1985

At 25°C the solubility product constant, K_{sp}, for strontium sulfate, $SrSO_4$, is 7.6×10^{-7}. The solubility product constant for strontium fluoride, SrF_2, is 7.9×10^{-10}.

(a) What is the molar solubility of $SrSO_4$ in pure water at 25°C?
(b) What is the molar solubility of SrF_2 in pure water at 25°C?
(c) An aqueous solution of $Sr(NO_3)_2$ is added slowly to 1.0 liter of a well-stirred solution containing 0.020 mole F^- and 0.10 mole SO_4^{2-} at 25°C. (You may assume that the added $Sr(NO_3)_2$ solution does not materially affect the total volume of the system.)

1. Which salt precipitates first?
2. What is the concentration of strontium ion, Sr^{2+}, in the solution when the first precipitate begins to form?

(d) As more $Sr(NO_3)_2$ is added to the mixture in (c) a second precipitate begins to form. At that stage, what percent of the anion of the first precipitate remains in solution?

1990

The solubility of iron(II) hydroxide, $Fe(OH)_2$, is 1.43×10^{-3} gram per liter at 25 °C.

(a) Write a balanced equation for the solubility equilibrium.

(b) Write the expression for the solubility product constant, K_{sp}, and calculate its value.

(c) Calculate the pH of the saturated solution of $Fe(OH)_2$ at 25 °C.

(d) A 50.0-milliliter sample of 3.00×10^{-3} molar $FeSO_4$ solution is added to 50.0 milliliters of 4.00×10^{-6} molar NaOH solution. Does a precipitate of $Fe(OH)_2$ form? Explain and show calculations to support your answer.

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1994

$$MgF_2(s) \leftrightarrows Mg^{2+}(aq) + 2\ F^-(aq)$$

In a saturated solution of MgF_2 at 18°C, the concentration of Mg^{2+} is 1.21×10^{-3} molar. The equilibrium is represented by the equation above.

(a) Write the expression for the solubility-product constant, K_{sp}, and calculate its value at 18° C.

(b) Calculate the equilibrium concentration of Mg^{2+} in 1.000 liter of saturated MgF_2 solution at 18°C to which 0.100 mole of solid KF has been added. The KF dissolves completely. Assume the volume change is negligible.

(c) Predict whether a precipitate of MgF_2 will form when 100.0 milliliters of a 3.00×10^{-3} molar $Mg(NO_3)_2$ solution is mixed with 200.0 milliliters of a 2.00×10^{-3} molar NaF solution at 18°C. Calculations to support your prediction must be shown.

(d) At 27°C the concentration of Mg^{2+} in a saturated solution of MgF_2 is 1.17×10^{-3} molar. Is the dissolving of MgF_2 in water an endothermic or an exothermic process? Give an explanation to support your conclusion.

1998

Solve the following problem related to the solubility equilibria of some metal hydroxides in aqueous solution.

(a) The solubility of $Cu(OH)_2$ is 1.72×10^{-6} gram per 100. milliliters of solution at 25°C.

(i) Write the balanced chemical equation for the dissociation of $Cu(OH)_2(s)$ in aqueous solution.

(ii) Calculate the solubility (in moles per liter) of $Cu(OH)_2$ at 25 °C.

(iii) Calculate the value of the solubility-product constant, K_{sp}, for $Cu(OH)_2$ at 25°C.

(b) The value of the solubility-product constant, K_{sp}, for $Zn(OH)_2$ is 7.7×10^{-17} at 25°C.

(i) Calculate the solubility (in moles per liter) of $Zn(OH)_2$ at 25°C in a solution with a pH of 9.35.

(ii) At 25°C, 50.0 milliliters of 0.100-molar $Zn(NO_3)_2$ is mixed with 50.0 milliliters of 0.300-molar NaOH. Calculate the molar concentration of $Zn^{2+}(aq)$ in the resulting solution once equilibrium has been established. Assume that volumes are additive.