

4. Solubility Equilibria

A. solubility Product Constant, K_{sp}

- Consider the equilibrium that exists in a saturated solution of $BaSO_4$

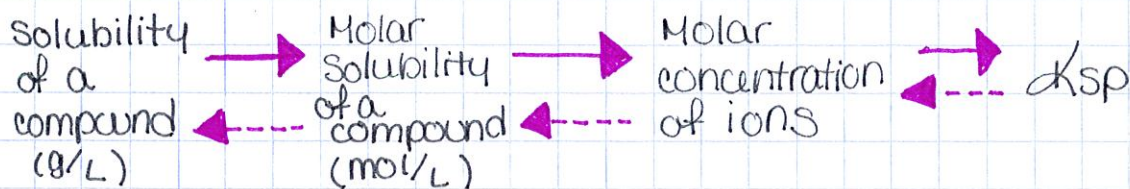


$$K_{sp} = [Ba^{2+}][SO_4^{2-}]$$

- In general $AB_b(s) \rightleftharpoons A^+(aq) + bB^-(aq)$ $K_{sp} = [A^+][B^-]^b$

- K_{sp} is not the solubility

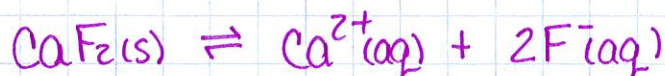
↳ quantity of solute that dissolves in a given amount of solvent.
↳ solubility product constant for the equilibrium b/w an ionic solid and its saturated solution



The smaller K_{sp} is, the less soluble the solid is.

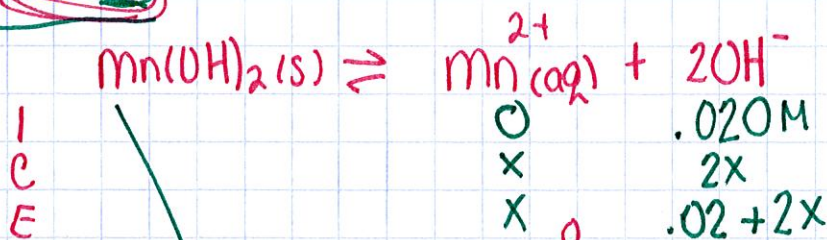
5. Factors That Affect Solubility (of ionic compounds)

- A. Common-Ion Effect - The solubility of a slightly soluble salt is decreased by the presence of a 2nd solute with a common ion.



which way would equilibrium shift if NaF was added?
 shift left

Ex (17) The value for K_{sp} for $\text{Mn}(\text{OH})_2$ is 1.6×10^{-13} . Calculate the molar solubility of $\text{Mn}(\text{OH})_2$ in a solution that contains .020M NaOH.

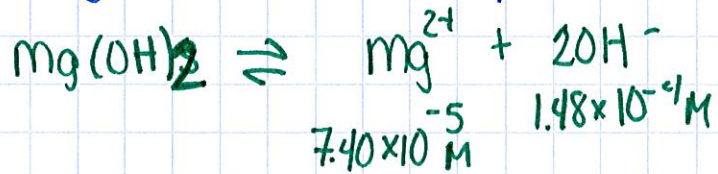


$$1.6 \times 10^{-13} = (x)(.02 + 2x)^2$$

$$1.6 \times 10^{-13} = (x)(.0004)$$

$$4 \times 10^{-10} \text{ M} = x$$

Ex (15) A saturated solution of $Mg(OH)_2$ in contact with undissolved solid is prepared at $25^\circ C$. The pH of the solution is 10.17. Assuming $Mg(OH)_2$ completely ionizes, calculate K_{sp} .



$$pOH = 3.83$$

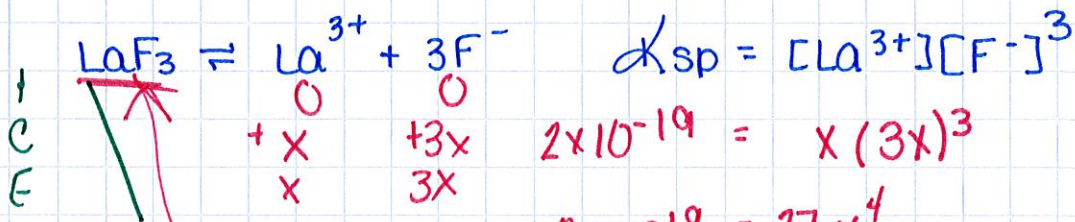
$$[OH^-] = 10^{-3.83}$$

$$[OH^-] = 1.48 \times 10^{-4} M$$

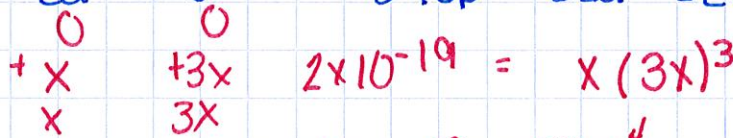
$$K_{sp} = [Mg^{2+}][OH^-]^2$$

$$= [7.40 \times 10^{-5}][1.48 \times 10^{-4}]^2 = 1.62 \times 10^{-12}$$

Ex (16) The K_{sp} of LaF_3 is 2×10^{-19} . What is the solubility of LaF_3 in water in mol/L



ICE



$$2 \times 10^{-19} = x(3x)^3$$

$$2 \times 10^{-19} = 27x^4$$

$$7.41 \times 10^{-21} = x^4$$

$$9.28 \times 10^{-6} M = x$$

$$9.28 \times 10^{-6} \frac{mol}{L} \left(\frac{196 g}{1 mol} \right) = 1.81 \times 10^{-3} \frac{g}{L}$$

B. Solubility and pH

- If a substance has a basic anion, it will be more soluble in an acidic solution
- substances with acidic cations are more soluble in basic solutions

p 761 # 50, 52, 54