17: Additional Aspects of Aqueous Equilibria

OVERVIEW OF THE CHAPTER

17.1 Common-Ion Effect

Review: Net ionic equations (4.2); LeChatelier's principle (15.7)

Learning Goals: You should be able to predict qualitatively and calculate quantitatively the effect of an added common ion on the pH of an aqueous solution of a weak acid or base.

17.2 Buffers

Review: pH (16.4)); weak acids and based (16.6, 16.7)

Learning Goals: You should be able to:

1. Calculate the concentrations of each species present in a solution formed by mixing an acid and a base.
2. Describe how a buffer solution of a particular pH is made and how it operates to control pH.
3. Calculate the change in pH of a simple buffer solution of known composition caused by adding a small amount of a strong acid or base.

17.3 Titrations of Acids and Bases: Titration Curves

Review: Neutralization (4.3); titrations and indicators (4.6); pH calculations involving strong and weak acids and bases (16.5, 16.6, 16.7).

Learning Goals: You should be able to:

1. Describe the form of titration curves for the titrations of a strong acid by a strong base, a weak acid by a strong base, or a strong acid by a weak base.
2. Calculate the pH at any point, including the equivalence point, in acid-base titrations.

17.4 Solubility Equilibria

Review: Homogeneous equilibria (15.2); hydrolysis of ions (16.9); LeChatelier's principle (15.7); solubility principles (13.1, 13.3, 15.3).

Learning Goals: You should be able to:

1. Write the solubility-product constant for a salt.
2. Calculate K_{sp} from solubility data and solubility from the value for K_{sp} of an insoluble salt.
3. Calculate the effect of an added common ion on the solubility of a slightly soluble salt.

17.5, 17.6, 17.7 Criteria for Precipitating or Dissolving Slightly Soluble Salts

Review: Hydration (13.1); Lewis acid-base concepts (16.11); concept of reaction quotient (15.3).

Learning Goals: You should be able to:

1. Predict whether a precipitate will form when two solutions are mixed, given appropriate K_{sp} values.
2. Explain the effect of pH on a solubility equilibrium involving a basic or acidic ion.
3. Write the equilibrium equation when a metal ion and a Lewis base react to form a metal complex ion.
4. Describe how complex formation can affect the solubility of a slightly soluble salt.
5. Calculate the concentration of a metal ion in equilibrium with a ligand its complex ion, from a knowledge of initial concentrations and K_f.
6. Explain the origin of amphoteric behavior and write equations describing the dissolution of an amphoteric metal hydroxide in either an acidic or basic medium.