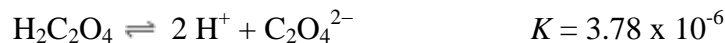


17 • Acid-Base Equilibrium

AP PROBLEM PRACTICE

The overall dissociation of oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$, is represented below. The overall dissociation constant is also indicated.



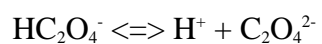
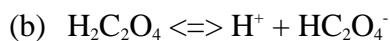
- (a) What volume of 0.400-molar NaOH is required to neutralize completely a 5.00×10^{-3} mole sample of pure oxalic acid?
- (b) Give the equations representing the first and second dissociations of oxalic acid.

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 $[\text{C}_2\text{O}_4^{2-}]$ 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 $\text{Na}_2\text{C}_2\text{O}_4$ is dissolved in water.

Answer:

$$(a) \quad 5.00 \times 10^{-3} \text{ mol oxalic acid} \times \frac{2 \text{ mol H}^+}{1 \text{ mol oxalic acid}} \times \frac{1 \text{ mol OH}^-}{1 \text{ mol H}^+} \times \frac{1000. \text{ mL NaOH}}{0.400 \text{ mol NaOH}} = 25.0 \text{ mL NaOH}$$



$$K = K_1 \times K_2$$

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

(c) X = amt. ionized

$$[\text{H}_2\text{C}_2\text{O}_4] = 0.015 - X$$

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

$$[\text{C}_2\text{O}_4^{2-}] = X$$

$$K_a = \frac{[\text{H}^+]^2 [\text{C}_2\text{O}_4^{2-}]}{[\text{H}_2\text{C}_2\text{O}_4]} = 3.78 \times 10^{-6}$$

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

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