AP Questions: K_{sp} / Solubility

1971

Solve the following problem

$AgBr(s) \rightarrow Ag^+(aq) + Br^-(aq)$ $\quad K_{sp} = 3.3\times10^{-13}$

$Ag^+(aq) + 2\ NH_3(aq) \rightarrow Ag(NH_3)_2^+(aq)$ $\quad K = 1.7\times10^{+7}$

(a) How many grams of silver bromide, AgBr, can be dissolved in 50 milliliters of water?

(b) How many grams of silver bromide can be dissolved in 50 milliliters of 10 molar ammonia solution?

1972 D

(a) How many moles of $Ba(IO_3)_2$ is contained in 1.0 liter of a saturated solution of this salt at 25°. K_{sp} of $Ba(IO_3)_2 = 6.5\times10^{-10}$

(b) When 0.100 liter of 0.060 molar $Ba(NO_3)_2$ and 0.150 liter of 0.12 molar KIO_3 are mixed at 25°C, how many milligrams of barium ion remains in each milliliter of the solution? Assume that the volumes are additive and that all activity coefficients are unity.

1973 D

The molar solubility of silver bromide is diminished by the addition of a small amount of solid potassium bromide to a saturated solution. However, the molar solubility of silver bromide is increased by the addition of solid potassium nitrate, a salt whose ions are not common to those of silver bromide.

Explain these experimental observations in terms of the principles involved.

1977 D

The solubility of $Zn(OH)_2$ is not the same in the following solutions as it is in pure water. In each case state whether the solubility is greater or less than that in water and briefly account for the change in solubility.

(a) 1-molar HCl

(b) 1-molar $Zn(NO_3)_2$

(c) 1-molar NaOH

(d) 1-molar NH_3

1979 A

A saturated solution of lead iodate in pure water has a lead ion concentration of 4.0×10^{-5} mole per liter at 20°C.

(a) Calculate the value for the solubility-product constant of $Pb(IO_3)_2$ at 25°C.

(b) Calculate the molar solubility of $Pb(IO_3)_2$ in a 0.10 molar $Pb(NO_3)_2$ solution at 25°C.

(c) To 333 milliliters of a 0.120-molar $Pb(NO_3)_2$ solution, 667 milliliters of 0.435-molar KIO_3 is added. Calculate the concentrations of Pb^{2+} and IO_3^- in the solution at equilibrium at 25°C.

1980 D

Account for the differences in solubility described in each of the following experimental observations:

(a) $BaCO_3$, $BaSO_3$, and $BaSO_4$ are only slightly soluble in water, but the first two dissolve in HCl solution whereas $BaSO_4$ does not.

(b) CuS cannot be dissolved by warm dilute HCl but it does dissolve in warm dilute HNO_3.

(c) AgCl, Hg_2Cl_2 and $PbCl_2$ are only slightly soluble in water, but AgCl does dissolve in ammonia solution whereas the other two do not.

(d) $Fe(OH)_3$ and $Al(OH)_3$ are only slightly soluble in water, but $Al(OH)_3$ dissolves in concentrated NaOH whereas $Fe(OH)_3$ does not.

1990 A

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 a saturated solution of $Fe(OH)_2$ at 25°C.

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

1998 A (Required)

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

(a) The solubility of $Cu(OH)_2(s)$ 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.

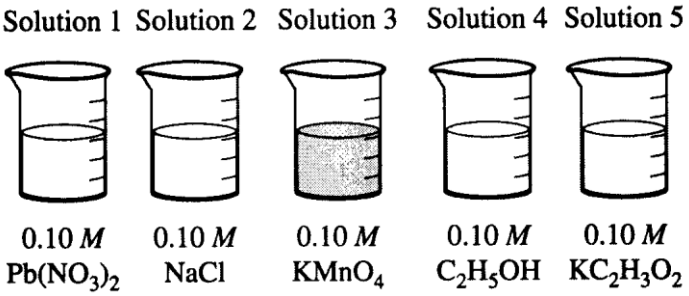
  (iii) Calculate the value of the solubility-product constant, K_{sp}, for $Cu(OH)_2$ at 25°C.

(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.

2001 D Required



Answer the questions below that relate to the five aqueous solutions at 25°C shown above.

(a) Which solution has the highest boiling point? Explain.

(b) Which solution has the highest pH? Explain.

(c) Identify a pair of the solutions that would produce a precipitate when mixed together. Write the formula of the precipitate.

(d) Which solution could be used to oxidize the $Cl^-(aq)$ ion? Identify the product of the oxidation.

(e) Which solution would be the <u>least</u> effective conductor of electricity? Explain.