Quiz 17.4 – Molar Solubility

Name: Key

Question 1

Use the K_{sp} values in Table 17.2 of your textbook to find the molar solubility of the following ionic compounds:

- MnS $K_{sp} = x^2$ $x = \sqrt{4.6 \cdot 10^{-14}}$ $x = 2.14 \cdot 10^{-7}\ M$
- $Mg(OH)_2$ $K_{sp} = x(2x)^2$ $x = \sqrt[3]{\frac{K_{sp}}{4}}$ $5.61 \cdot 10^{-12}$ $x = 1.12 \cdot 10^{-4}\ M$
- $Ba_3(PO_4)_2$

$K_{sp} = (3x)^3(2x)^2$ $K_{sp} = 27x^3 \cdot 4x^2$ $x = \sqrt[5]{\frac{3.40 \cdot 10^{-23}}{108}} = 1.26 \cdot 10^{-5}\ M$

Question 2

Use the given molar solubilities to find the K_{sp} for the following ionic compounds (don't use Table 17.2!)

- $CaSO_4$: $7.02 \times 10^{-3}\ M$ $K_{sp} = x^2 = 4.93 \cdot 10^{-5}$
- PbI_2 : $1.35 \times 10^{-3}\ M$ $K_{sp} = x(2x)^2 = 4x^3 = 9.84 \cdot 10^{-9}$
- $Al(OH)_3$: 3.61×10^{-9} $K_{sp} = x(3x)^3 = 27x^4 = 4.59 \cdot 10^{-33}$

Question 3

The smallest K_{SP} value in Table 17.2 is for SnS_2, with $K_{sp} = 1 \times 10^{-70}$. This is a phenomenally small value. Calculate the volume of water required to dissolve just 10 formula units of SnS_2.

$K_{sp} = x(2x)^2 = 4x^3$ $x = \sqrt[3]{\frac{1 \cdot 10^{-70}}{4}} = 2.92 \cdot 10^{-24}\ M/L$

$\frac{10 \text{ formula units}}{} \cdot \frac{1 \text{ mol}}{6.022 \cdot 10^{23}} \cdot \frac{1\ L}{2.92 \cdot 10^{-24} \text{ mol}} = 5.7\ L$

Question 4

CdF_2 has a relatively high solubility ($K_{sp} = 6.44 \times 10^{-3}$). Calculate the molar solubility of CdF_2 in both pure water, and in a 0.5 M solution of NaF

water

$K_{sp} = x(2x)^2 = 4x^3$

$x = \sqrt[3]{\frac{6.44 \cdot 10^{-3}}{4}} = 0.117 M$

solution

$K_{sp} = x(0.5 + 2x)^2$

small?

$6.44 \cdot 10^{-3} = x \cdot 0.5^2$

$x = 0.0258$ 10.32%

Solve ~~quadratically~~ numerically

$x = 0.0218\ M$