PROVA teórica

(1)(A) 1 g de $Ba_3(PO_4)_2$ em Água pura. → MASSA em EXCESSO, solução saturada.

$$Ba_3(PO_4)_2 \rightleftharpoons 3Ba^{2+} + 2PO_4^{3-}$$

$K_{ps} = 6{,}03 \times 10^{-39}$

$$K_{ps} = [Ba^{2+}]^3 [PO_4^{3-}]^2$$

$$K_{ps} = (3s)^3 (2s)^2$$

$$K_{ps} = (27s^3)(4s^2)$$

$$K_{ps} = 108 s^5$$

$$s = \sqrt[5]{\frac{K_{ps}}{108}} = s = \sqrt[5]{\frac{6{,}03 \times 10^{-39}}{108}} = s = \sqrt[5]{5{,}58 \times 10^{-41}}$$

$$s = 8{,}90 \times 10^{-9}$$

$[Ba^{2+}] = 3s = 3 \times 8{,}90 \times 10^{-9} = 2{,}67 \times 10^{-8}\ mol\ L^{-1}$

$[PO_4^{3-}] = 2s = 2 \times 8{,}90 \times 10^{-9} = 1{,}78 \times 10^{-8}\ mol\ L^{-1}$

(1B) $BaCl_2$ = Ba = 137 g mol^{-1}

Cl = 35,5 g mol^{-1} × 2 = 71 g mol

M.M = 208 g mol^{-1}

1 mol —— 208 g

x —— 20,8 g

x = 0,1 mol $BaCl_2$

$$K_{ps} = [Ba^{2+}]^3 (PO_4^{3-})^2$$

$$K_{ps} = (0{,}1 + \cancel{3s})^3 (2s)^2$$ ← valor muito pequeno.

$$K_{ps} = 1{,}0 \times 10^{-3} \times 4s^2$$

$$6{,}03 \times 10^{-39} = 4{,}0 \times 10^{-3} s^2$$

$$s = \sqrt[2]{\frac{6{,}03 \times 10^{-39}}{4{,}0 \times 10^{-3}}} = \sqrt[2]{1{,}51 \times 10^{-36}}$$

$$s = 1{,}23 \times 10^{-18}$$

$[Ba^{2+}] = 0{,}1 + 3s = 0{,}1 + 3 \times 1{,}23 \times 10^{-18} = 0{,}1\ mol\ L^{-1}$

$[PO_4^{3-}] = 2 \times s = 2 \times 1{,}23 \times 10^{-18} = 2{,}46 \times 10^{-18}\ mol\ L^{-1}$

② $Fe(OH)_3$

$[Fe^{3+}] = 1{,}0 \times 10^{-7}\ mol\,L^{-1}$

$Fe(OH)_3 \rightleftharpoons Fe^{3+} + 3\,OH^-$

$K_{ps} = [Fe^{3+}][OH^-]^3$

$3{,}2 \times 10^{-38} = 1{,}0 \times 10^{-7}\ [OH^-]^3$

$[OH^-] = \sqrt[3]{\dfrac{3{,}2 \times 10^{-38}}{1{,}0 \times 10^{-7}}}$

$[OH^-] = \sqrt[3]{3{,}20 \times 10^{-31}}$

$[OH^-] = 6{,}84 \times 10^{-11}\ mol\,L^{-1}$

$pOH = -\log[OH^-]$

$pOH = -\log(6{,}84 \times 10^{-11})$

$pOH = 10{,}16$

$pH = 14 - 10{,}16 = \boxed{3{,}84}$

Em pH 2,0 todo o precipitado seria solubilizado. Valor de pH abaixo do pH de equilíbrio.

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③ 50 ml → $1{,}89 \times 10^{-5}$ g de Ag^+ → 1 mol — 108 g; x — $1{,}89 \times 10^{-5}$ g; $x = 1{,}75 \times 10^{-7}$ mol Ag^+

200 ml → $1{,}40 \times 10^{-5}$ g de Br^- → 1 mol — 80 g; x — $1{,}40 \times 10^{-5}$; $x = 1{,}75 \times 10^{-7}$ mol Br^-

Cálculo da concentração.

