

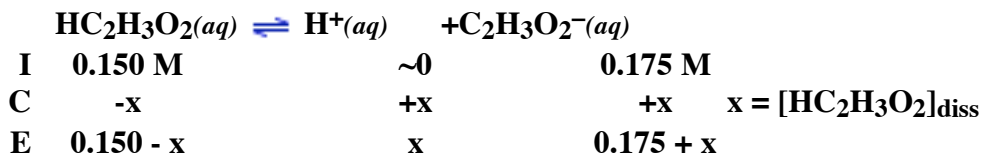
1. Complete the following problems

a. Calculate the pH of a solution prepared by mixing 20.0 mL of 0.300 M $\text{HC}_2\text{H}_3\text{O}_2$ with 20.0 mL of 0.350 M $\text{NaC}_2\text{H}_3\text{O}_2$.

Dilution calculation:

$$[\text{HC}_2\text{H}_3\text{O}_2] = 0.300 \text{ M} \left(\frac{20.0 \text{ mL}}{40.0 \text{ mL}} \right) = 0.150 \text{ M}$$

$$[\text{C}_2\text{H}_3\text{O}_2^-] = 0.350 \text{ M} \left(\frac{20.0 \text{ mL}}{40.0 \text{ mL}} \right) = 0.175 \text{ M}$$



$$K_a = \frac{[\text{H}^+][\text{C}_2\text{H}_3\text{O}_2^-]}{[\text{HC}_2\text{H}_3\text{O}_2]}$$

$$1.8 \times 10^{-5} = \frac{(x)(0.175 + x)}{0.150 - x} \text{ assume } x \ll 0.150$$

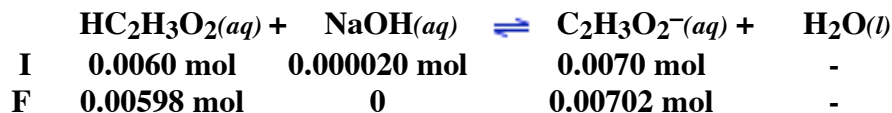
$$1.8 \times 10^{-5} = \frac{(x)(0.175)}{0.150}$$

$$1.54 \times 10^{-5} = x = [\text{H}^+]$$

$$\text{pH} = 4.81$$

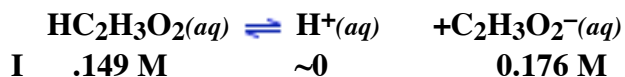
b. Calculate the pH after adding 0.0000200 moles of NaOH to the buffer in part a.

Add .0000200 mol of NaOH



$$[\text{HC}_2\text{H}_3\text{O}_2] = \frac{0.00598 \text{ mol}}{0.040 \text{ L}} = 0.149 \text{ M}$$

$$[\text{C}_2\text{H}_3\text{O}_2^-] = \frac{0.00702 \text{ mol}}{0.040 \text{ L}} = 0.176 \text{ M}$$



C	-x	+x	+x	x = [HC₂H₃O₂]_{diss}
E	.149 - x	x	0.176 + x	

$$K_a = \frac{[H^+][C_2H_3O_2^-]}{[HC_2H_3O_2]}$$

$$1.8 \times 10^{-5} = \frac{(x)(0.176 + x)}{0.149 - x} \text{ assume } x \ll 0.100$$

$$1.8 \times 10^{-5} = \frac{(x)(0.176)}{0.149}$$

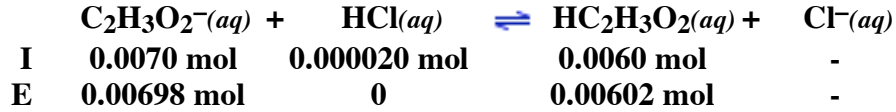
$$1.52 \times 10^{-5} = x = [H^+]$$

$$\text{pH} = 4.82$$

changed by 0.01 pH units

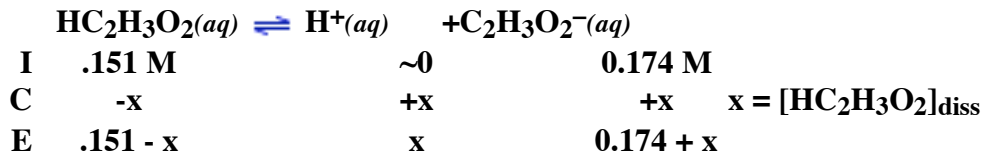
c. Calculate the pH after adding 0.0000200 mole of HCl to a new sample of the buffer in part a.

Add .00200 mol of HCl



$$[\text{HC}_2\text{H}_3\text{O}_2] = \frac{0.00602 \text{ mol}}{0.040 \text{ L}} = 0.151 \text{ M}$$

$$[\text{C}_2\text{H}_3\text{O}_2^-] = \frac{0.00698 \text{ mol}}{0.040 \text{ L}} = 0.174 \text{ M}$$



$$K_a = \frac{[\text{H}^+][\text{C}_2\text{H}_3\text{O}_2^-]}{[\text{HC}_2\text{H}_3\text{O}_2]}$$

$$1.8 \times 10^{-5} = \frac{(x)(0.174 + x)}{0.151 - x} \text{ assume } x \ll 0.125$$

$$1.8 \times 10^{-5} = \frac{(x)(0.174)}{0.151}$$

$$1.56 \times 10^{-5} = x = [\text{H}^+]$$

$$\text{pH} = 4.80$$

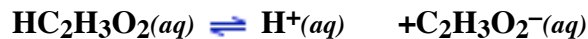
changed by 0.01 pH units

d. Calculate the pH after adding 0.0000200 mole of HCl to an unbuffered solution of 20.0 mL of a 0.300 M solution of $\text{HC}_2\text{H}_3\text{O}_2$

Add .0000200 mol of HCl

$$[\text{HC}_2\text{H}_3\text{O}_2] = 0.300 \text{ M}$$

$$[\text{H}^+] = \left(\frac{0.0000200 \text{ mol}}{0.020 \text{ L}} \right) = 0.001 \text{ M}$$



I	.300 M	0.001		
C	-x	+x	+x	x = [HC₂H₃O₂]_{diss}
E	.300 - x	0.001 + x	x	

$$K_a = \frac{[H^+][C_2H_3O_2^-]}{[HC_2H_3O_2]}$$

$$1.8 \times 10^{-5} = \frac{(x)(0.001 + x)}{0.300 - x} \text{ assume } x \ll 0.001$$

$$1.8 \times 10^{-5} = \frac{(x)(0.001 + x)}{0.300}$$

solving the quadratic equation

$$0.0054 \text{ M} = x = [H^+]$$

$$\text{pH} = 4.82$$

changed by 0.01 pH units