Self-Assessment: Aqueous Solutions

Weekly Homework Quiz – Solution Outlines

(a) The value of $K_a$ for perchloric acid, $\text{HClO}_4(aq)$, is $1 \times 10^8$. Calculate the $p\text{H}$ and the $p\text{OH}$ of 1.11 M $\text{HClO}_4(aq)$ in water.

with a value of $K_a = 10^8$, $\text{HClO}_4$ is a strong acid $\Rightarrow$ complete dissociation

∴ $1.11$ M $\text{HI(aq)} \Rightarrow 1.11$ M $[\text{H}^+] = [\text{ClO}_4^-]$

∴ $p\text{H} = -\log_{10}[\text{H}^+] = -\log_{10}1.11 = -0.0453$

∴ $p\text{OH} + p\text{H} = 14 \Rightarrow p\text{OH} = 14.0453$

(b) The compound, yttrium iodate, $\text{Y}(\text{IO}_3)_3$, upon dissolution in water dissociates into $\text{Y}^{3+}$ and $\text{IO}_3^-$. At $37^\circ\text{C}$ the solubility of $\text{Y}(\text{IO}_3)_3$ in water is $2.22 \times 10^{-3}$ M. Calculate the value of the solubility product, $K_{sp}$, of $\text{Y}(\text{IO}_3)_3$.

$\text{Y}(\text{IO}_3)_3 = \text{Y}^{3+} + 3\text{IO}_3^-$, from which we get $K_{sp} = [\text{Y}^{3+}][\text{IO}_3^-]^3$

$c_s = 2.22 \times 10^{-3} = [\text{Y}^{3+}] = 1/3 [\text{IO}_3^-] \quad \text{∴} \quad [\text{IO}_3^-] = 3 [\text{Y}^{3+}]$

∴ $K_{sp} = c_s (3 c_s)^3 = 27 c_s^4 = 27 (2.22 \times 10^{-3})^4 = 6.56 \times 10^{-10}$