Hydrolysis in Acid-Base Reactions

Hydrolysis can help explain why the end point of a neutralization reaction can occur at a pH other than 7. The hydrolysis properties of salts are determined by the relative strengths of the acids and bases from which the salts were formed. Salts can be placed in four general categories, depending on their hydrolysis properties: strong acid–strong base, strong acid–weak base, weak acid–strong base, and weak acid–weak base.

Salts of strong acids and strong bases produce neutral solutions because neither the cation of a strong base nor the anion of a strong acid hydrolyzes appreciably in aqueous solutions. HCl(*aq*) is a strong acid, and NaOH(*aq*) is a strong base. Neither the Na^+ cation of the strong base nor the Cl^- anion of the strong acid undergoes hydrolysis in water solutions. Therefore, aqueous solutions of NaCl are neutral. Similarly, KNO_3 is the salt of the strong acid HNO_3 and the strong base KOH. Measurements show that the pH of an aqueous KNO_3 solution is always very close to 7.

The aqueous solutions of salts formed from reactions between weak acids and strong bases are basic, as **Figure 11** shows. Anions of the dissolved salt are hydrolyzed by the water molecules, and the pH of the solution is raised, indicating that the hydroxide-ion concentration has increased. Aqueous solutions of sodium acetate, $NaCH_3COO$, are basic. The acetate ions, CH_3COO^-, undergo hydrolysis because they are the anions of the weak acid–acetic acid. The cations of the salt are the positive ions from a strong base, NaOH, and do not hydrolyze, because NaOH is 100% dissociated.

Figure 12 shows that salts of strong acids and weak bases produce acidic aqueous solutions. Cations of the dissolved salt are hydrolyzed in

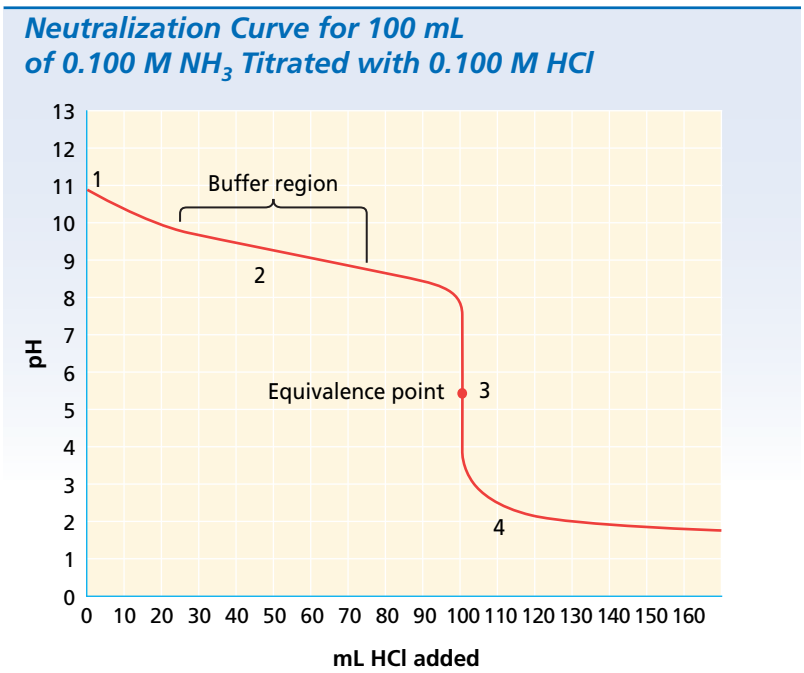

FIGURE 12 At point *1* on the titration curve, only aqueous ammonia is present. The pH is determined by the base alone. At *2* there is a mixture of NH_3 and NH_4^+. Adding HCl changes the pH slowly. At point *3* all aqueous ammonia has been converted to NH_4^+. At *4* the pH is determined by the excess H_3O^+ that is being added.