Marks 2

- In order to reduce the incidence of dental cavities, water is fluoridated to a level of 1 mg L^{-1}. In regions where the water is "hard" the calcium concentration is typically 100 mg L^{-1}. Given that the K_{sp} of calcium fluoride is 3.9×10^{-11} M^3, would it precipitate in these conditions? Show all working.

For the dissolution of $CaF_2(s)$ $\rightleftharpoons$ $Ca^{2+}(aq) + 2F^-(aq)$, $Q_{sp} = [Ca^{2+}(aq)][F^-(aq)]^2$. If $Q_{sp} > K_{sp}$, then $CaF_2(s)$ will precipitate. If $Q_{sp} < K_{sp}$, then $CaF_2(s)$ will completely dissolve.

The atomic mass of calcium is 40.08 g mol^{-1}. A 100 mg L^{-1} solution contains $\frac{100\times10^{-3}}{40.08}$ mol and has a concentration of $\frac{100\times10^{-3}}{40.08}$ M. $[Ca^{2+}(aq)] = 2.495\times10^{-3}$ M.

The atomic mass of fluorine is 19.00 g mol^{-1}. A 1 mg L^{-1} solution contains $\frac{1\times10^{-3}}{19.00}$ mol and has a concentration of $\frac{1\times10^{-3}}{19.00}$ M. $[F^-(aq)] = 5.263 \times 10^{-5}$ M.

Hence, $Q_{sp} = (2.495 \times 10^{-3}\ M) \times (5.263 \times 10^{-5}\ M)^2 = 6.911 \times 10^{-12}\ M^3$. As $Q_{sp} < K_{sp}$, calcium fluoride will not precipitate.

Answer: **No, it does not precipitate**