Practice exam questions for Chapter 10: Solubility equilibria (Paper-saver version)

Question 1 (Bursary 2001 Question 3)

Chrome yellow

Lead chromate is the pigment 'chrome yellow'. The equation for the equilibrium in a saturated solution of lead chromate is:

$$PbCrO_4(s) \rightleftharpoons Pb^{2+}(aq) + CrO_4^{2-}(aq)$$

a Write the expression for the solubility product (K_s) for lead chromate. A

b Calculate the concentration of CrO_4^{2-} ions in a saturated solution of lead chromate. A M
$K_s(PbCrO_4) = 1.8 \times 10^{-14}$

Lead chromate can be prepared using aqueous lead(II) nitrate and aqueous potassium chromate. In one preparation of lead chromate, 30 mL of 0.100 mol L^{-1} lead nitrate is mixed with 20 mL of 0.100 mol L^{-1} potassium chromate. (An excess of lead nitrate is used.)

c **i** Show that the concentration of Pb^{2+} ions remaining in solution after precipitation is 0.0200 mol L^{-1}. A M

ii Calculate the concentration of CrO_4^{2-} ions in this solution after the precipitation of lead chromate. A M

Question 2 (Bursary 2001 Question 8)

Photography

Silver compounds are used in the photographic industry. Water used to wash processed film contains silver ions at a concentration of 0.0018 mol L^{-1}.

Show that a precipitate of solid silver chloride would be formed from wash water if sodium chloride was added so that the total chloride concentration was 0.00020 mol L^{-1}. A M
$K_s(AgCl) = 1.6 \times 10^{-10}$

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Question 3 (Bursary 2000 Question 3)

Milk of magnesia, a common antacid, is a saturated solution of $Mg(OH)_2$ in water. It appears milky when shaken because the undissolved $Mg(OH)_2$ becomes dispersed as fine particles. The following equilibrium exists.

$$Mg(OH)_2(s) \rightleftharpoons Mg^{2+}(aq) + 2OH^-(aq) \qquad K_s \text{ for } Mg(OH)_2 = 1.8 \times 10^{-11}$$

a Write the K_s expression for $Mg(OH)_2$. A

b Select the species in milk of magnesia below that has a concentration equal to the solubility of $Mg(OH)_2$ in water. $Mg^{2+}(aq)$ $OH^-(aq)$ $H_3O^+(aq)$ A

A saturated solution of $Mg(OH)_2$ is prepared by stirring excess solid $Mg(OH)_2$ with water.

c Show that the concentration of $Mg^{2+}(aq)$ in this saturated solution is 1.7×10^{-4} mol L^{-1}. A M

d Calculate the pH of the saturated solution in **a** above. A M

100 mL of freshly shaken milk of magnesia is mixed with 100 mL of water in beaker **A**. The mixture is stirred vigorously. After stirring, undissolved $Mg(OH)_2$ settles at the bottom of the beaker.

e **i** Select the word or phrase below which correctly completes the following sentence:
Compared with the $[Mg^{2+}(aq)]$ in beaker **A**, the $[Mg^{2+}(aq)]$ in undiluted milk of magnesia is:
Higher lower the same A

ii Justify your answer. M

100 mL of the solution in part **(e)** above is removed from beaker **A** without taking any undissolved solid. On mixing this solution with 100 mL of 0.10 mol L^{-1} KOH in beaker **B**, a precipitate forms.

f **i** Write the equation for the reaction which results in the formation of the precipitate. A

Select the word or phrase which correctly completes the sentence in each of parts **ii** and **iii** below.

ii Compared with the solution in beaker **B**, the pH of the solution in beaker **A** is:
higher lower the same A
Justify your answer. M

iii Compared with the solution in beaker **B**, the $[Mg^{2+}(aq)]$ in beaker **A** is:
higher lower the same A
Justify your answer. M