$[Ag^+] = \dfrac{1{,}75 \times 10^{-7}\ mol\ Ag^+}{0{,}25\ L} = 7{,}0 \times 10^{-7}\ mol\,L^{-1}$

$[Br^-] = \dfrac{1{,}75 \times 10^{-7}\ mol\ Br^-}{0{,}25\ L} = 7{,}0 \times 10^{-7}\ mol\,L^{-1}$

$AgBr \rightleftharpoons Ag^+ + Br^-$

$K_{ps} = [Ag^+][Br^-] = 5{,}3 \times 10^{-13}$

$Q = [Ag^+][Br^-]$

$Q = 7{,}0 \times 10^{-7} \times 7{,}0 \times 10^{-7}$

$\boxed{Q = 4{,}9 \times 10^{-13}}$

$\boxed{Q < K_{ps}}$ ⇒ Não precipita.

④ pH = 5,0

$Fe^{2+} = 0,1 \text{ mol } L^{-1}$

EDTA = $0,2 \text{ mol } L^{-1}$

$\log K_{est} = 14,33 \longrightarrow 10^{14,33} = K_{est} = 2,14 \times 10^{14}$

$y^{4-}_{pH=5,0} = 2,47 \times 10^{-7}$

$\alpha_{y^{4-}} = 0,2 \times 2,47 \times 10^{-7}$

$\boxed{\alpha_{y^{4-}} = 4,94 \times 10^{-8}}$

↳ EDTA.

$Fe^{2+} + Y^{4-} \rightleftharpoons [FeY]^{2-}$

$$K_{est} = \frac{[FeY]^{2-}}{[Fe^{2+}][Y^{4-}]}$$

$$2,14 \times 10^{14} = \frac{x}{(0,1 - x)\ 4,94 \times 10^{-8}}$$

$$2,14 \times 10^{14} = \frac{x}{4,94 \times 10^{-9} - 4,94 \times 10^{-8} x}$$

$1,06 \times 10^{6} - 1,06 \times 10^{7} x = x$

$1,06 \times 10^{6} = x + 1,06 \times 10^{7} x$

$$x = \frac{1,06 \times 10^{6}}{1,06 \times 10^{7}} = \boxed{0,1 \text{ mol } L^{-1}}$$

0,1 — 100%

0,1 — x

x = 100% do Fe^{2+} complexado

(5)

$BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$

$BaF_2 \rightleftharpoons Ba^{2+} + 2F^-$

$CaSO_4 \rightleftharpoons Ca^{2+} + SO_4^{2-}$

$CaF_2 \rightleftharpoons Ca^{2+} + 2F^-$

Cátions : Ba^{2+} e Ca^{2+}

Ânions : SO_4^{2-} e F^-

Kps

$BaSO_4 = 1,1\times10^{-10} \Rightarrow s = \sqrt{Kps} = \boxed{1,05\times10^{-5}\ mol\,L^{-1}}$

$BaF_2 = 1,1\times10^{-6} \Rightarrow s = \sqrt[3]{\frac{Kps}{4}} = \boxed{6,50\times10^{-3}\ mol\,L^{-1}}$

$CaSO_4 = 9,1\times10^{-6} \Rightarrow s = \sqrt{Kps} = \boxed{3.02\times10^{-3}\ mol\,L^{-1}}$

$CaF_2 = 4,0\times10^{-11} \Rightarrow s = \sqrt[3]{\frac{Kps}{4}} = \boxed{2,15\times10^{-4}\ mol\,L^{-1}}$

Ordem de solubilidade

mais insolúvel

$BaSO_4 > CaF_2 > CaSO_4 > BaF_2$

Dois mais insolúveis.