Marks

- Calcium oxalate is a major constituent of kidney stones. Calculate the solubility product constant for calcium oxalate given that a saturated solution of the salt can be made by dissolving 0.0061 g of $CaC_2O_4{\cdot}H_2O(s)$ in 1.0 L of water. **2**

The molar mass of $CaC_2O_4{\cdot}H_2O$ is:

$(40.08(Ca) + 2\times12.01(C) + 5\times16.00(O) + 2\times1.008(H))$ g mol^{-1} = 146.116 g mol^{-1}

Hence, 0.0061 g corresponds to $\frac{0.0061\,g}{146.116\,g\,mol^{-1}} = 4.2\times10^{-5}$ mol. As this amount dissolves in 1.0 L, the molar solubility = $S = 4.2 \times 10^{-5}$ M.

The dissolution equilibrium is:

$CaC_2O_4{\cdot}H_2O(s) \rightarrow Ca^{2+}(aq) + C_2O_4^{2-}(aq) + H_2O(l)$.

As one mol of cation and one mol of anion is produced, the solubility product is:

$K_{sp} = [Ca^{2+}(aq)][C_2O_4^{2-}(aq)] = (S)(S) = S^2 = (4.2 \times 10^{-5})^2 = 1.7 \times 10^{-9}$

Answer: **1.7×10^{-9}**

- A sample of 2.0 mg of $Cu(OH)_2$ is added to 1.0 L of a solution buffered at a pH of 8.00. Will all of the $Cu(OH)_2$ dissolve? Show all working. (The K_{sp} of $Cu(OH)_2$ is 4.8×10^{-20} M^3.) **3**

As pH + pOH = 14.00, pOH = 14.00 – 8.00 = 6.00. Hence, $[OH^-(aq)] = 10^{-6}$ M.

The dissolution equilibrium is: $Cu(OH)_2(s) \rightarrow Cu^{2+}(aq) + 2OH^-(aq)$

Hence, if S is the molar solubility, $K_{sp} = [Cu^{2+}(aq)][OH^-(aq)]^2 = S \times [OH^-(aq)]^2$.

As $K_{sp} = 4.8 \times 10^{-20}$, $S = \frac{4.8\times10^{-20}}{(10^{-6})^2} = 4.8\times10^{-8}$ M

The molar mass of $Cu(OH)_2$ is (63.55 (Cu) + 2 × (16.00 (O) + 1.008 (O)) g mol^1 = 97.566 g mol^{-1}.

The solubility in g L^{-1} is therefore $(4.8 \times 10^{-8}) \times 97.566 = 4.7 \times 10^{-6}$.

Hence, only 4.7×10^{-3} mg will dissolve.

Answer: **NO**