- The K_{sp} of $Al(OH)_3$ is 1.0×10^{-33} M^4. What is the solubility of $Al(OH)_3$ in g L^{-1}? **6**

The solubility equilibrium is:

$$\mathbf{Al(OH)_3(s) \rightleftharpoons Al^{3+}(aq) + 3OH^-(aq)}$$

If the molar solubility = S then $[Al^{3+}(aq)]$ = S and $[OH^-(aq)]$ = 3S. Hence:

$$K_{sp} = [Al^{3+}(aq)][OH^-(aq)] = (S)(3S)^3 = 27S^4 = 1.0 \times 10^{-33}$$

Hence, $S = \sqrt[4]{\frac{1.0\times10^{-33}}{27}} = 2.5 \times 10^{-9}$ **M**

The formula mass of $Al(OH)_3$ is (26.98 (Al)) + 3×(16.00 (O) + 1.008 (H)) = 78.004

As mass = number of moles × formula mass, the solubility in g L^{-1} is:

solubility = $(2.5 \times 10^{-9}) \times (78.004) = 1.9 \times 10^{-7}$ g L^{-1}

Answer: **1.9×10^{-7} g L^{-1}**

What is the solubility of $Al(OH)_3$ in g L^{-1} at pH 4.00?

As pH + pOH = 14.00, pOH = 14.00 – 4.00 = 10.00.

As pOH = $-\log_{10}([OH^-(aq)]$, $[OH^-(aq)] = 10^{-10.00}$ M.

From above, $K_{sp} = [Al^{3+}(aq)][OH^-(aq)]$. If the molar solubility is S then:

$K_{sp} = (S) \times (10^{-10.00})^3 = 1.0 \times 10^{-33}$ and so $S = 1.0 \times 10^{-3}$ M

Converting the molar solubility into g L^{-1} gives:

solubility = $(1.0 \times 10^{-3}) \times (78.004) = 0.078$ g L^{-1}

Answer: **0.078 g L^{-1}**