South Pasadena • AP Chemistry

Name_____
Period __ Date ___/___/___

17 • Acid-Base Equilibrium

AP PROBLEM PRACTICE

The overall dissociation of oxalic acid, $H_2C_2O_4$, is represented below. The overall dissociation constant is also indicated.

$$H_2C_2O_4 \rightleftharpoons 2\ H^+ + C_2O_4^{2-} \qquad K = 3.78 \times 10^{-6}$$

(a) What volume of 0.400-molar NaOH is required to neutralize completely a 5.00×10^{-3} mole sample of pure oxalic acid?

(b) Give the equations representing the first and second dissociations of oxalic acid.

Calculate the value of the first dissociation constant, K_1, for oxalic acid if the value of the second dissociation constant, K_2, is 6.40×10^{-5}.

(c) To a 0.015-molar solution of oxalic acid, a strong acid is added until the pH is 0.5. Calculate the $[C_2O_4^{2-}]$ in the resulting solution. (Assume the change in volume is negligible.)

(d) Calculate the value of the equilibrium constant, K_b, for the reaction that occurs when solid $Na_2C_2O_4$ is dissolved in water.

Answer:

(a) 5.00×10^{-3} mol oxalic acid x $\frac{2 \text{ mol } H^+}{1 \text{ mol oxalic acid}}$ x $\frac{1 \text{ mol OH}}{1 \text{ mol } H^+}$ x $\frac{1000. \text{ mL NaOH}}{0.400 \text{ mol NaOH}}$ =

= 25.0 mL NaOH

(b) $H_2C_2O_4 <=> H^+ + HC_2O_4^-$

$HC_2O_4^- <=> H^+ + C_2O_4^{2-}$

$K = K_1 \times K_2$

$K_1 = \frac{K}{K_2} = \frac{3.78 \infty 10^{6}}{6.40 \infty 10^{5}} = 5.91 \times 10^{-2}$

(c) X = amt. ionized

$[H_2C_2O_4] = 0.015 - X$

$[H^+] = 10^{-pH} = 10^{-0.5} = 0.316\ M$

$[C_2O_4^{2-}] = X$

$K_a = \frac{[H^+]^2 [C_2O_4^{2-}]}{[H_2C_2O_4]} = 3.78 \times 10^{-6}$

$3.78 \times 10^{-6} = \frac{[0.316]^2 [X]}{[0.015 - X]}$; $X = 5.67 \times 10^{-7}\ M$

(d) $K_b = \frac{K_w}{K_2} = \frac{1 \infty 10^{14}}{6.40 \infty 10^{6}} = 1.56 \times 10^{-10}$