- The K_{sp} of $Fe(OH)_3$ is 2.0×10^{-39} M^4. What is the solubility of $Fe(OH)_3$ in g L^{-1}? **5**

The solubility equilibrium and constant for the dissolution of $Fe(OH)_3$ are:

$$\mathbf{Fe(OH)_3(s) \rightleftharpoons Fe^{3+}(aq) + 3OH^-(aq) \qquad K_{sp} = [Fe^{3+}(aq)][OH^-(aq)]^3}$$

If S moles of $Fe(OH)_3$ dissolve, S mol of $Fe^{3+}(aq)$ and $3S$ mol of $OH^-(aq)$ are formed. Thus,

$$\mathbf{K_{sp} = (S) \times (3S)^3 = 27S^4 = 2.0 \times 10^{-39}}$$

$$\mathbf{S = 9.3 \times 10^{-11}\ M}$$

The formula mass of $Fe(OH)_3$ is (55.85 (Fe) + 3 × (16.00 (O) + 1.008 (H))) g mol^{-1} = 106.874 g mol^{-1}. Thus, as 9.3×10^{-11} mol dissolves in 1.0 L, the mass which dissolves in 1.0 L is:

mass = number of moles × formula mass
= (9.3×10^{-11} mol) × 106.874 g mol^1 = 9.9×10^{-9} g

Answer: **9.9×10^{-9} g L^{-1}**

What effect does lowering the pH have on the solubility of $Fe(OH)_3$? Explain your answer.

The equilibrium for the reaction:

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

lies to the left. Addition of H^+ removes the OH^- and hence, from Le Chatelier's principle more $Fe(OH)_3(s)$ will dissolve.

Hence, lowering the pH will increase the solubility.