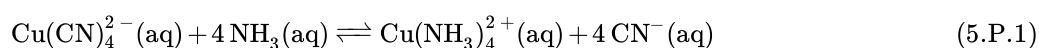


5.P: Le Chatelier's Principle (Pre-Lab)

1. Cadmium hydroxide, an important component of NiCd batteries, is only slightly soluble in water.
 - Write a reaction for the dissolution of cadmium hydroxide in water.
 - Write the K_{sp} expression for cadmium hydroxide.
 - You add a small amount of NaOH to a test tube containing cadmium nitrate solution. Initially nothing happens, but as you add more NaOH you begin to observe the formation of a white, powdery solid that resembles snowflakes. Eventually, all the precipitate settles to the bottom of your test tube. Explain why you do not see the precipitate initially as you first begin to add NaOH (aq).
 - Explain why you eventually do see a precipitate.
 - Which of the following two reagents: HNO_3 or KOH , do you think will increase the solubility of cadmium hydroxide solution? Explain your answer.
2. The following complex ion formation equilibrium takes place in water:



- Write the K_f expression for this complex ion reaction
 - The color of $\text{Cu}(\text{CN})_4^{2-}(\text{aq})$ is light blue, while the color of $\text{Cu}(\text{NH}_3)_4^{2+}$ is violet. Suppose you mix solutions of $\text{Cu}(\text{NO}_3)_2$, NaCN and NH_3 in a test tube and allow the reaction to reach equilibrium. The color of the solution is light blue at this point. Given that the above reaction is endothermic, should you heat the solution, or cool the solution in order to change the color from light blue to violet? Explain your answer using Le Chatelier's principle.
3. Congo Red (CR) is a pH indicator which has a blue color in its acidic form and red color in its basic form. When dissolved in water, CR forms a red-colored solution.
 - Write a reaction for the equilibrium between the two forms of congo red. Use HCR for the acidic form and CR^- for the basic form.
 - You make a solution of CR in water. Which of the following reagents, 6 M HCl or 6 M NaOH , will cause the solution to change color? Explain your answer using the concept of coupled reaction.

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