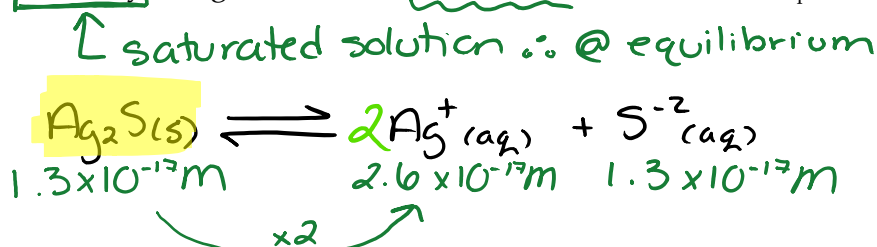


VIII) Type A Problems: Calculating K_{sp}

K_{sp} constants can be calculated for **soluble or low solubility salts**, as long as there is information available about the respective **saturated** solution.

Example:

1. If the **solubility** of Ag_2S in water is $1.3 \times 10^{-17} M$, calculate the K_{sp} .



$$K_{sp} = [Ag^+]^2 [S^{2-}] = (2.6 \times 10^{-17} M)^2 (1.3 \times 10^{-17} M)$$

$$K_{sp} = 8.888 \times 10^{-51} M$$

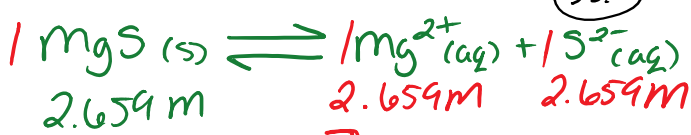
$K_{sp} < 1$ supports the fact that Ag_2S is a **low solubility salt**.

Example:

2. Calculate the K_{sp} of MgS if a maximum of 300.0g can be dissolved in 2.00L of water.

$$\frac{300.0g \text{ MgS}}{56.4g \text{ MgS}} \times \frac{1 \text{ mol}}{1} = \frac{5.319 \text{ mol MgS}}{2.00L} = 2.659 M$$

(3 s.f.)



$$K_{sp} = [Mg^{2+}][S^{2-}] = (2.659)^2$$

$$K_{sp} = 7.07$$

∴ $K_{sp} > 1$ ∴ MgS is a **soluble salt**.

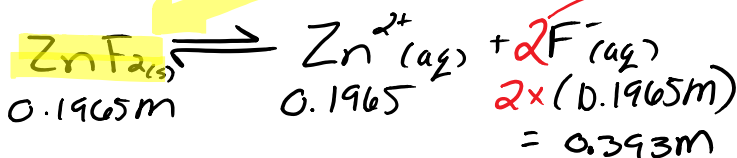
3. A 25.00mL sample of a ZnF_2 saturated solution has the excess solid filtered off. Then, the solution is evaporated to dryness. The mass of the ZnF_2 salt that remained was 0.508g. Calculate the **solubility product constant ZnF_2** .

↳ K_{sp} .

$$\frac{0.508g \text{ ZnF}_2}{103.4g} \times \frac{1 \text{ mol}}{1} = \frac{4.193 \times 10^{-3} \text{ mol ZnF}_2}{0.02500L}$$

(3 s.f.)

$$[ZnF_2] = \frac{4.193 \times 10^{-3} \text{ mol}}{0.02500L} = 0.1965 M$$



$$K_{sp} = [Zn^{2+}][F^-]^2 = (0.1965)(0.393)^2$$

$$K_{sp} = 3.04 \times 10^{-2}$$

$$= 0.393M$$

$$\boxed{K_{sp} = 3.04 \times 10^{-2}}$$

$\therefore K_{sp} < 1$, therefore
 ZnF_2 is a low solubility salt.

Assignment 6: Type A Exercises

1. At 25°C , only 0.00245g of BaSO_4 can be dissolved in 1.0L of H_2O . Calculate the K_{sp} for BaSO_4 .
2. At 25°C , the solubility of Ag_3PO_4 is $1.8 \times 10^{-5}\text{M}$. Calculate the K_{sp} for Ag_3PO_4 .
3. An experiment showed that a maximum of 1.49g of AgBrO_3 can dissolve in 1.00L of water at 25°C . What is the K_{sp} for AgBrO_3 at this temperature?
4. A saturated solution of CaF_2 contains $4.15 \times 10^{-4}\text{mol}$ of CaF_2 in 2.0L of solution. What is the K_{sp} for CaF_2 ?
5. A solution in equilibrium with solid Ag_2S on the bottom of the beaker was found to contain $1.6 \times 10^{-16}\text{M S}^{2-}$ and $2.5 \times 10^{-18}\text{M Ag}^+$. Calculate the solubility product constant of Ag_2S .