Weak Bases

Weak bases react with water to form the hydroxide ion and conjugate acid of the base.

$$NH_{3(aq)} + H_2O_{(l)} \rightleftharpoons NH_{4(aq)}^{+} + OH_{(aq)}^{-}$$

base dissociation constant

$$K_b = \frac{[NH_{4(aq)}^{+}][OH_{(aq)}^{-}]}{[NH_{3(aq)}]}, \quad [NH_{4(aq)}^{+}] = [OH_{(aq)}^{-}]$$

$$K_b = \frac{[OH_{(aq)}^{-}]^2}{[NH_{3(aq)}]}$$

$$K_aK_b = K_w$$

$$K_b = \frac{K_w}{K_a} = \frac{1.0\times10^{-14}}{5.8\times10^{-10}}$$

$$K_b = 1.72\times10^{-5}$$

Calculate the pH of a 0.221 mol/L solution of $NH_{3(aq)}$ at equilibrium.

$$[OH_{(aq)}^{-}] = \sqrt{K_b\,[NH_{3(aq)}]}$$

$$[OH_{(aq)}^{-}] = \sqrt{(1.72\times10^{-5})[0.221]}$$

$$[OH_{(aq)}^{-}] = 1.95\times10^{-3}\,M$$

$$pOH = -\log[OH_{(aq)}^{-}]$$

$$pOH = 2.710$$

$$pH + pOH = 14.000$$

$$pH = 14.000 - 2.710$$

$$pH = 11.290$$

$$K_a K_b = K_w$$

Worksheet