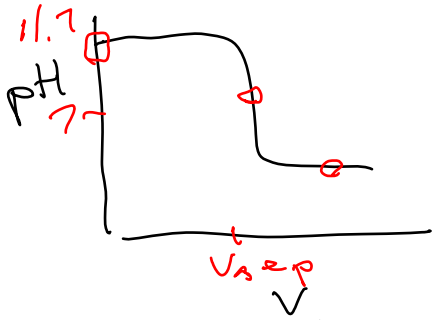
ch 17.3 acid-base titration II (cont.)

strong acid + strong base titration

Case 2 strong acid

strong base

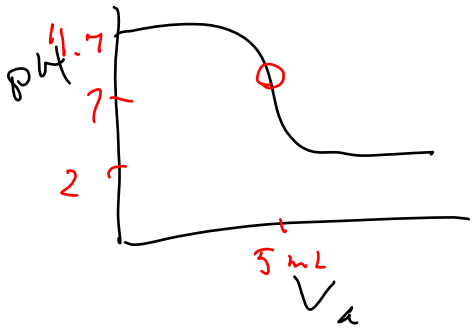


Problems ① sketch titration curve

$[HNO_2] = 10\ mM$

$[KOH] = 5\ mM$

$10\ mL$



i) @ $V_a = V_{a,eq}$

$[HNO_2]\ V_{HNO_2} = [KOH]\ V_{KOH}$

$10\ mM\ V_{HNO_2} = 5\ mM\ (10\ mL)$

$V_{HNO_2} = \dfrac{5\ mM\ (10\ mL)}{10\ mM} = 5\ mL$

ii) @ $V_a = 0$

$[OH^-] = [KOH] = 5 \cdot 10^{-3}\ M$

$pOH = -\log [OH^-] = -\log (5 \cdot 10^{-3})$

$= 2.30$

$pH + pOH = 14$

$pH + 2.3 = 14 \rightarrow pH = 11.7$

iii) @ $V_a =$

$[H^+] = [HNO_3] = 10\ mM = 10^{-2}\ M$

$pH = -\log[H^+] = -\log(10^{-2}) = 2.0$

② Find pH @ $V_a = 3\ mL$

i) $n_{HNO_3} = [HNO_3]\, V_{HNO_3}$

$= 10\ \frac{mmol}{L} \cdot 3\ mL \cdot \frac{L}{10^3\ mL} = 0.03\ mmol$

$n_{KOH} = [KOH]\, V_{KOH} = 5\ \frac{mmol}{L} \cdot 10\ mL \cdot \frac{L}{10^3\ mL}$

$= 0.05\ mmol$

ii) $KOH + HNO_3 \rightarrow H_2O + KNO_3$

I	0.05 mmol	0.03 mmol			
C	− 0.03 mmol	− 0.03 mmol			
E	0.02 mmol	0			

iii) $[OH^-] = [KOH] = \frac{n_{KOH}}{V_{total}}$

$= \frac{0.02\ mmol}{13\ mL} \cdot \frac{1\ mol}{10^3\ mmol} \cdot \frac{10^3\ mL}{L}$

$= 0.0015\ M$

iv) $[H^+][OH^-] = 10^{-14}$

$[H^+] = \frac{10^{-14}}{[OH^-]} = \frac{10^{-14}}{0.0015} = 6.7 \cdot 10^{-12}\ M$

iv) $pH = -\log[H^+] = -\log(6.5 \cdot 10^{-12})$

$= 11.19$

③ Final pH of $V_f = 8\ mL$

i) $n_{HNO_3} = [HNO_3]\ V_{HNO_3}$

$= 10 \frac{mmol}{L} \cdot 8\ mL \cdot \frac{L}{10^3\ mL} = 0.08\ mmol$

ii) $HNO_3 + KOH \rightarrow H_2O + KNO_3$

	HNO_3	KOH	
n_1	0.08 mmol	0.05 mmol	
n_2	~0.05 mmol	~0.05 mmol	
n_3	0.03 mmol	0	

iii) $[H^+] = \frac{n_{HNO_3}}{V_{total}}$

$= \frac{0.03\ mmol}{18\ mL} \cdot \frac{10^3\ mL}{L} \cdot \frac{mol}{10^3\ mmol}$

$= 0.00167\ M$

iv) $pH = -\log[H^+] = -\log(0.00167)$

$= 2.78$