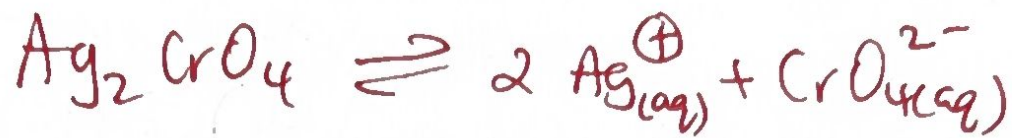


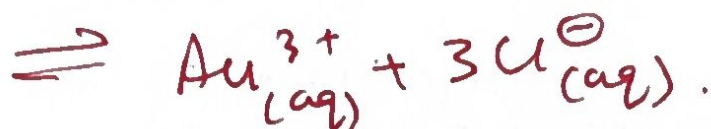
- 1) Write the balanced dissociation equation and solubility product expressions for the following compounds.

a) Ag_2CrO_4



$$K_{sp} = [\text{Ag}^+]^2 [\text{CrO}_4^{2-}]$$

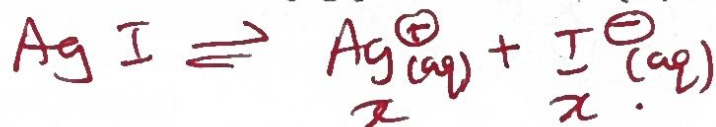
b) AuCl_3



$$K_{sp} = [\text{Au}^{3+}] [\text{Cl}^-]^3$$

- 2) Calculate the concentration of ions in the following saturated solutions:

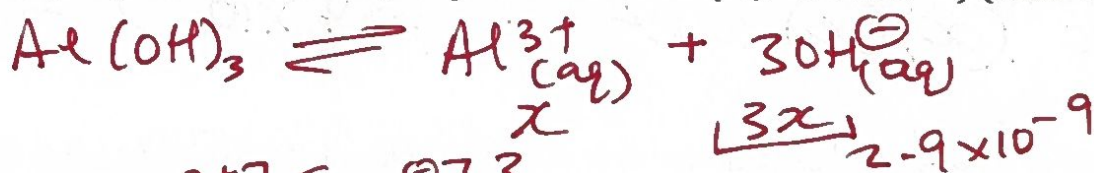
a) $[\text{I}^-]$ in AgI solution with $[\text{Ag}^+] = 9.1 \times 10^{-9} \text{ M}$. ($K_{sp}: 8.3 \times 10^{-17}$) (Ans: $9.1 \times 10^{-9} \text{ M}$)



$$8.3 \times 10^{-17} = [\text{I}^-] [9.1 \times 10^{-9}]$$

$$\text{I}^- = \frac{8.3 \times 10^{-17}}{9.1 \times 10^{-9}} = \boxed{9.1 \times 10^{-9} \text{ M}}$$

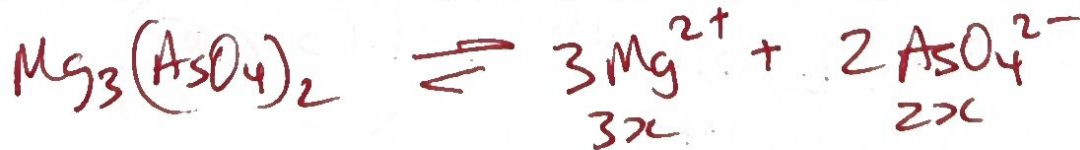
b) $[\text{Al}^{3+}]$ in $\text{Al}(\text{OH})_3$ solution with $[\text{OH}^-] = 2.9 \times 10^{-9} \text{ M}$. ($K_{sp}: 1.8 \times 10^{-33}$) (Ans: $97.4 \times 10^{-8} \text{ M}$)



$$K_{sp} = [\text{Al}^{3+}] [\text{OH}^-]^3$$

$$[\text{Al}^{3+}] = \frac{1.8 \times 10^{-33}}{(2.9 \times 10^{-9})^3} = \boxed{7.4 \times 10^{-8} \text{ M}}$$

- 3) Calculate the molar solubility of $\text{Mg}_3(\text{AsO}_4)_2$. ($K_{sp}: 2.0 \times 10^{-20}$) (Ans: $4.5 \times 10^{-5} \text{ M}$)

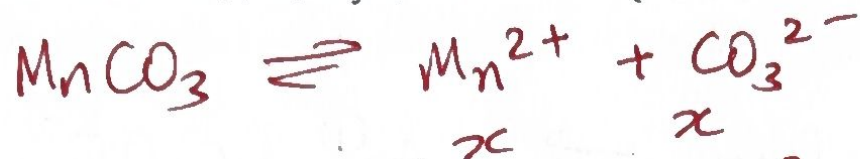


$$K_{sp} = (3x)^3 (2x)^2 = 108x^5$$

$$x = \sqrt[5]{\frac{2.0 \times 10^{-20}}{108}} = \boxed{4.5 \times 10^{-5} \text{ M}}$$

