~~40~~ 38

8. Given a 2.00 L saturated solution of $Cu(IO_3)_2$, $K_{sp} = 1.4 \times 10^{-7}$, how many moles of $NaIO_3$ would need to be dissolved in solution to reduce $[Cu^{2+}]$ to 6.0×10^{-5} M? (Assume the added $NaIO_3$ does not appreciably change the total volume of solution.)

$$K_{sp} = [Cu^{2+}][IO_3^-]^2 = (6.0E-5)[IO_3^-]^2 = 1.4E-7$$

$$[IO_3^-] = \sqrt{\frac{1.4E-7}{6.0E-5}} = 0.048 \text{ M } IO_3^- \times 2.00 \text{ L} = 0.097 \text{ mol } IO_3^-$$

$$0.097 \text{ mol } IO_3^- \times \frac{1 \text{ mol } NaIO_3}{1 \text{ mol } IO_3^-} = \boxed{0.097 \text{ mol } NaIO_3}$$

Even more practice!

9. Copper(I) bromide has a measured solubility of 2.0×10^{-4} mol/L at 25°C. Calculate its K_{sp} value.

$$K_{sp} = [Cu^+][Br^-] = x^2 = (2.0E-4)^2 = \boxed{4.0 \times 10^{-8}}$$

10. The K_{sp} value for copper(II) iodate, $Cu(IO_3)_2$, is 1.4×10^{-7} at 25°C. What is the maximum mass, in grams, of copper (II) iodate that can dissolve in 500. mL of water?

$$K_{sp} = [Cu^{2+}][IO_3^-]^2 = x(2x)^2 = 4x^3 = 1.4E-7$$

$$x = \sqrt[3]{\frac{1.4E-7}{4}} = \underbrace{3.271E-3 \text{ M}}_{x} \times 0.500 \text{ L} = 1.636E-3 \text{ mol } Cu(IO_3)_2 \times \frac{413.37 \text{ g}}{1 \text{ mol}}$$

$$= \boxed{0.68 \text{ g } Cu(IO_3)_2}$$

11. In pure water at 25°C, the molar solubility of $PbCl_2$ is 1.3×10^{-6} and the K_{sp} is 1.6×10^{-5}. LiCl is added to 5.00 L of a saturated solution of $PbCl_2$ at 25°C until the $[Pb^{2+}]$ is reduced to 4.5×10^{-4} M. How many moles of chloride ions are dissolved in solution at the point when $[Pb^{2+}] = 4.5 \times 10^{-4}$ M? (Assume the added ~~$Ca(NO_3)_2$~~ LiCl has a negligible effect on the total volume of solution.)

$$K_{sp} = [Pb^{2+}][Cl^-]^2 = (4.5E-4)[Cl^-]^2 = 1.6E-5$$

$$[Cl^-] = \sqrt{\frac{1.6E-5}{4.5E-4}} = 0.19 \text{ M } Cl^- \times 5.00 \text{ L} = \boxed{0.94 \text{ mol } Cl^-}$$

Multiple Choice Practice!

Use the following information to answer questions 12–14.

150 mL of saturated SrF_2 solution is present in a 250 mL beaker at room temperature. The molar solubility of SrF_2 at 298 K is 1.0×10^{-3} M.

$SrF_2 \rightleftharpoons Sr^{2+} + 2F^-$

$+x \quad +2x$

12. What are the concentrations of Sr^{2+} and F^- in the beaker?

    a. $[Sr^{2+}] = 1.0 \times 10^{-3}$ M; $[F^-] = 1.0 \times 10^{-3}$ M

    (b.) $[Sr^{2+}] = 1.0 \times 10^{-3}$ M; $[F^-] = 2.0 \times 10^{-3}$ M

    c. $[Sr^{2+}] = 2.0 \times 10^{-3}$ M; $[F^-] = 1.0 \times 10^{-3}$ M

    d. $[Sr^{2+}] = 2.0 \times 10^{-3}$ M; $[F^-] = 2.0 \times 10^{-3}$ M

$[Sr^{2+}] = x = 1E-3$

$[F^-] = 2x = 2E-3$

13. What would be the effect on $[Sr^{2+}]$ if some NaF(s) was added to the beaker?

    a. $[Sr^{2+}]$ would remain unchanged; neither ion in NaF(s) is common to Sr^{2+}

    b. $[Sr^{2+}]$ would increase; more Sr^{2+} ions would be needed to balance the additional F^- ions to re-establish equilibrium.

    (c.) $[Sr^{2+}]$ would decrease; the additional fluoride ions would cause the system to shift left to re-establish equilibrium.

    d. $[Sr^{2+}]$ would decrease; the additional Na^+ would cause an excess of positive charge, and the system would shift left to reduce overall positive charge.

14. Calculate the solubility product for SrF_2 at 25°C.

    a. 2×10^{-9} (c.) 4×10^{-9}

    b. 2×10^{-6} d. 4×10^{-6}

$K_{sp} = [Sr^{2+}][F^-]^2$

$= x(2x)^2 = 4x^3$

$= 4(1E-3)^3$

$= 4E-9$