AS91393 Demonstrate understanding of equilibrium principles in aqueous systems
Solubility and solubility product questions from past papers

(2018:1)

(b) (i) Write the equation for the equilibrium occurring in a saturated solution of calcium fluoride, CaF_2.

(ii) Calculate the solubility of CaF_2 in water at 25°C. K_s (CaF_2) = 3.20×10^{-11}

(2018:3)

(a) (i) Write the solubility product expression, Ks, for silver chloride, AgCl.

(2017:2)

(b) (i) Write the equation for the equilibrium occurring in a saturated solution of copper(II) hydroxide, $Cu(OH)_2$.

(ii) Write the expression for Ks ($Cu(OH)_2$).

(iii) Calculate the solubility of $Cu(OH)_2$ in water at 25°C.

K_s ($Cu(OH)_2$) = 4.80×10^{-20}.

(2016:1)

Silver carbonate, Ag_2CO_3, is a sparingly soluble salt. $K_s(Ag_2CO_3) = 8.10 \times 10^{-12}$ at 25°C
$M(Ag_2CO_3)$ = 276 g mol^{-1}

(a) Write the solubility product expression, K_s, for silver carbonate (Ag_2CO_3).

(b) Calculate the mass of Ag_2CO_3 that will dissolve in 50 mL of water to make a saturated solution at 25°C.

(2015:2)

Sufficient calcium carbonate, $CaCO_3(s)$, is dissolved in water to make a saturated solution.

(a) (i) Write the equation for the equilibrium occurring in a saturated solution of $CaCO_3$.

(ii) Write the expression for K_s ($CaCO_3$).

(iii) Calculate the solubility product of $CaCO_3$, K_s ($CaCO_3$). The solubility of $CaCO_3$ is 5.74×10^{-5} mol L^{-1}.

(2014:2)

A flask contains a saturated solution of $PbCl_2$ in the presence of undissolved $PbCl_2$.

(a) (i) Write the equation for the dissolving equilibrium in a saturated solution of $PbCl_2$.

(ii) Write the expression for K_s ($PbCl_2$).

(iii) Calculate the solubility (in mol L^{-1}) of lead(II) chloride in water at 25°C, and give the [Pb^{2+}] and [Cl^-] in the solution. K_s ($PbCl_2$) = 1.70×10^{-5} at 25°C.

(2013:2)

In an experiment, a saturated solution was made by dissolving 1.44×10^{-3} g of Ag_2CrO_4 in water, and making it up to a volume of 50.0 mL.

M (Ag_2CrO_4) = 332 g mol^{-1}.

(a) Write the K_s expression for Ag_2CrO_4(s).

(b) (i) Calculate the solubility of Ag_2CrO_4(s), and hence give the [Ag^+] and [CrO_4^{2-}] in the solution.

(ii) Determine the K_s(Ag_2CrO_4).

From expired AS90700 (but still useful practice)

(2012: 2)

Iron(II) hydroxide, $Fe(OH)_2$, has a K_s of 4.10×10^{-15} at 25°C.

(a) (i) Write the equation for $Fe(OH)_2$ dissolving in water.

(ii) Write the expression for K_s ($Fe(OH)_2$).

(b) Calculate the solubility (in mol L^{-1}) of iron(II) hydroxide in water at 25°C.

(2011:2)

Zinc hydroxide, $Zn(OH)_2$, has a K_s of 3.00×10^{-17} at 25°C.

(a) (i) Write an equation for zinc hydroxide dissolving in water.

(ii) Write the K_s expression for zinc hydroxide.

(b) Calculate the solubility (in mol L^{-1}) of zinc hydroxide at 25°C.

(2010:2)

(a) Sufficient Ag_2CrO_4 is dissolved in water to form a saturated solution.

(i) Write the equation for the equilibrium present in a saturated solution of Ag_2CrO_4.

(ii) Write the expression for K_s (Ag_2CrO_4).

(c) Calculate the solubility of Ag_2CrO_4 in a saturated solution in mol L^{-1}.
K_s (Ag_2CrO_4) = 3.00×10^{-12}.

(2009:2)

Addition of chloride ions to a solution of silver nitrate often results in the formation of a white precipitate of silver chloride (AgCl).

$$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$$

K_s (AgCl) = 1.56×10^{-10}

(a) Calculate the concentration, in mol L^{-1}, of silver ions in a saturated solution of silver chloride at 25°C.

(2008:3)

(a) (i) Write an equation for the sparingly soluble salt lead(II) chloride ($PbCl_2$) dissolving in water.

(ii) Write the solubility product expression for lead(II) chloride.

(b) Calculate the solubility, in mol L^{-1}, of $PbCl_2$ in water at 25°C.
K_s ($PbCl_2$) = 1.60×10^{-5} at 25°C

- ❑ I can recognise AB and AB_2 / A_2B type ionic substances
- ❑ I can recall $K_s = s^2$ and $s = \sqrt{Ks}$ (for AB type) and $K_s = 4s^3$ and $s = \sqrt[3]{Ks/4}$ (for AB_2 / A_2B type)
- ❑ I can calculate s from K_s and vice versa
- ❑ I know that the units of s are mol L^{-1}
- ❑ I can convert solubility in mol L^{-1} to g L^{-1} & vice versa (mol L^{-1} to g L^{-1} X *M*, g L^{-1} to mol L^{-1} ÷ *M*)

Selected Answers

(2018:1)

(b) (i) $CaF_2 \rightleftharpoons Ca2^+ + 2F^-$

(ii) $K_s = [Ca^{2+}][F^-]^2$

Let solubility be 's':

$[Ca^{2+}] = s$, $[F^-] = 2s$, $K_s = 4s^3$

$s = 2.00 \times 10^{-4}$ mol L^{-1}

(2018:3)

(a) (i) $K_s = [Ag^+][Cl_-]$

(2017:2)

(b) (i) $Cu(OH)_2 \rightleftharpoons Cu^{2+} + 2OH^-$

(ii) $K_s = [Cu^{2+}]\ [OH^-]^2$

(iii) Let s = solubility $[Cu^{2+}] = s$

$[OH^-]\ ^2 = (2s)^2$

$K_s = 4s^3$

$4s^3 = 4.80 \times 10^{-20}$ So; $s = 2.29 \times 10^{-7}$ mol L^{-1}

(2016,1)

(a) $K_s = [Ag^+]^2[CO_3^{2-}]$

(b) Let s = solubility

$[Ag^+] = 2s$ $[CO_3^{2-}] = s$ $K_s = 4s^3$

$s = 1.27 \times 10^{-4}$ mol L^{-1}

$n = c \times v$ = 6.33×10^{-6} mol $m = n \times M$ = 1.75×10^{-3} g

OR

$g\ L^{-1} = c \times M$ = 0.0349 g L^{-1}

so mass in 50 mL = $\frac{0.0349 \times 50}{1000}$ = 1.75×10^{-3} g