

CH302H – Principles of Chemistry II: Honors
Fall 2016, Unique 49420

Homework, Week 10

1. The K_{sp} of BaSO_4 in water is 4.3×10^{-11} .
 - a) What is the molar solubility of BaSO_4 ?
 - b) Is BaSO_4 more soluble in an acidic or basic solution? Justify your reasoning.
 - c) To be specific, what is the molar solubility of BaSO_4 in a solution that is buffered at pH 2?
2. $\text{Ni}(\text{OH})_2$ is minimally soluble in water ($K_{sp} = 6.0 \times 10^{-16}$). To what pH would you have to buffer the solution in order to dissolve $\text{Ni}(\text{OH})_2$ to the point that $[\text{Ni}^{2+}] = 1.0 \times 10^{-3} \text{ M}$?
3. 6.0 g of NaCl is added to a 1.0 L solution containing both $1.0 \times 10^{-3} \text{ M Ag}^+$ and Pb^{2+} . ($K_{sp}(\text{AgCl}) = 1.8 \times 10^{-10}$; $K_{sp}(\text{PbCl}_2) = 1.7 \times 10^{-5}$.)
 - a) As NaCl is added, a precipitate forms. What is this?
 - b) After all the NaCl is added, what are the concentrations of all species in solution at equilibrium?
4. The solubility of PbF_2 increases when HNO_3 is added to the solution, while the solubility of PbCl_2 is not changed by the addition of this acid. Explain this observation.
5. To try to dissolve PbCl_2 in solution, you now add HCl . Will this increase or decrease the amount of PbCl_2 that dissolves? Justify your reasoning.
6. Copper tetraamine is a water-soluble complex formed between copper and the ammonia ligand, $\text{Cu}(\text{NH}_3)_4^{2+}$. It has step-wise formation constants of 1.0×10^4 , 2.0×10^3 , 5.0×10^2 , and 9.0×10^1 for K_1 to K_4 , respectively.
 - a) What is the formation constant of the entire molecule?
 - b) A solution that is made containing 1.0 M NH_3 and $1.0 \times 10^{-3} \text{ M Cu}^{2+}$. Determine the concentration of all copper-containing species at equilibrium. (For this problem, you may ignore any acid-base activity of the NH_3 ligand, but justify to yourself how it will change your answer.)
 - c) 1.0 g of CuCO_3 is mixed with 1.0 L of water ($K_{sp}(\text{CuCO}_3) = 2.3 \times 10^{-10}$). In order to dissolve this and make $\text{Cu}(\text{NH}_3)_4^{2+}$, NH_3 is added to the solution. How much NH_3 must be added to dissolve all of the CuCO_3 ?

7. Austin's native soils have a relatively high pH (~9.5). Serious home gardeners consider this to be beneficial for keeping lead from accumulating in home-grown fruits and vegetables.

a) Is there any logic to this commonly held belief? Justify your reasoning.

b) How would the concentration of soluble lead in soil increase if the pH were lowered by one unit?

8. CaCO_3 precipitates from water and accumulates on the insides of pipes, restricting and eventually blocking the flow of water. This is particularly a problem in pipes that carry hot water and on the inside of hot water heaters.

a) Based on this information, predict the sign of the enthalpy of formation of CaCO_3 .

b) Suggest a solution to this problem.