Marks 2

- Oxalic acid, $H_2C_2O_4$, found in rhubarb, causes muscle spasms by precipitating Ca^{2+} ions from the blood as calcium oxalate, $CaC_2O_4 \cdot H_2O$. Given the solubility product constant for calcium oxalate is 2.3×10^{-9} M^2, calculate the concentration of calcium ions in g L^{-1} formed by dissolving $CaC_2O_4 \cdot H_2O$ in water at 25 °C to give a saturated solution.

The dissolution equilibrium for $CaC_2O_4.H_2O$ is:

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

Hence, the solubility product $K_{sp} = [Ca^{2+}(aq)][C_2O_4^{2-}(aq)]$

The chemical equation shows that dissolution of one mole of $CaC_2O_4.H_2O(s)$ leads to one mole of $Ca^{2+}(aq)$ and one mole of $C_2O_4^{2-}(aq)$.

If $[Ca^{2+}(aq)] = [C_2O_4^{2-}(aq)] = x$,

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

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

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

Answer: **1.9×10^{-3} g**