Question #64116, Chemistry / Other

What will be the titration curve and pH for titrating 0.2 M acetic acid with 25 ml 0.2 M of NaOH.

Answer*:*

For the beginning you have only CH_3COOH in the solution. Initial pH is a pH of the weak monoprotic acid solution:

$CH_3COOH = CH_3COO^- + H^+$

$$K_a = \frac{[H^+]^2}{c_0 - [H^+]}$$

$$[H^+]^2 + [H^+]K_a - K_a c_0 = 0$$

$$c_0 = 0.2\ M$$

$$K_a = 1.8 \times 10^{-5}$$

$$[H^+] = 1.89 \times 10^{-3}$$

$$pH = -\log[H^+] = -\log 1.89 \times 10^{-3} = 2.72$$

Equivalence point at 25 mL. All acid converted to salt:

$CH_3COOH + NaOH = CH_3COONa + H_2O$

This salt undergoes hydrolysis:

$CH_3COO^- + H_2O = CH_3COOH + OH^-$

$$K_b = \frac{K_w}{K_a} = \frac{1.0 \times 10^{-14}}{1.8 \times 10^{-5}} = 5.6 \times 10^{-10}$$

$$K_a = \frac{[OH^-]^2}{c_0 - [OH^-]}$$

$$[OH^-]^2 + [OH^-]K_b - K_b c_0 = 0$$

$$K_b = 5.6 \times 10^{-10}$$

Due to dilution:

$$c_0 = 0.1\ M$$

$$[OH^-] = 7.48 \times 10^{-6}$$

$$pOH = -\log[OH^-] = -\log 7.48 \times 10^{-6} = 5.13$$

$$pH = 14 - pOH = 14 - 5.13 = 8.87$$

Before equivalence point pH will rise slowly, at equivalence point – sharp increase, after – again slow growth: