Weak Acid Titrated by Strong Base

Add 25.0 mL of 0.100M NaOH to 50.0mL of 0.100M $HC_2H_3O_2$ (HAc)

Using stoichiometry to get rid of all NaOH

$$1\ NaOH_{(aq)} + 1\ HAc_{(aq)} \rightarrow 1\ H_2O_{(l)} + 1\ NaAc_{(aq)}$$

$$mol\,OH^{1-}_{Add} = (25.0mL)\left(\frac{1L}{1000mL}\right)(0.100M\,NaOH)\left(\frac{1\,mol\,OH^{1-}}{1\,mol\,NaOH}\right) =$$

$$= 2.50\times10^{-3}\,mol\,OH^{1-}_{add}$$

$$mol\,HAc_{left} = mol\,HAc_I - mol\,HAc_r$$

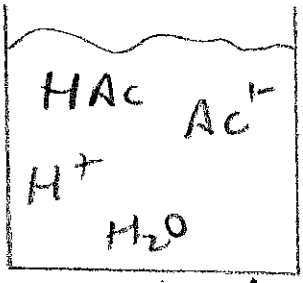
$$= \left[(50.0mL)\left(\frac{1L}{1000mL}\right)(0.100M\,HAc)\right] - \left[(2.50\times10^{-3}\,mol\,OH^{1-})\left(\frac{1\,mol\,HAc_r}{1\,mol\,OH^{1-}_r}\right)\right]$$

$$mol\,HAc_{left} = 2.50\times10^{-3}\,mol\,HAc_{Left}$$

Enough HAc to get rid of all NaOH

$$V = (25.0mL + 50.0mL)\left(\frac{1L}{1000mL}\right)$$

$$V = 0.075L$$



Weak Acid so Acid Buffer

$$[HAc]_{NI} = \frac{2.50\times10^{-3}\,mol\,HAc}{0.075L} = 0.0333M$$

$$mol\,Ac^{1-}_r = (2.50\times10^{-3}\,mol\,OH^{1-}_r)\left(\frac{1\,mol\,Ac^{1-}_r}{1\,mol\,OH^{1-}_r}\right)$$

$$[Ac^{1-}]_{NI} = \frac{2.50\times10^{-3}\,mol\,Ac^{1-}_r}{0.075L} = 0.0333M$$

H-H Equation since it is Buffer

$$pH = pK_{a\,HAc} + \log\frac{[Ac^{1-}]}{[HAc]} = -\log(1.8\times10^{-5}M) + \log\left(\frac{0.0333M}{0.0333M}\right)$$

$\log(1) = 0$

$$pH = -(-4.744)$$

$$\boxed{pH = 4.74}$$

$[H^+] = 10^{-pH} = 10^{-4.74} = 1.82\times10^{-5}M$ 5% rule ✓

$\frac{1.82\times10^{-5}M}{0.0333M}\cdot 100\% < 5\%$

CALLED HALF-WAY POINT ($pH = pK_a$)