

Part A: Understanding K_{sp} Conceptually

True or False

- _____ The solubility product constant for the salt CoS is: $[Co^{2+}]^2[S^{2-}]$
- _____ CuS ($K_{sp} = 8 \times 10^{-37}$) is more soluble than MnS ($K_{sp} = 7 \times 10^{-16}$)
- _____ K_{sp} is the equilibrium constant for a solid substance dissolving in an aqueous solution.
- _____ The more soluble the substance, the smaller the solubility product constant (K_{sp}).
- _____ We cannot compare the solubility constants of two compounds when the ratio of ions is not the same. (e.g. $FeCO_3$ ($K_{sp} = 3.1 \times 10^{-11}$) to $Fe(OH)_2$ ($K_{sp} = 4.9 \times 10^{-17}$).
- _____ The solubility of a salt in the presence of a common ion has a lower solubility.
- _____ The solubility of an ionic compound with a basic anion increases in acid.

Part B: K_{sp} and Molar solubility

- 1) The K_{sp} of lead(II) sulfate is 1.6×10^{-8} .
- a) Write the expression of the solubility product constant (K_{sp}) for lead sulfate.
- b) What is the molar solubility of lead(II) sulfate in pure water?
- c) Would you expect the molar solubility of lead(II) sulfate to be lower or higher in a solution that has $[SO_4^{2-}] = 0.25$ M. Calculate the solubility and compare.

Part C: The solubility of salts in acidic and basic solutions

- 2) The K_{sp} of lead(II) hydroxide is 4.2×10^{-15} .
- Write the expression of the solubility product constant (K_{sp}) for lead hydroxide.
 - What is the molar solubility of lead(II) hydroxide in pure water?
 - Would you expect the solubility to be higher or lower in an acidic solution? How about a basic solution?
 - What is the solubility of lead(II) hydroxide in a pH = 4.00 buffer? (**hint:** although we are referring to an acid solution, remember that OH^- and H_3O^+ are related to each other (i.e. $[\text{OH}^-][\text{H}_3\text{O}^+] = K_w$ and $\text{pH} + \text{pOH} = 14$) so approach this problem by calculating pOH and $[\text{OH}^-]$ and use $[\text{OH}^-]$ in ICE table.)
 - What is the solubility of lead hydroxide in a pH = 11.00 buffer?

Part D: Comparing the solubility of salts

- 3) Based on the K_{sp} values provided below for six lead salts. Can you predict which is most soluble and which is least? Would you have to calculate the solubility of each?

Salt	Ksp
Pb(OH) ₂	4.2×10^{-15}
PbF ₂	4.0×10^{-8}
PbI ₂	1.4×10^{-8}
PbC ₂ O ₄	3.0×10^{-11}
PbSO ₄	1.6×10^{-8}
PbCrO ₄	1.7×10^{-14}