

Name

KEY

Date

## Chemistry 12

## Extra Solubility Problems (ESP)

Do as many of these problems as you can and check your answers with the key. Get help on any you don't understand. This sheet contains most of the major types of problems found in Unit 3—Solubility.

1. It is found that  $1.892 \times 10^{-13}$  grams of the compound cadmium (II) sulphide (CdS) will dissolve in 350.0 mL of water to form a saturated solution. Using this data, calculate the value for the  $K_{sp}$  of CdS. Show all of your steps clearly.  $g \rightarrow mol \rightarrow M \rightarrow K_{sp}$

$$1.892 \times 10^{-13} \text{ g CdS} \times \frac{1 \text{ mol}}{144.5 \text{ g}} = 1.309 \times 10^{-15} \text{ mol}$$

$$M = \frac{1.309 \times 10^{-15} \text{ mol}}{0.3500 \text{ L}} = 3.741 \times 10^{-15} \text{ M (molar solubility)}$$

$$\text{CdS}_{(s)} \rightleftharpoons \text{Cd}^{2+} + \text{S}^{2-}$$

$$-3.741 \times 10^{-15} \text{ M} \quad +3.741 \times 10^{-15} \text{ M} \quad +3.741 \times 10^{-15} \text{ M}$$

$$K_{sp} = [\text{Cd}^{2+}][\text{S}^{2-}] = (3.741 \times 10^{-15})^2 = 1.399 \times 10^{-29}$$

2. Calculate the maximum mass of Mg(OH)<sub>2</sub>, which will dissolve in 150.0 mL of water. Show all of your steps clearly.  $K_{sp} \rightarrow M \rightarrow mol \rightarrow g$

$$\text{Mg(OH)}_{2(s)} \rightleftharpoons \text{Mg}^{2+} + 2\text{OH}^{-}$$

$$K_{sp} = [\text{Mg}^{2+}][\text{OH}^{-}]^2 = s(2s)^2 = 4s^3$$

$$s = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{5.6 \times 10^{-12}}{4}} = 1.119 \times 10^{-4} \text{ M}$$

$$mol = M \times L = 1.119 \times 10^{-4} \text{ M} \times 0.1500 \text{ L} = 1.678 \times 10^{-5} \text{ mol}$$

$$mass = 1.678 \times 10^{-5} \text{ mol} \times \frac{58.3 \text{ g}}{1 \text{ mol}} = 9.8 \times 10^{-4} \text{ g}$$

3. Calculate the molar solubility of calcium oxalate (CaC<sub>2</sub>O<sub>4</sub>). Show all of your steps clearly.

$$\text{CaC}_2\text{O}_4(s) \rightleftharpoons \text{Ca}^{2+} + \text{C}_2\text{O}_4^{2-}$$

$$K_{sp} = [\text{Ca}^{2+}][\text{C}_2\text{O}_4^{2-}]$$

$$K_{sp} = s^2$$

$$s = \sqrt{K_{sp}} = \sqrt{2.3 \times 10^{-9}} = 4.8 \times 10^{-5} \text{ M}$$

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