

Solubility Product Lab Calculation Help

Part III:

M of $\text{Na}_2\text{S}_2\text{O}_3$:

$$0.010 \text{ L KIO}_3 \times \frac{\text{mol KIO}_3}{\text{L KIO}_3} \times \frac{3 \text{ mol I}_2}{1 \text{ mol KIO}_3} \times \frac{2 \text{ mol S}_2\text{O}_3^{2-}}{\text{mol I}_2} = \text{moles S}_2\text{O}_3^{2-}$$

You pipetted 10 mL of your KIO_3 Soln.

molarity of your KIO_3 soln

$$\frac{\text{moles S}_2\text{O}_3^{2-}}{\text{L S}_2\text{O}_3^{2-} \text{ added}} = M \text{ S}_2\text{O}_3^{2-} = M \text{ Na}_2\text{S}_2\text{O}_3$$

Part IV:

moles IO_3^- :

$$\text{L S}_2\text{O}_3^{2-} \text{ added} \times \frac{\text{moles S}_2\text{O}_3^{2-}}{\text{L S}_2\text{O}_3^{2-}} \times \frac{1 \text{ mol I}_2}{2 \text{ mol S}_2\text{O}_3^{2-}} \times \frac{1 \text{ mol IO}_3^-}{3 \text{ mol I}_2} = \text{moles IO}_3^-$$

amount of $\text{Na}_2\text{S}_2\text{O}_3$ Soln. needed to reach endpoint

molarity of your $\text{Na}_2\text{S}_2\text{O}_3$ soln.

Solubility of $\text{Ca}(\text{IO}_3)_2$ in pure water:

$$\frac{\text{moles IO}_3^-}{2} = M \text{ IO}_3^- = 2s$$

endpoint

Solubility of $\text{Ca}(\text{IO}_3)_2$ in pure water:

$$\frac{\text{moles IO}_3^-}{0.010 \text{ L IO}_3^-} = M \text{ IO}_3^- = 2s$$

$$s = \text{Solubility} = \frac{M \text{ IO}_3^-}{2}$$

You should have pipetted 10 mL $\text{Ca}(\text{IO}_3)_2$ Soln.

Stoichiometry. Since it's $\text{Ca}(\text{IO}_3)_2$, you would have 2 IO_3^- for every $1 \text{ Ca}(\text{IO}_3)_2$ that dissolved.

Part V:

Moles IO_3^- :

$$L \text{ S}_2\text{O}_3^{2-} \times \frac{\text{moles S}_2\text{O}_3^{2-}}{L \text{ S}_2\text{O}_3^{2-}} \times \frac{1 \text{ mol I}_2}{2 \text{ mol S}_2\text{O}_3^{2-}} \times \frac{1 \text{ mol IO}_3^-}{3 \text{ mol I}_2}$$

molarity of your $\text{Na}_2\text{S}_2\text{O}_3$ soln.

Amount of $\text{Na}_2\text{S}_2\text{O}_3$ Soln. needed to reach endpoint = moles IO_3^-

Solubility of $\text{Ca}(\text{IO}_3)_2$ in Sat. 0.01 M KIO_3 :

$$\frac{\text{Moles IO}_3^-}{0.010 L \text{ IO}_3^-} = M \text{ IO}_3^- = 0.01 + 2s$$

Existing 0.01 M IO_3^- from the KIO_3

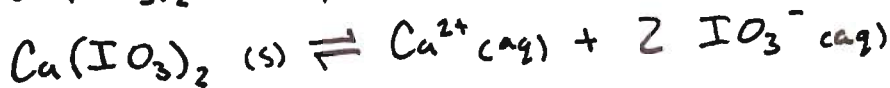
$$S = \frac{(M \text{ IO}_3^- - 0.01)}{2}$$

Stoichiometry from 2 IO_3^- from every 1 $\text{Ca}(\text{IO}_3)_2$

10 mL of $\text{Ca}(\text{IO}_3)_2$ in 0.01 M KIO_3 Soln. you pipetted

K_{sp} based on concentration:

K_{sp} of $[\text{Ca}(\text{IO}_3)_2]$ in pure water: (from part IV)



$$K_{sp} = [\text{Ca}^{2+}][\text{IO}_3^-]^2 = (s)(2s)^2 = 4s^3$$

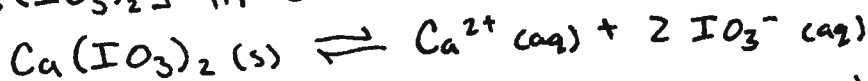
you calculated this S in part IV

K_{sp} of $[\text{Ca}(\text{IO}_3)_2]$ in sat. 0.01 M KIO_3 : (from part V)

$$K_{sp} = [\text{Ca}^{2+}][\text{IO}_3^-]^2 = (s)(2s)^2 = 4s^3$$

you calculated this S in part IV

K_{sp} of $[\text{Ca}(\text{IO}_3)_2]$ in sat. 0.01 M KIO_3 : (from part V)



$$K_{sp} = [\text{Ca}^{2+}][\text{IO}_3^-]^2 = (s)(0.010 M + 2s)^2$$

you calculated this S in part IV

due to the 0.01 M KIO_3

K_{sp} based on activity:

Note: The activity coefficients you need for the ionic strength of the solns. you worked with can be found in table 1 of this exp. in your lab manual

Ca(IO₃)₂ in pure water:

Ionic Strength:

$$\mu = \frac{1}{2} ([Ca^{2+}](2)^2 + [IO_3^-](1)^2) = \frac{1}{2} (4s + 1(2s)) = 3s$$

K_{sp} using activities:

Based on the μ that you just calculated, look up $\gamma_{Ca^{2+}}$ + $\gamma_{IO_3^-}$

$$\begin{aligned} K_{sp} &= \gamma_{Ca^{2+}} [Ca^{2+}] \gamma_{IO_3^-}^2 [IO_3^-]^2 \\ &= \gamma_{Ca^{2+}} + \gamma_{IO_3^-}^2 (s)(2s)^2 \\ &= 4 \gamma_{Ca^{2+}} + \gamma_{IO_3^-}^2 (s^3) \end{aligned}$$

Ca(IO₃)₂ in sat. 0.01 M KIO₃:

Ionic Strength:

$$\begin{aligned} \mu &= \frac{1}{2} ([K^+](1)^2 + [Ca^{2+}](2)^2 + [IO_3^-](1)^2) \\ &= \frac{1}{2} (1(0.01) + 4s + 1(0.01 + 2s)) \end{aligned}$$

K_{sp} using activities:

Again, look up $\gamma_{Ca^{2+}}$ and $\gamma_{IO_3^-}$ based on the μ that you calculated

$$\begin{aligned} K_{sp} &= \gamma_{Ca^{2+}} [Ca^{2+}] \gamma_{IO_3^-}^2 [IO_3^-]^2 \\ &= \gamma_{Ca^{2+}} + \gamma_{IO_3^-}^2 (s)(0.01 M + 2s)^2 \end{aligned}$$

Again, look up $\gamma_{Ca^{2+}}$ and $\gamma_{IO_3^-}$ based on the μ that you calculated

$$\begin{aligned} K_{sp} &= \gamma_{Ca^{2+}} [Ca^{2+}] \gamma_{IO_3^-}^2 [IO_3^-]^2 \\ &= \gamma_{Ca^{2+}} + \gamma_{IO_3^-}^2 (s)(0.01 M + 2s)^2 \end{aligned}$$