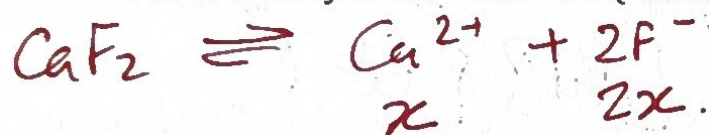
4) Calculate the K_{sp} in the problems below.

a) $MnCO_3$ when its molar solubility is 4.2×10^{-6} M. (Ans: 1.8×10^{-11})



$$K_{sp} = (x)(x) = x^2 = (4.2 \times 10^{-6})^2 = \boxed{1.8 \times 10^{-11}}$$

b) CaF_2 when the molar solubility is 3.32×10^{-4} M. (Ans: 1.46×10^{-10})



$$K_{sp} = (x)(2x)^2 = (3.32 \times 10^{-4})(2 \times 3.32 \times 10^{-4})^2$$

$$\boxed{K_{sp} = 1.46 \times 10^{-10}}$$

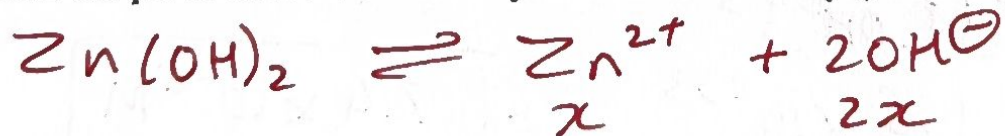
c) The solubility of an ionic compound MX (mol mass = 346 g/mol) is 4.63×10^{-3} g/L. (Ans: 1.79×10^{-10})

$$4.63 \times 10^{-3} \text{ g/L} \times \frac{1 \text{ mol}}{346 \text{ g}} = 1.34 \times 10^{-5} = x$$

$$MX \rightleftharpoons \underset{x}{M^{\oplus}} + \underset{x}{X^{\ominus}}$$

$$K_{sp} = (x)(x) = x^2 = (1.34 \times 10^{-5})^2 = \boxed{1.8 \times 10^{-10}}$$

5) What is the pH of a saturated zinc hydroxide solution? (K_{sp} : 1.8×10^{-14}) (Ans: 9.52)



$$1.8 \times 10^{-14} = (x)(2x)^2 = 4x^3$$

$$x = \sqrt[3]{\frac{1.8 \times 10^{-14}}{4}} = \frac{1.65 \times 10^{-5} \times 2}{3.3 \times 10^{-5}} \quad (\text{for } 2OH^{\ominus})$$

$$pOH = 4.48 \quad \boxed{pH = 9.52}$$

Practice/Solubility Equilibrium – Solubility and Predicting Precipitation DO NOT SUBMIT

- 6) If 20.0 mL of 0.10 M $\text{Ba}(\text{NO}_3)_2$ is added to 50.0 mL of 0.10 M Na_2CO_3 , will BaCO_3 precipitate?
(K_{sp} : 8.1×10^{-9}) (Ans: $Q_{sp} = 2.1 \times 10^{-3} > K_{sp}$, yes ppt occurs)

$$\frac{20 \text{ mL} \times 0.1 \text{ M}}{(20 + 50) \text{ mL}} = 2.9 \times 10^{-2} \text{ Ba}^{2+} \quad \parallel \quad \frac{50 \text{ mL} \times 0.1 \text{ M}}{(20 + 50) \text{ mL}} = 7.2 \times 10^{-2} \text{ CO}_3^{2-}$$



$$Q_{sp} = (2.9 \times 10^{-2})(7.1 \times 10^{-2}) = 2.1 \times 10^{-3}$$

$$\boxed{Q_{sp} > K_{sp} = \text{yes ppt}}$$

- 7) Will there be a precipitation of CaSO_4 when 200 mL of a 0.0250 M calcium nitrate solution is mixed with 150 mL of 0.0750 M magnesium sulfate? ($K_{sp} = 9.1 \times 10^{-6}$) (Ans: Q_{sp} is $4.59 \times 10^{-4} > K_{sp}$, yes ppt occurs)

$$\frac{200 \text{ mL} \times 0.025 \text{ M}}{(200 + 150) \text{ mL}} = 0.0143 \text{ M Ca}^{2+} \quad \parallel \quad \frac{150 \text{ mL} \times 0.075 \text{ M}}{(200 + 150) \text{ mL}} = 0.0321 \text{ M SO}_4^{2-}$$



$$Q_{sp} = (0.0143)(0.0321) = 4.596 \times 10^{-4}$$

$$\boxed{Q_{sp} > K_{sp} = \text{yes ppt}}$$

- 8) Which of the following ionic compounds will be more soluble in acid solution than pure water:

a) BaSO_4

b) PbCl_2

c) $\text{Fe}(\text{OH})_3$

d) CaCO_3

✓
little more
since SO_4^{2-}
is CB of
SA.

✓
 OH^- will react
with acid

✓
 CO_3^{2-} is CB
of WA so will
react with acid.