

91392 Demonstrate understanding of equilibrium principles in aqueous systems

Understanding the “s & K_s question”

Write the equation for the equilibrium occurring in a saturated solution of copper(II) hydroxide, Cu(OH)₂.

Write an equation for the equilibrium occurring in a saturated solution of AgBr

This means – **WRITE AN EQUATION!** For the equilibrium Use the \rightleftharpoons arrow.

Do NOT write + H₂O(l)

- $\text{Cu(OH)}_2(\text{s}) \rightleftharpoons \text{Cu}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq})$ (correct ions and balancing)
- $\text{AgBr}(\text{s}) \rightleftharpoons$

Write the expression for K_s (Cu(OH)₂).

Write the expression for K_s (CaCO₃).

Write the solubility product expression, K_s, for silver carbonate (Ag₂CO₃).

This means - **WRITE K_s = [] []** Make them [] and NOT () or { } brackets!

- $K_s = [] []$ AB type
- $K_s = [] []^2$ or $K_s = []^2 []$ AB₂ or A₂B type

Calculate the solubility product of CaCO₃, K_s(CaCO₃)

Calculate the solubility product of PbI₂, K_s(PbI₂)

This means - **Calculate K_s (solubility product) from s (which must be in mol L⁻¹)**

If solubility is given in g L⁻¹, first convert to mol L⁻¹. How? Divide by M (molar mass).

Decide first AB or AB₂ / A₂B, then use

$$K_s = s^2 \quad \text{OR} \quad K_s = 4s^3$$

K_s has no units in L3 Chemistry

(You will be given these equations on the Resource sheet in 2018)

Calculate the solubility (in mol L⁻¹) of lead(II) chloride in water at 25°C, and give the [Pb²⁺] and [Cl⁻] in the solution.

Calculate the solubility of Ag₂CrO₄(s), and hence give the [Ag⁺] and [CrO₄²⁻] in the solution.

Calculate the solubility of Cu(OH)₂ in water at 25°C.

This means – Calculate solubility, *s*, from *K_s* *s* will be in mol L⁻¹

Decide first AB or AB₂ / A₂B

$$s = \sqrt{K_s} \quad \text{OR} \quad s = \sqrt[3]{\frac{K_s}{4}}$$

(You will have to rearrange the formula given on the Resource sheet)

The 's' you calculate will be in mol L⁻¹. You may then be asked to do some additional calculations such as

- State the concentrations of the different ions e.g. [Pb²⁺] and [Cl⁻]
- Convert solubility from mol L⁻¹ to g L⁻¹
- Scale solubility in g L⁻¹ to a different volume e.g. mass (g) in 50 mL

Calculate the mass of Ag₂CO₃ that will dissolve in 50 mL of water to make a saturated solution at 25°C

Strategy

$K_s \rightarrow s \text{ (mol L}^{-1}\text{)} \rightarrow \text{solubility (g L}^{-1}\text{)} \rightarrow \text{mass (g) that dissolves in 50 mL}$

- Use given value of *K_s* to find *s* – think – this is an A₂B type.
Answer for *s* will be in mol L⁻¹.
- Convert mol L⁻¹ to g L⁻¹. How? Multiply by *M* (molar mass).
- “Scale” your answer in g L⁻¹ which means g per 1000 mL to find g per 50 mL ; it's just a ratio.