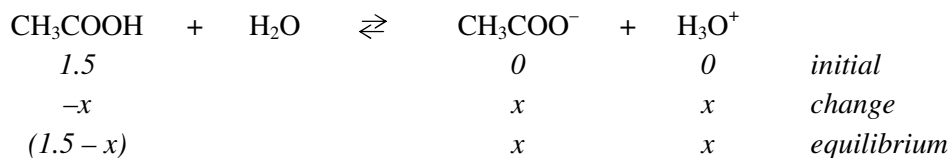
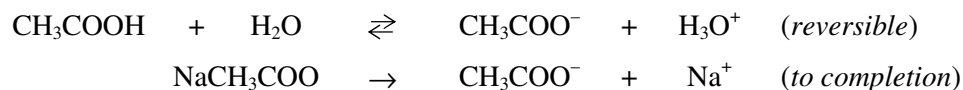


Part 3. The Ionization Constant of Acetic Acid**Solution: 10 ml of 1.5 M CH₃COOH****Measured:** pH**To be determined:** K_a**Calculations:** 1. $[\text{H}_3\text{O}^+] = 10^{-\text{pH}} = x$ 2. Determine $[\text{CH}_3\text{COO}^-]$ and $[\text{CH}_3\text{COOH}]$ from the following:

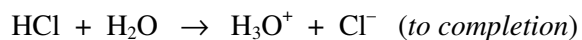
$$3. \quad K_a = \frac{[\text{H}_3\text{O}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]} = \frac{x^2}{(1.5 - x)}$$

Solution: 30 ml of 1.5 M NaCH₃COO + 10 ml of 1.5 M CH₃COOH**Measured:** pH**To be determined:** K_a

Assume that the equilibrium molarities of CH₃COOH and CH₃COO⁻ 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)

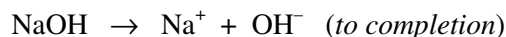
Calculations: 1. $[\text{H}_3\text{O}^+] = 10^{-\text{pH}}$ 2. Determine $[\text{CH}_3\text{COO}^-]$ in a new volume of 40 ml (*dilution problem*)3. Determine $[\text{CH}_3\text{COOH}]$ in a new volume of 40 ml (*dilution problem*)

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

Part 4. Buffering Capacity**Solution: 40 ml of DI H₂O + 3 ml of 3.0 M HCl****To be determined:** pH (calculated)

- Calculations:**
1. Determine $[\text{HCl}]$ in a new volume of 43 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 H₂O + 3 ml of 3.0 M NaOH



To be determined: pH (calculated)

- Calculations:** Use the same approach as shown above for the (H₂O + 3.0 M HCl) solution.
Remember that $[\text{H}_3\text{O}^+] \times [\text{OH}^-] = 10^{-14}$

Solution: 40 ml of 1.5 M NaCH₃COO + 40 ml of 1.5 M CH₃COOH = 80 ml of the buffer

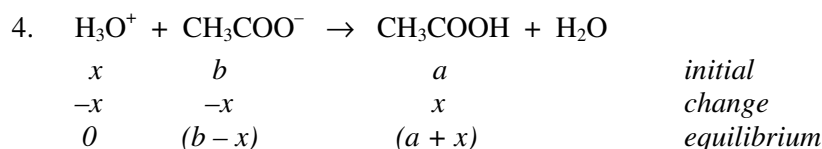
To be determined: pH (calculated)

- 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) + 3 ml of 3.0 M HCl

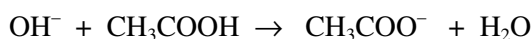
To be determined: pH (calculated)

- Calculations:**
1. Determine the initial number of moles of CH₃COOH in solution: *a*
 2. Determine the initial number of moles of CH₃COO⁻ in solution: *b*
 3. Determine the number of moles of HCl added: *x*



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

Solution: 40 ml of the buffer (prepared previously) + 3 ml of 3.0 M NaOH



- Calculations:** Use the same approach as shown above for the (buffer + 3.0 M HCl) solution.