

Question One

Calcium carbonate (CaCO_3) and calcium sulfate (CaSO_4) are sparingly soluble in water.

- (a) (i) Write the equation for the equilibrium present in a saturated solution of calcium carbonate.

- (ii) Write the expression for $K_s(\text{CaCO}_3)$.

- (iii) Calculate the solubility of CaCO_3 in mol L^{-1} .

$$K_s(\text{CaCO}_3) = 1.70 \times 10^{-8}$$

- (b) A solution contains CO_3^{2-} and SO_4^{2-} ions both at a concentration of $1.18 \times 10^{-2} \text{ mol L}^{-1}$. A solution of calcium chloride (CaCl_2) is added to this mixture until a precipitate forms. (Assume any change in volume is insignificant)

$$K_s(\text{CaCO}_3) = 1.70 \times 10^{-8}$$

$$K_s(\text{CaSO}_4) = 2.30 \times 10^{-4}$$

- (i) State the salt which will precipitate first.
Give a reason for your answer.

(ii) Calculate the concentration of calcium ions required for calcium sulfate to precipitate.

(iii) Account for the fact that the solubility of calcium carbonate increases in dilute nitric acid but the solubility of calcium sulfate is not changed. Include equations in your answer. (Assume any change in volume is insignificant).