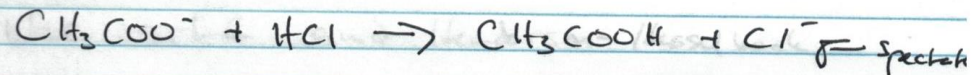
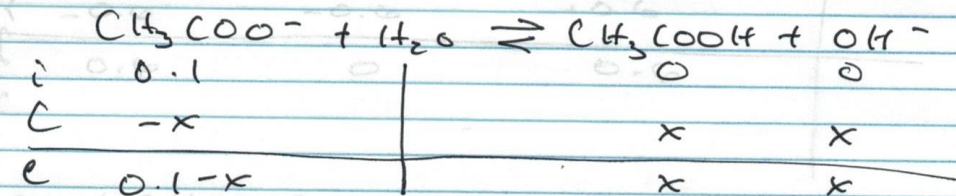


Titration Equation for s r f C table



Zone 1 only weak base

use ICE table and weak base equation



$$K_b = \frac{[\text{CH}_3\text{COOH}][\text{OH}^-]}{[\text{CH}_3\text{COO}^-]} \quad K_b = \frac{K_w}{K_a}$$

$$5.5 \times 10^{-10} = \frac{(x)(x)}{(0.1-x)}$$

$$K_b = \frac{1 \times 10^{-14}}{K_a}$$

$$5.5 \times 10^{-10} = \frac{x^2}{0.1}$$

$$0.1 \gg 5.5 \times 10^{-10}$$

$$5.5 \times 10^{-11} = x^2$$

$$7.42 \times 10^{-6} = x = [\text{OH}^-]$$

$$\text{pOH} = -\log[\text{OH}^-] = -\log(7.42 \times 10^{-6})$$

$$\text{pOH} = 5.13$$

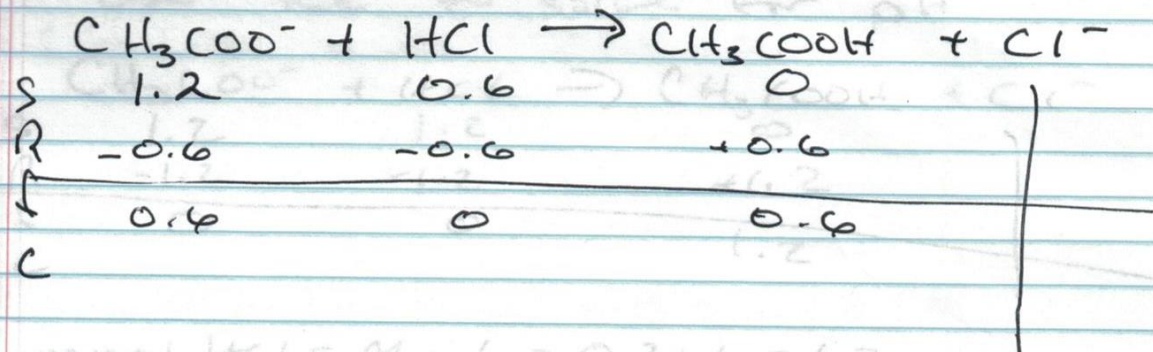
$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = 14 - 5.13$$

$$\text{pH} = 8.87$$

Zone 2 mixture of acid and base

Use srfc and Henderson-Hasselbalch



$$\text{mmol CH}_3\text{COO}^- = M \cdot m(\text{l}) = 0.1 \cdot 12 = 1.2$$

$$\text{mmol HCl} = M \cdot m(\text{l}) = 0.2 \cdot 3 = 0.6$$

Both acid and base conjugates present
it is a buffer

$$\text{pH} = \text{pK}_a + \log \frac{\text{base}}{\text{acid}}$$

$$\text{pH} = -\log(1.82 \times 10^{-5}) + \log \frac{0.6}{0.6}$$

$$\text{pH} = 4.74 + 0$$

$$\underline{\underline{\text{pH} = 4.74}}$$

$$K_a = \frac{K_w}{K_b}$$

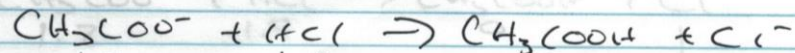
$$K_a = \frac{1 \times 10^{-14}}{5.5 \times 10^{-10}}$$

$$K_a = 1.82 \times 10^{-5}$$

Zone 3 At the equivalence point

use srfc to find amount of acid/base

use ICE to solve for pH



S	-1.2	-1.2	+1.2
B	-1.2	-1.2	+1.2
E	0	0	1.2

$$\text{mmol HCl} = \text{M} \cdot \text{ml} = 0.2 \cdot 6 = 1.2$$

only weak base left, need ICE table



i	0.067	0	0
C	-x	+x	+x
e	0.067-x	x	x

$$[\text{CH}_3\text{COOH}] = \frac{\text{mmol}}{\text{ml}} = \frac{1.2}{18 \text{ ml}} =$$

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

$$1.82 \times 10^{-5} = \frac{(x)(x)}{(0.067-x)} \quad 0.067 \gg 1.82 \times 10^{-5}$$

$$1.82 \times 10^{-5} = \frac{x^2}{0.067}$$

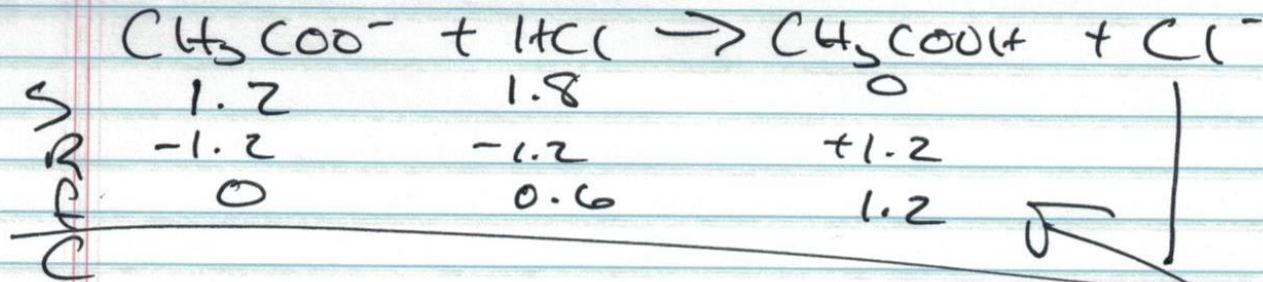
$$1.21 \times 10^{-6} = x^2$$

$$1.1 \times 10^{-3} = x = [\text{H}_3\text{O}^+]$$

$$\text{pH} = -\log([\text{H}_3\text{O}^+]) = -\log(1.1 \times 10^{-3}) = 2.96$$

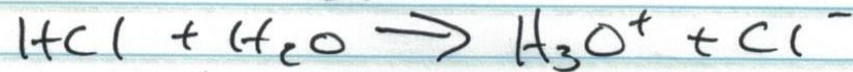
Zone 4 excess titrant

Use srfl table



$$\text{mmol HCl} = M \cdot mL = 0.2 \cdot 9 = 1.8$$

$$[\text{HCl}] = \frac{0.6 \text{ mmol}}{21 \text{ mL}}$$



$$[\text{HCl}] = [\text{H}_3\text{O}^+] = \frac{0.6}{21} = 0.029$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+] = -\log(0.029)$$

$$\text{pH} = \underline{\underline{1.54}}$$

ignore
Weak acid
when Strong
acid present