+}}$

4th: $[MgI_2] = \dfrac{2.80 \times 10^{-3}\ M \times 0.0350\ L}{0.0600\ L} = 1.63 \times 10^{-3}\ M\ MgI_2$

$\therefore \boxed{3.27 \times 10^{-3}\ M\ I^-}$

$Q = [Pb^{2+}][I^-]^2 = [1.88 \times 10^{-3}][3.27 \times 10^{-3}]^2$

$= 2.01 \times 10^{-8} > 8.5 \times 10^{-9}$ $\therefore$ yes a ppt will form!

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

1st: $AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$

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

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

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

4th:

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

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

Seatwork/Homework:Exercises 57 - 69 pgs 98-99 (odd numbers only)
PLO's :I5 - I6