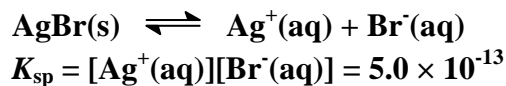


Marks
4

A solution is prepared that is 0.10 M in potassium bromide and 0.10 M in potassium chromate. A concentrated aqueous solution of silver nitrate is added with stirring. What is the concentration of $\text{Ag}^+(\text{aq})$ ions when silver bromide first appears?
 K_{sp} of $\text{AgBr} = 5.0 \times 10^{-13}$

When precipitation occurs, the following equilibrium is established and $[\text{Ag}^+(\text{aq})]$ and $[\text{Br}^-(\text{aq})]$ are controlled by the value of the solubility product:



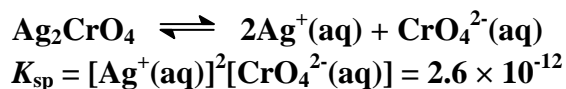
As the solution is 0.10 M in KBr, $[\text{Br}^-(\text{aq})] = 0.10 \text{ M}$:

$$[\text{Ag}^+(\text{aq})] \times (0.10) = 5.0 \times 10^{-13} \quad \text{so } [\text{Ag}^+(\text{aq})] = 5.0 \times 10^{-12} \text{ M}$$

Answer: $5.0 \times 10^{-12} \text{ M}$

What is the concentration of $\text{Ag}^+(\text{aq})$ ions when silver chromate first appears?
 K_{sp} of $\text{Ag}_2\text{CrO}_4 = 2.6 \times 10^{-12}$

When precipitation occurs, the following equilibrium is established and $[\text{Ag}^+(\text{aq})]$ and $[\text{CrO}_4^{2-}(\text{aq})]$ are controlled by the value of the solubility product:



As the solution is 0.10 M in K_2CrO_4 , $[\text{CrO}_4^{2-}(\text{aq})] = 0.10 \text{ M}$:

$$[\text{Ag}^+(\text{aq})]^2 \times (0.10) = 2.6 \times 10^{-12} \quad \text{so } [\text{Ag}^+(\text{aq})] = 5.1 \times 10^{-6} \text{ M}$$

Answer: $5.1 \times 10^{-6} \text{ M}$

What is the concentration of $\text{Br}^-(\text{aq})$ ions when silver chromate first appears?

$[\text{Br}^-(\text{aq})]$ is control by the K_{sp} for AgBr and so when $[\text{Ag}^+(\text{aq})] = 5.1 \times 10^{-6} \text{ M}$,

$$K_{\text{sp}} = [\text{Ag}^+(\text{aq})][\text{Br}^-(\text{aq})] = 5.0 \times 10^{-13}$$

$$(5.1 \times 10^{-6}) \times [\text{Br}^-(\text{aq})] = 5.0 \times 10^{-13} \quad \text{so } [\text{Br}^-(\text{aq})] = 9.8 \times 10^{-8} \text{ M}$$

Answer: $9.8 \times 10^{-8} \text{ M}$