

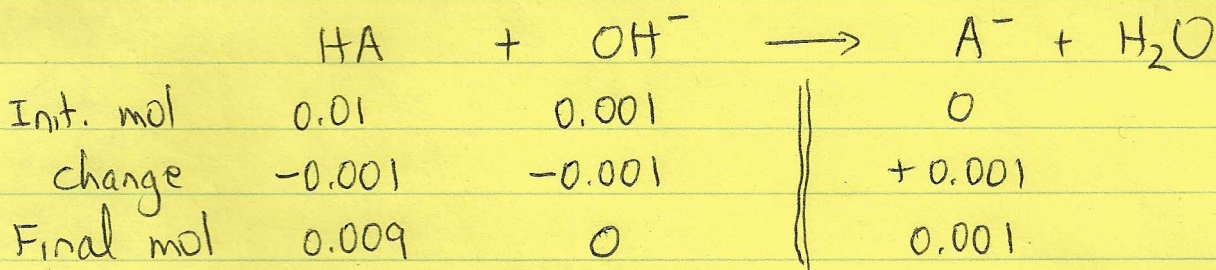
10-6. Given HA ( $pK_a = 5.00$ ), 100.0 mL + 0.100 M conc.  
 Titrant = 1.00 M KOH; Calc. pH at  $V_b = 1.00$ ,  
~~9.90~~, 10.00 and 10.10 mL

Work: First, calc.  $V_e \Rightarrow V_e = \frac{M_a V_a}{M_b} = \frac{(0.100 \text{ M})(100.0 \text{ mL})}{1.00 \text{ M}}$

$$V_e = 10.00 \text{ mL}$$

(a)  $V_b = 1.00 \text{ mL} \Rightarrow$  before the equiv. point; since HA is a weak acid, reaction with  $\text{OH}^-$  produces  $\text{A}^- \Rightarrow$  buffer region

Initial mol HA = 0.0100; mol  $\text{OH}^- = 0.00100$

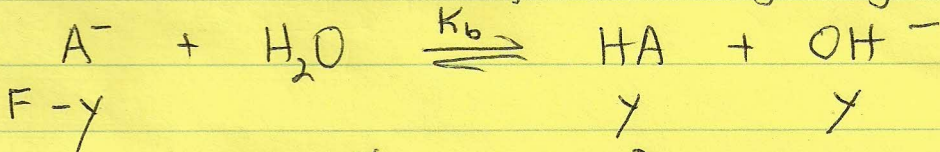


$$\text{pH} = \text{p}K_a + \log\left(\frac{\text{mol A}^-}{\text{mol HA}}\right) = 5.00 + \log\left(\frac{0.001}{0.009}\right)$$

$$\text{pH} = 4.05$$

(b)  $V_b = 10.00 \text{ mL} = V_e$ ; Only  $\text{A}^-$  in water at the eq. pt.  
 mol  $\text{A}^-$  formed = mol HA initially present = 0.0100  
 $F_{\text{A}^-} = \frac{0.0100 \text{ mol}}{0.110 \text{ L}} = 9.09 \times 10^{-2} \text{ M}$   
 100 mL + 10.00 mL

Since  $\text{A}^-$  is a weak base, it will hydrolyze:



$$K_b = \frac{K_w}{K_a} = \frac{1 \times 10^{-14}}{1 \times 10^{-5}} = \frac{y^2}{(9.09 \times 10^{-2} - y)}$$

$$1.0 \times 10^{-9} = \frac{y^2}{9.09 \times 10^{-2} - y} \quad \text{Assume } y \ll 9.09 \times 10^{-2}$$

$$y^2 = 9.09 \times 10^{-11} \Rightarrow y = [\text{OH}^-] = 9.53 \times 10^{-6}$$

$$\text{pOH} = 5.02; \quad \text{pH} = 8.98$$

pH > 7 at the equiv. pt. because  $\text{A}^-$  is a weak base