Answers More Chapters 14 Study Questions

1. $NH_4Cl(aq) \rightarrow NH_4^+(aq) + Cl^-(aq)$; since Cl^- is a spectator ion, just consider NH_4^+, which is a weak acid.

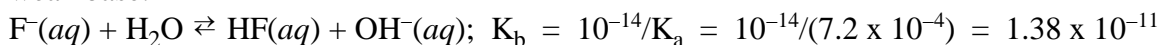 $NH_4^+(aq) \rightleftarrows H^+(aq) + NH_3(aq)$; $K_a = 5.6 \times 10^{-10}$

   $K_a = \dfrac{[H^+][NH_3]}{[NH_4^+]}$; $x = [H^+] = [NH_3]$; $[NH_4^+] = 0.030$ M; $5.6 \times 10^{-10} = \dfrac{x^2}{0.030\ M}$

   $x^2 = (0.030)(5.6 \times 10^{-10}) = 1.7 \times 10^{-11}$; $x = (1.7 \times 10^{-11})^{1/2} = 4.1 \times 10^{-6}$ M $= [H^+]$

   $pH = -\log[H^+] = -\log(4.1 \times 10^{-6}$ M); $pH = 5.4$

2. $NaF(aq) \rightarrow Na^+(aq) + F^-(aq)$; since Na^+ is a spectator ion, just consider F^-, which is a weak base.

   $F^-(aq) + H_2O \rightleftarrows HF(aq) + OH^-(aq)$; $K_b = 10^{-14}/K_a = 10^{-14}/(7.2 \times 10^{-4}) = 1.38 \times 10^{-11}$

   $K_b = \dfrac{[HF][OH^-]}{[F^-]}$; $x = [OH^-] = [HF]$; $[F^-] = 0.14$ M; $1.38 \times 10^{-11} = \dfrac{x^2}{0.14\ M}$

   $x^2 = (0.14)(1.38 \times 10^{-11}) = 1.9 \times 10^{-12}$; $x = (1.9 \times 10^{-12})^{1/2} = 1.4 \times 10^{-6}$ M $= [OH^-]$

   $pOH = -\log[OH^-] = -\log(1.4 \times 10^{-6}$ M$) = 5.9$; $pH = 14 - pOH = 14 - 5.9$; $pH = 8.1$

3. $V_1 \times M_1 = V_2 \times M_2$; HNO_3 is a strong acid; $[HNO_3] = [H^+]$; calculate $[HNO_3]$.

   0.00600 L $\times\ 3.00$ M $= 18.0$ L $\times M_2$; $M_2 = \dfrac{0.00600 \times 3.00}{18.0} = 1.00 \times 10^{-3}$ M $= [H^+]$

   $pH = -\log[H^+] = -\log(1.00 \times 10^{-3}$ M$)$; $pH = 3.0$

4. $NH_4^+(aq) + OH^-(aq) \rightarrow NH_3(aq) + H_2O$

   conjugate acid base pairs: NH_4^+/NH_3 and H_2O/OH^-

5. c) NaOH (strong base)