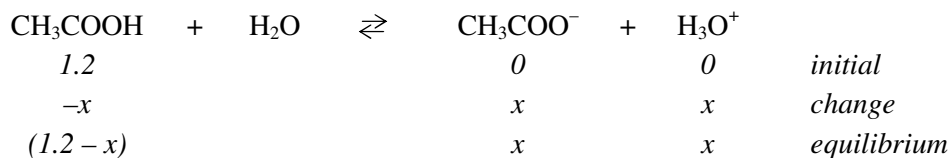
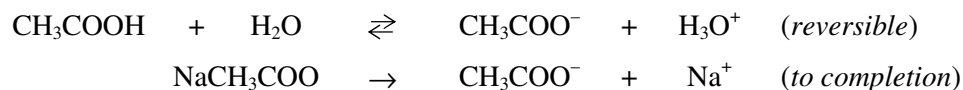


**Part 3. The Ionization Constant of Acetic Acid****Solution: 10 ml of 1.2 M CH<sub>3</sub>COOH****Measured:** pH**To be determined:** K<sub>a</sub>**Calculations:** 1.  $[\text{H}_3\text{O}^+] = 10^{-\text{pH}} = x$ 2. Determine  $[\text{CH}_3\text{COO}^-]$  and  $[\text{CH}_3\text{COOH}]$  from the following:

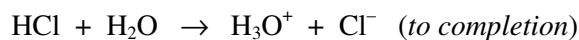
$$3. \quad K_a = \frac{[\text{H}_3\text{O}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]} = \frac{x^2}{(1.2 - x)}$$

**Solution: 30 ml of 1.2 M NaCH<sub>3</sub>COO + 10 ml of 1.2 M CH<sub>3</sub>COOH****Measured:** pH**To be determined:** K<sub>a</sub>

Assume that the equilibrium molarities of CH<sub>3</sub>COOH and CH<sub>3</sub>COO<sup>-</sup> are the same as their initial molarities. However, keep in mind that the initial molarities decrease after the two solutions are mixed together (they dilute each other)

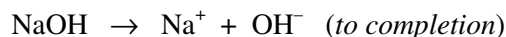
**Calculations:** 1.  $[\text{H}_3\text{O}^+] = 10^{-\text{pH}}$ 2. Determine  $[\text{CH}_3\text{COO}^-]$  in a new volume of 40 ml (*dilution problem*)3. Determine  $[\text{CH}_3\text{COOH}]$  in a new volume of 40 ml (*dilution problem*)

$$4. \quad K_a = \frac{[\text{H}_3\text{O}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]}$$

**Part 4. Buffering Capacity****Solution: 40 ml of DI H<sub>2</sub>O + 4 ml of 2.0 M HCl****To be determined:** pH (calculated)

- Calculations:**
1. Determine  $[\text{HCl}]$  in a new volume of 44 ml (*dilution problem*)
  2.  $[\text{H}_3\text{O}^+] = [\text{HCl}]$
  3.  $\text{pH}_{\text{calc}} = -\log [\text{H}_3\text{O}^+]$

**Solution: 40 ml of DI H<sub>2</sub>O + 4 ml of 2.0 M NaOH**



**To be determined:** pH (calculated)

**Calculations:** Use the same approach as shown above for the (H<sub>2</sub>O + 2.0 M HCl) solution.  
Remember that  $[\text{H}_3\text{O}^+] \times [\text{OH}^-] = 10^{-14}$

**Solution: 40 ml of 1.2 M NaCH<sub>3</sub>COO + 40 ml of 1.2 M CH<sub>3</sub>COOH = 80 ml of the buffer**

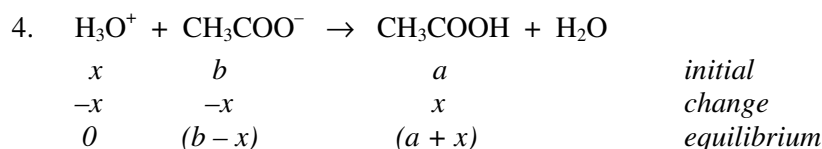
**To be determined:** pH (calculated)

- Calculations:**
1. Determine  $[\text{CH}_3\text{COO}^-]$  in a new volume of 80 ml (*dilution problem*)
  2. Determine  $[\text{CH}_3\text{COOH}]$  in a new volume of 80 ml (*dilution problem*)
  3.  $\text{pH} = \text{pK}_a + \log \frac{[\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]}$  Use  $\text{K}_a = 1.76 \times 10^{-5}$

**Solution: 40 ml of the buffer (prepared previously) + 4 ml of 2.0 M HCl**

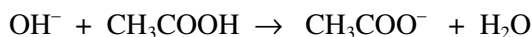
**To be determined:** pH (calculated)

- Calculations:**
1. Determine the initial number of moles of CH<sub>3</sub>COOH in solution: *a*
  2. Determine the initial number of moles of CH<sub>3</sub>COO<sup>-</sup> in solution: *b*
  3. Determine the number of moles of HCl added: *x*



$$5. \text{pH} = \text{pK}_a + \log \frac{\text{moles of CH}_3\text{COO}^-}{\text{moles of CH}_3\text{COOH}} = \text{pK}_a + \log \frac{(b-x)}{(a+x)} \quad \text{Use } \text{K}_a = 1.76 \times 10^{-5}$$

**Solution: 40 ml of the buffer (prepared previously) + 4 ml of 2.0 M NaOH**



**Calculations:** Use the same approach as shown above for the (buffer + 2.0 M HCl) solution.