Demonstrate understanding of equilibrium principles in aqueous systems

Understanding the "s & Ks 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 ⇌ arrow.

Do NOT write + $H_2O(l)$

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

Write the expression for Ks ($Cu(OH)_2$).

Write the expression for K_s ($CaCO_3$).

Write the solubility product expression, Ks , for silver carbonate (Ag_2CO_3).

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

- $K_s = [\ ][\ ]$ AB type
- $K_s = [\ ][\ ]^2$ or $K_s = [\ ]^2[\ ]$ AB_2 or A_2B type

Calculate the solubility product of $CaCO_3$, $K_s(CaCO_3)$

Calculate the solubility product of PbI_2, $K_s(PbI_2)$

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 AB_2 / A_2B, 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 $[Pb^{2+}]$ and $[Cl^-]$ in the solution.

Calculate the solubility of $Ag_2CrO_4(s)$, and hence give the $[Ag^+]$ and $[CrO_4^{2-}]$ 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 AB_2 / A_2B

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

(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. $[Pb^{2+}]$ 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 Ag_2CO_3 that will dissolve in 50 mL of water to make a saturated solution at 25°C

Strategy

K_s → s (mol L^{-1}) → solubility (g L^{-1}) → mass (g) that dissolves in 50 mL

- Use given value of K_s to find s – think – this is an A_2B 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.