

Introductory Ksp Worksheet #1 (2011)
Predicting Precipitate Formation

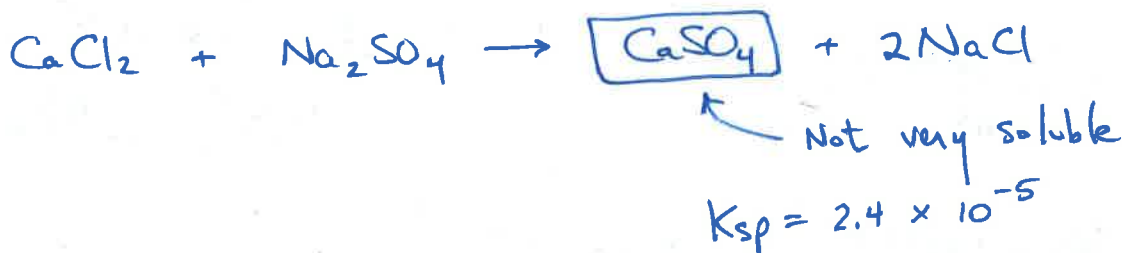
1. Complete the following chart.

Compound	Solubility Equilibrium Reaction	Ksp Expression
NaCl	$\text{NaCl} \rightleftharpoons \text{Na}^+ + \text{Cl}^-$	$K_{sp} = [\text{Na}^+][\text{Cl}^-]$
CaSO ₄	$\text{CaSO}_4 \rightleftharpoons \text{Ca}^{2+} + \text{SO}_4^{2-}$	$K_{sp} = [\text{Ca}^{2+}][\text{SO}_4^{2-}]$
SrF ₂	$\text{SrF}_2 \rightleftharpoons \text{Sr}^{2+} + 2\text{F}^-$	$K_{sp} = [\text{Sr}^{2+}][\text{F}^-]^2$
BaCO ₃	$\text{BaCO}_3 \rightleftharpoons \text{Ba}^{2+} + \text{CO}_3^{2-}$	$K_{sp} = [\text{Ba}^{2+}][\text{CO}_3^{2-}]$

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 CaCl₂ and 650 mL of 0.010 M Na₂SO₄



Consider Ksp for CaSO₄

$$K_{sp} = 2.4 \times 10^{-5} = [\text{Ca}^{2+}][\text{SO}_4^{2-}]$$

$$Q = [\text{Ca}^{2+}][\text{SO}_4^{2-}]$$

$$[\text{Ca}^{2+}] = \frac{(0.010)(.120)}{.77 \text{ Liters}} = .0016 \text{ M}$$

$$[\text{SO}_4^{2-}] = \frac{(0.010)(.65)}{.77} = .0084 \text{ M}$$

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

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

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

3. Would a precipitate be observed if the following were mixed?

75 mL of 0.010 M AgNO₃ and 75 mL of 0.010 M NaCl



$$[\text{Ag}^+] = \frac{(0.010)(0.075)}{.15} = .0050 \text{ M}$$

$$[\text{Cl}^-] = \frac{(0.010)(0.075)}{.15} = .0050 \text{ M}$$

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

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

$K < Q$ ppt would form

4. Would a precipitate be observed if the following were mixed?

100. mL of 0.10 M CaCl₂ and 50.0 mL of 0.10 M KF



$$[\text{Ca}^{2+}] = \frac{(0.10)(100)}{.150} = .067 \text{ M}$$

$$[\text{F}^-] = \frac{(0.10)(50)}{.150} = .033 \text{ M}$$

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

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

$K < Q$ 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 AgNO₃



$K_{sp} = 8.3 \times 10^{-17}$

$$[\text{I}^-] = \frac{(0.030)(200)}{.600} = .01 \text{ M}$$

$$[\text{Ag}^+] = \frac{(0.040)(400)}{.600} = .027 \text{ M}$$

$$Q = [\text{Ag}^+][\text{I}^-]$$

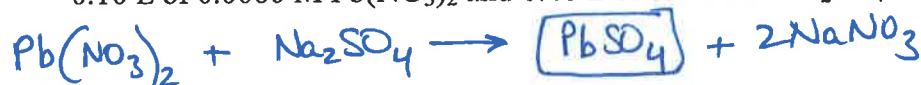
$$Q = [.027][.01]$$

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

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

6. Would a precipitate be observed if the following were mixed?

0.10 L of 0.0080 M Pb(NO₃)₂ and 0.40 L of 0.0050 M Na₂SO₄?



$K_{sp} = 6.3 \times 10^{-7}$

$$[\text{Pb}^{2+}] = \frac{(0.0080)(.10)}{.50} = .0016 \text{ M}$$

$$[\text{SO}_4^{2-}] = \frac{(0.0050)(.40)}{.50} = .004 \text{ M}$$

$$Q = [\text{Pb}^{2+}][\text{SO}_4^{2-}]$$

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

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

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