

18 • Reactions between Acids and Bases

STUDY QUESTIONS & PROBLEMS

- Calculate the equilibrium constant for the neutralization of hydrocyanic acid by ammonia:
$$\text{HCN}(aq) + \text{NH}_3(aq) \rightleftharpoons \text{NH}_4^+(aq) + \text{CN}^-(aq)$$
$$K_a \text{ for hydrocyanic acid} = 4.0 \times 10^{-10} \text{ at } 25^\circ \text{ C}$$
$$K_b \text{ for ammonia} = 1.8 \times 10^{-5} \text{ at } 25^\circ \text{ C}$$
- Is the solution that results from the neutralization of hydrocyanic acid by ammonia basic or acidic?
- If exactly 50 mL of a 0.050M solution of hydrochloric acid is added to exactly 50 mL of 0.050M ammonia, what is the pH of the resulting solution?
- Calculate the pH of a 0.20M solution of formic acid HCO_2H .
 - Now suppose sufficient sodium formate is added to make the solution 0.10M in formate ion (without changing the total volume). Would you expect the pH to increase or decrease?
 - Calculate the pH of the new solution.
 - What would the pH be if the concentration of formate ion was increased to 0.20M?
 - What do you notice about the pH of this solution?
- What is the pH of 100 mL of pure water at 25° C ?
 - What would the pH of this 100 mL water sample be if 0.10 mL of 12M HCl was added to it? (Assume the volume doesn't change).
 - Calculate the pH of a buffer solution composed of 0.20M ammonia and 0.20M ammonium chloride.
 - Calculate the pH of 100 mL of this buffer solution if 0.10mL of 12M hydrochloric acid is added to it. (Assume the volume doesn't change).
- From the list of weak acids shown in Table 17.4 on page 799, choose an appropriate acid for the preparation of a buffer with a pH equal to 7.25. Calculate the relative quantities of the acid and its conjugate base required for the buffer solution.
- Repeat question 6 for a buffer requiring a pH = 9.25.
- Benzoic acid is a weak monoprotic acid ($K_a = 6.3 \times 10^{-5}$). Calculate the pH of the solution at the equivalence point when 25.0 mL of a 0.100 M solution of benzoic acid is titrated against 0.050 M sodium hydroxide.
- A solution contains KH_2PO_4 and K_2HPO_4 and has a pH of 7.10. What is the mole ratio of K_2HPO_4 to KH_2PO_4 ?