

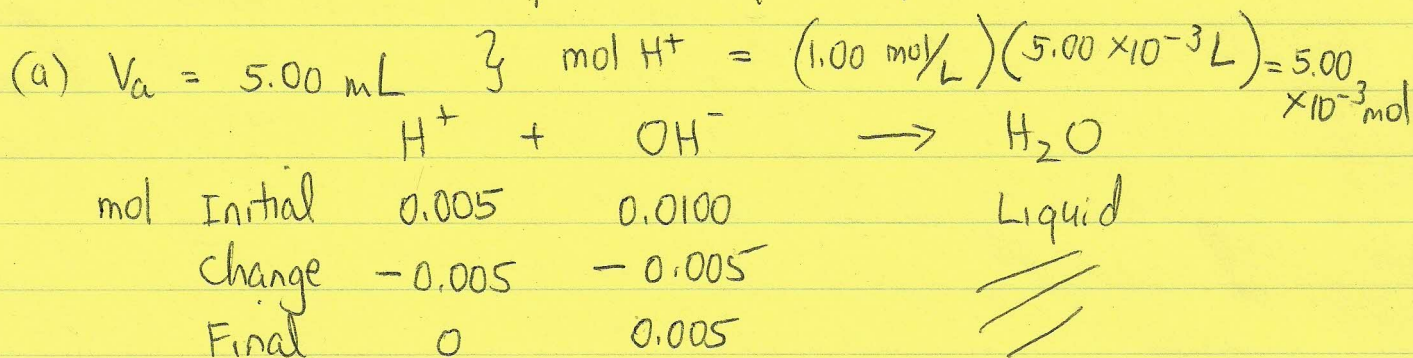
10-2. Given 100.0 mL of 0.100 M NaOH titrated with 1.00 M HBr. \Rightarrow strong acid - strong base titration
 Calc. pH at $V_a = 5.00, 9.90$ and 12.0 mL

Work:

Calc. V_e first

$$V_e = \frac{M_b V_b}{M_a} = \frac{(0.100 \text{ M})(100.0 \text{ mL})}{1.00 \text{ M}} = 10.0 \text{ mL}$$

Thus, $V_a = 5.00$ and $9.90 \text{ mL} < V_e$
 before the equiv. pt.



$$\begin{aligned} \sum[\text{OH}^-]_{\text{unreacted}} &= \frac{0.005 \text{ mol}}{(0.105 \text{ L})} \leftarrow \begin{array}{l} 100 \text{ mL} \\ \text{OH}^- \end{array} + \begin{array}{l} 5 \text{ mL} \\ \text{H}^+ \end{array} \\ &= 0.04762 \text{ M} \end{aligned}$$

pOH = 1.32 pH = 12.68

(b) $V_a = 9.90 \text{ mL} \Rightarrow \text{mol H}^+ = 9.90 \times 10^{-3}$

mol unreacted $\text{OH}^- = 0.01 - 9.90 \times 10^{-3} = 1 \times 10^{-4}$

$$\sum[\text{OH}^-] = \frac{1 \times 10^{-4} \text{ mol}}{0.1099 \text{ L}} = 9.099 \times 10^{-4} \text{ M}$$

pOH = 3.04 ; pH = 10.96

(c) $V_a = 12.0 \text{ mL} \Rightarrow$ beyond the equiv. pt., so excess mol H^+ determines pH ; mol H^+ added = 1.2×10^{-2}

mol H^+ in excess = $1.2 \times 10^{-2} - 0.010 = 2 \times 10^{-3}$

$$\sum[\text{H}^+]_{\text{in excess}} = \frac{2 \times 10^{-3} \text{ mol}}{0.112 \text{ L}} = 0.01786 \Rightarrow \text{pH} = 1.75$$