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AP Chemistry

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Period _____

Introductory Ksp Worksheet #1 (2011)
Predicting Precipitate Formation

1. Complete the following chart.

Compound	Solubility Equilibrium Reaction	Ksp Expression
NaCl	$NaCl \rightleftarrows Na^+ + Cl^-$	Ksp = $[Na^+][Cl^-]$
$CaSO_4$	$CaSO_4 \rightleftarrows Ca^{2+} + SO_4^{2-}$	Ksp = $[Ca^{2+}][SO_4^{2-}]$
SrF_2	$SrF_2 \rightleftarrows Sr^{2+} + 2F^-$	Ksp = $[Sr^{2+}][F^-]^2$
$BaCO_3$	$BaCO_3 \rightleftarrows Ba^{2+} + CO_3^{2-}$	Ksp = $[Ba^{2+}][CO_3^{2-}]$

2. We can think of Ksp as an indication of a "solubility limit" for each compound.

Would a precipitate be observed if the following were mixed?
120 mL of 0.010 M $CaCl_2$ and 650 mL of 0.010 M Na_2SO_4

$CaCl_2 + Na_2SO_4 \rightarrow \boxed{CaSO_4} + 2NaCl$

← Not very soluble

$K_{sp} = 2.4 \times 10^{-5}$

Consider Ksp for $CaSO_4$

$K_{sp} = 2.4 \times 10^{-5} = [Ca^{2+}][SO_4^{2-}]$

$Q = [Ca^{2+}][SO_4^{2-}]$

$[Ca^{2+}] = \frac{(.010)(.120)}{.77 \text{ Liters}} = .0016\ M$

$[SO_4^{2-}] = \frac{(.010)(.65)}{.77} = .0084\ M$

$Q = [.0016][.0084]$

$Q = 1.3 \times 10^{-5}$

$K_{sp} > Q$ so no ppt will form

3. Would a precipitate be observed if the following were mixed?
75 mL of 0.010 M $AgNO_3$ and 75 mL of 0.010 M NaCl

$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

AgCl is not very soluble $K_{sp} = 1.8 \times 10^{-10}$

$AgCl \rightleftharpoons Ag^+ + Cl^-$

$[Ag^+] = \frac{(.010)(.075)}{.15} = .0050\ M$

$[Cl^-] = \frac{(.010)(.075)}{.15} = .0050\ M$

$Q = [.0050][.0050]$

$Q = 2.5 \times 10^{-5}$

$K < Q$ ppt would form

4. Would a precipitate be observed if the following were mixed?
100. mL of 0.10 M $CaCl_2$ and 50.0 mL of 0.10 M KF

$CaCl_2 + KF \rightarrow CaF_2 + 2\ KCl$

CaF_2 not very soluble $K_{sp} = 3.9 \times 10^{-11}$

$CaF_2 \rightleftharpoons Ca^{2+} + 2\ F^-$

$[Ca^{2+}] = \frac{(.10)(.100)}{.150} = .067\ M$

$[F^-] = \frac{(.10)(.05)}{.150} = .033M$

$Q = [.067][.033]^2$

$Q = 7.3 \times 10^{-5}$

$K < Q$ ppt would form

5. Would a precipitate be observed if the following were mixed?
200. mL of 0.030 M NaI and 400. mL of 0.040 M $AgNO_3$

$NaI + AgNO_3 \rightarrow AgI + NaNO_3$ $K_{sp} = 8.3 \times 10^{-17}$

$[I^-] = \frac{(.030)(.200)}{.600} = .01\ M$

$[Ag^+] = \frac{(.040)(.400)}{.600} = .027\ M$

$Q = [Ag^+][I^-]$

$Q = [.027][.01]$

$Q = 2.7 \times 10^{-4}$

$Q > K_{sp}$ so yes a ppt forms

6. Would a precipitate be observed if the following were mixed?
0.10 L of 0.0080 M $Pb(NO_3)_2$ and 0.40 L of 0.0050 M Na_2SO_4?

$Pb(NO_3)_2 + Na_2SO_4 \rightarrow PbSO_4 + 2NaNO_3$ $K_{sp} = 6.3 \times 10^{-7}$

$[Pb^{2+}] = \frac{(.0080)(.10)}{.50} = .0016\ M$

$[SO_4^{2-}] = \frac{(.0050)(.40)}{.50} = .004\ M$

$Q = [Pb^{2+}][SO_4^{2-}] =$

$Q = [.0016][.004]$

$Q = 6.4 \times 10^{-6}$

$Q > K_{sp}$ yes a ppt forms