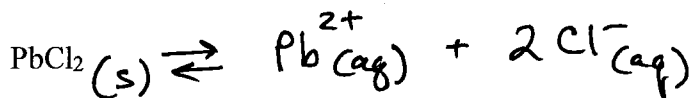


AP Test Prep: Solubility Product Calculations (2020)

1. Write the K_{sp} expression for:

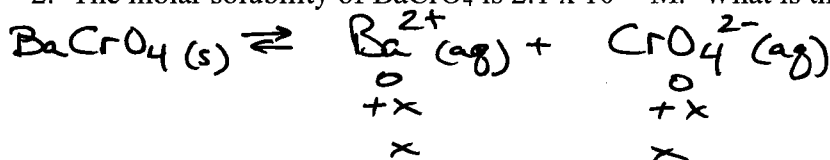


$$K_{sp} = [\text{Ag}^+][\text{Cl}^-]$$



$$K_{sp} = [\text{Pb}^{2+}][\text{Cl}^-]^2$$

2. The molar solubility of BaCrO_4 is 2.1×10^{-10} M. What is the K_{sp} ?

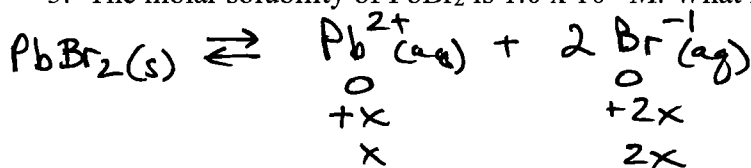


$$K_{sp} = [2.1 \times 10^{-10}][2.1 \times 10^{-10}]$$

$$K_{sp} = 4.4 \times 10^{-20}$$

$$x = 2.1 \times 10^{-10} \text{ (in problem)}$$

3. The molar solubility of PbBr_2 is 1.0×10^{-2} M. What is the K_{sp} ?



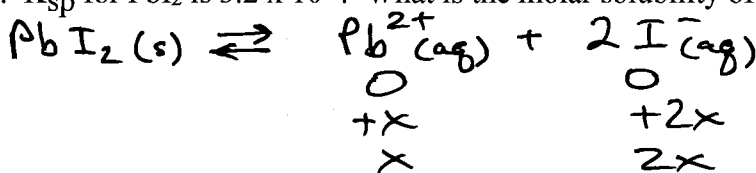
$$K_{sp} = [x][2x]^2$$

$$K_{sp} = [1.0 \times 10^{-2}][2.0 \times 10^{-2}]^2$$

$$K_{sp} = 4.0 \times 10^{-6}$$

$$x = 1.0 \times 10^{-2} \text{ (in problem)}$$

4. K_{sp} for PbI_2 is 3.2×10^{-8} . What is the molar solubility of PbI_2 ?



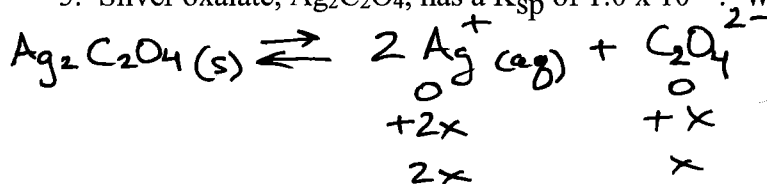
$$K_{sp} = 3.2 \times 10^{-8} = [\text{Pb}^{2+}][\text{I}^-]^2$$

$$3.2 \times 10^{-8} = [x][2x]^2$$

$$3.2 \times 10^{-8} = 4x^3$$

$$x = .002$$

5. Silver oxalate, $\text{Ag}_2\text{C}_2\text{O}_4$, has a K_{sp} of 1.0×10^{-11} . What is the molar solubility of silver oxalate?



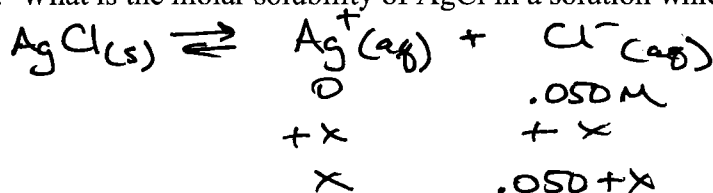
$$K_{sp} = 1.0 \times 10^{-11} = [\text{Ag}^+]^2[\text{C}_2\text{O}_4^{2-}]$$

$$1.0 \times 10^{-11} = [2x]^2[x]$$

$$1.0 \times 10^{-11} = 4x^3$$

$$x = 1.4 \times 10^{-4}$$

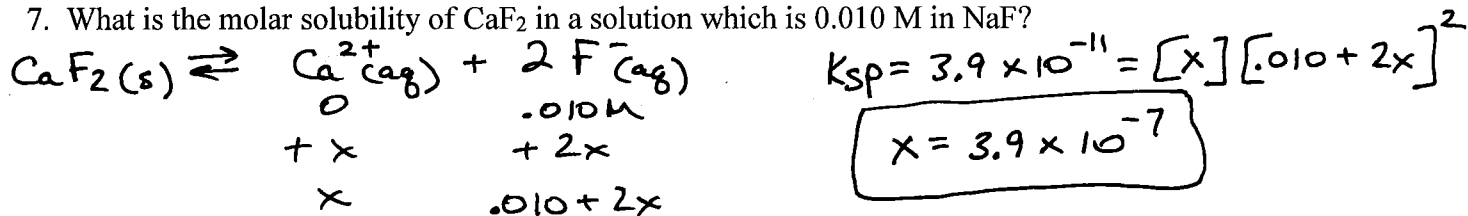
6. What is the molar solubility of AgCl in a solution which is 0.050 M in KCl ?



$$K_{sp} = 1.8 \times 10^{-10} = [x][.050+x]$$

$$x = 3.6 \times 10^{-9}$$

7. What is the molar solubility of CaF_2 in a solution which is 0.010 M in NaF?



8. Will a silver chloride precipitate form under the following conditions? K_{sp} of AgCl is 1.8×10^{-10}

(a) 0.1 M in Ag^+ and 0.1 M in Cl^-

$$Q = [\text{Ag}^+][\text{Cl}^-]$$

$$Q = [.1][.1] = .01$$

$Q > K_{sp}$ so
yes ppt

(b) 1×10^{-5} M in Ag^+ and 2×10^{-5} M in Cl^-

$$Q = [1 \times 10^{-5}][2 \times 10^{-5}] = 2 \times 10^{-10}$$

$Q > K_{sp}$ so yes
ppt

(c) 1×10^{-7} M in Ag^+ and 1×10^{-6} M in Cl^-

$$Q = [1 \times 10^{-7}][1 \times 10^{-6}] = 1 \times 10^{-13}$$

$Q < K_{sp}$ so
No ppt forms
"ions don't find each other"

9. If 200 mL of 0.030 M NaI and 400 mL of 0.040 M AgNO_3 are mixed, will a precipitate of AgI form?

The K_{sp} for AgI is 8.3×10^{-17} . Assume volumes are additive.

* get mixed molarity values for each ion that could form ppt

* use total volume $200 + 400 = 600 \text{ mL} = \underline{.600 \text{ Liters}}$

$$[\text{Ag}^+] = \frac{(.040)(.400)}{.600 \text{ Liters}} = .027 \text{ M Ag}^+$$

$$[\text{I}^-] = \frac{(.030)(.200)}{.600 \text{ Liters}} = .010 \text{ M I}^-$$

$$Q = [.027][.010] = 2.7 \times 10^{-4}$$

$Q > K_{sp}$ so yes
a ppt of AgI
will form