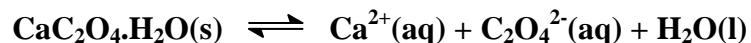


Marks
2

- Oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$, found in rhubarb, causes muscle spasms by precipitating Ca^{2+} ions from the blood as calcium oxalate, $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$. Given the solubility product constant for calcium oxalate is $2.3 \times 10^{-9} \text{ M}^2$, calculate the concentration of calcium ions in g L^{-1} formed by dissolving $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ in water at 25°C to give a saturated solution.

The dissolution equilibrium for $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ is:



Hence, the solubility product $K_{\text{sp}} = [\text{Ca}^{2+}(\text{aq})][\text{C}_2\text{O}_4^{2-}(\text{aq})]$

The chemical equation shows that dissolution of one mole of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}(\text{s})$ leads to one mole of $\text{Ca}^{2+}(\text{aq})$ and one mole of $\text{C}_2\text{O}_4^{2-}(\text{aq})$.

If $[\text{Ca}^{2+}(\text{aq})] = [\text{C}_2\text{O}_4^{2-}(\text{aq})] = x$,

$$K_{\text{sp}} = x^2 = 2.3 \times 10^{-9} \text{ so } x = 4.8 \times 10^{-5}.$$

Ca^{2+} will be present at $4.8 \times 10^{-5} \text{ mol L}^{-1}$. As the atomic mass of Ca is 40.08, this corresponds to a mass of:

$$\begin{aligned} \text{mass of } \text{Ca}^{2+} \text{ ions} &= \text{number of moles} \times \text{atomic mass} \\ &= (4.8 \times 10^{-5}) \times 40.08 = 1.9 \times 10^{-3} \text{ g} \end{aligned}$$

Answer: $1.9 \times 10^{-3} \text{ g}$