



St Andrew's Junior College
H2 Chemistry 2026
Tutorial 20: Solubility Equilibria

SELF-CHECK QUESTIONS

- Write an expression for K_{sp} of the following sparingly soluble salts, and calculate the unknown solubility products and solubilities in mol dm^{-3} .

Salt	K_{sp} expression with units	K_{sp} value	Solubility / mol dm^{-3}
CaCO_3			6.93×10^{-5}
ZnS		1.6×10^{-23}	
Cu_2O			8.08×10^{-6}
Fe_2S_3		1.0×10^{-88}	

Worked example for Cu_2O



In 1 dm^3 of solution,
 Cu_2O dissolves, giving

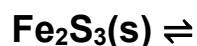
- $[\text{Cu}^+] =$
- $[\text{O}^{2-}] =$

$$K_{sp} = [\text{Cu}^+]^2[\text{O}^{2-}]$$

$$=$$

$$=$$

Worked example for Fe_2S_3



mol of Let the solubility be $z \text{ mol dm}^{-3}$.
In 1 dm^3 of solution, $z \text{ mol}$ of Fe_2S_3
dissolves, giving

- $[\text{Fe}^{3+}] =$
- $[\text{S}^{2-}] =$

$$K_{sp} = [\text{Fe}^{3+}]^2[\text{S}^{2-}]^3$$

$$1.0 \times 10^{-88} =$$

2. [2017/P1/Q15]

Chrome Yellow, lead(II) chromate(VI), PbCrO_4 , is the pigment used for marking yellow lines on roads. Its solubility in water at 25°C is $1.3 \times 10^{-7} \text{ mol dm}^{-3}$.

What is the value of the solubility product of lead(II) chromate(VI) at 25°C ?

- A 1.7×10^{-14} B 6.8×10^{-14} C 1.3×10^{-7} D 2.6×10^{-7}

3. [2008/P2/Q2]

The solubility of barium hydroxide, $\text{Ba}(\text{OH})_2$ at 25°C is 0.24 g dm^{-3} .

- (a) (i) Calculate the concentration of the saturated aqueous solution, in terms of mol dm^{-3} . [1]

- (ii) If it is assumed that the solute is completely ionised, calculate the hydroxide ion concentration of the solution. [1]

- (b) (i) Write an expression for the solubility product of barium hydroxide. [1]

- (ii) Using the values obtained in part (a), calculate the value of the solubility product, stating the units. [1]

- (c) Bottles containing aqueous barium hydroxide need to be kept firmly stoppered or white deposit forms on the surface.

- (i) What is the white deposit? [1]

- (ii) Explain, with the aid of an equation, how it is formed. [2]

4. [2011/P3/Q3b]

One of the most common phosphorous-containing rocks is fluorapatite, $\text{Ca}_5(\text{PO}_4)_3\text{F}$. The first step in the production of phosphate as a mineral supplement for animal feed is defluorination, which is achieved by heating the rock in a rotary kiln at 1500°C with silica and steam.

The following equation represents this process.



- (i) Complete the balancing of the above equation by deducing values for **a**, **b**, **c**, **d**, **e** and **f**. [3]

- (ii) Write the expression for the solubility product of calcium phosphate, stating its units. [2]

- (iii) The value of K_{sp} for calcium phosphate is 1×10^{-26} . Calculate $[\text{Ca}^{2+}]$ in a saturated solution of calcium phosphate. Show your working clearly. [1]

- 5.** A solution **A** is saturated with both calcium hydroxide and calcium sulfate. Both salts are sparingly soluble.

- (a) The pH of solution **A** is 12.3. Calculate $[\text{OH}^-]$ in mol dm^{-3} . **[1]**

(b) (i) Write an expression for the K_{sp} of calcium hydroxide. **[1]**

(ii) The numerical value of the solubility product of calcium hydroxide is 4.0×10^{-5} . Calculate the concentration, in mol dm^{-3} , of calcium ions in solution **A**. **[1]**

(c) (i) Write an expression for the K_{sp} , of calcium sulfate. **[1]**

(ii) The numerical value of the solubility product of calcium sulfate is 2.5×10^{-5} . What is $[\text{SO}_4^{2-}]$ in solution **A**? **[1]**

(iii) $[\text{SO}_4^{2-}]$ in solution **A** is less than $5.0 \times 10^{-3} \text{ mol dm}^{-3}$, i.e., the square root of the K_{sp} value of calcium sulfate. Explain why this is so. **[2]**