Sept 28 Sun

Acid-base Eq (14) Titration WA + SB.

Calculate the pH of the titration of 25.0 mL of 0.250 M CH_3CH_2COOH (HPr; $K_a = 1.3 \times 10^{-5}$) with 0.330 M NaOH at (a) half neutralization pt and (b) at equivalence pt.

Ans

(a) half neutr. $HPr + NaOH \rightleftharpoons Pr^{\ominus} Na^{\oplus} + H_2O + H^{\oplus}$

M = mol/L

at half pt only ½ HPr is neutral. so only ½ of NaOH

$0.250\,M \times 25.0\,mL = 6.25\,mmol$ / 2 = 3.125 mmol

3.125 mmol. b/c of Xs acid.

$K_a = 1.3 \times 10^{-5} = \frac{(3.125\,mmol)[H^{\oplus}]}{(3.125\,mmol)}$

no vol of NaOH reqd.

at half pt.

$K_a = 1.3 \times 10^{-5} = [H^{\oplus}]$

$pK_a = pH = 4.89$

(b) $HPr + NaOH \rightleftharpoons Pr^{\ominus} + Na^{\oplus} + H_2O$

(at eq. pt mol HPr = mol NaOH.)

6.25 mmol 6.25 mmol. 6.23 mmol.

no $H_3O^{\oplus}$ only $Pr^{\ominus}$ soln

vol of soln of NaOH. ? mL = mol / molarity = 6.25 / 0.33 = 18.9 mL

total vol = 25 + 18.9 mL = 43.9 mL

Molarity of $Pr^{\ominus}$ = 6.25 mM * 1/43.9 mL = 0.142 M

$Pr^{\ominus} + H_2O \rightleftharpoons HPr + OH^{\ominus}$

need K_b 0.142 M − x; +x; +x

$K_b = 7.69 \times 10^{-10} = \frac{x^2}{(0.142 - x)}$; x = 1.05×10^{-5}

ignore conc $OH^{\ominus}$

$K_b = \frac{1 \times 10^{-14}}{1.3 \times 10^{-5}} = 7.69 \times 10^{-10}$

$pOH = -\log 1.05 \times 10^{-5} = 4.98$

* pH = 14 − 4.98 = 9.02