

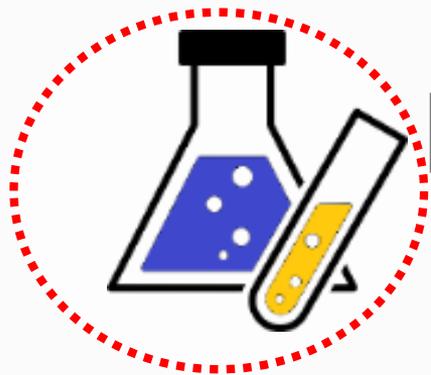
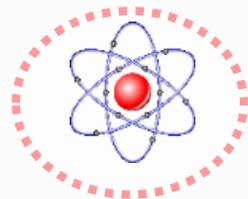


和平高中

HEPING HIGH SCHOOL

www.hpsh.tp.edu.tw

高中化學



[強酸滴定弱鹼的滴定曲線]

HPSH

強酸滴定弱鹼的滴定曲線

pH=11.10
開始

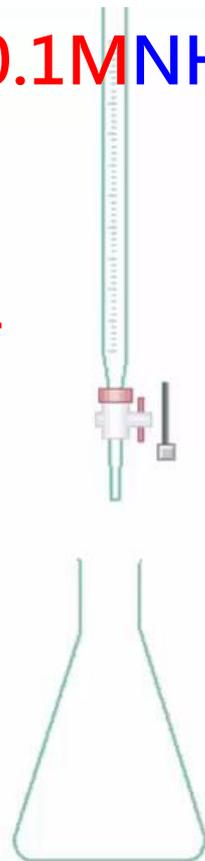
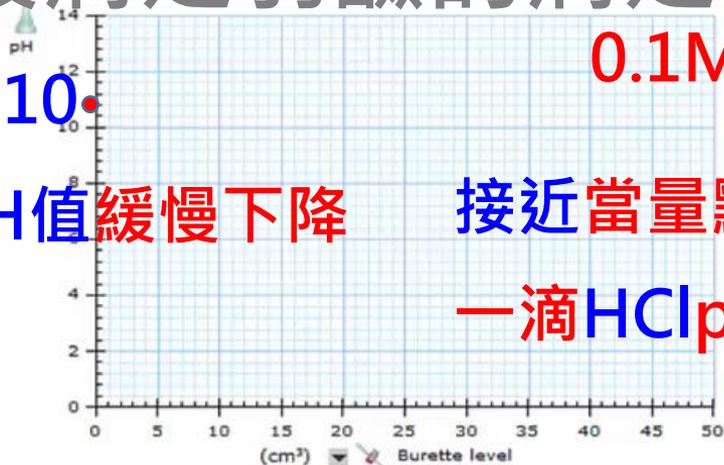
pH值緩慢下降

接近當量點

一滴HCl pH值減少4

25mL當量點

0.1M HCl 滴定 0.1M NH_3 25毫升



指示劑變色



當量點後的
pH及指示劑選擇

未滴定前的
pH

學習
重點

當量點的
pH

滴定前期的
pH

強酸滴定弱鹼的原理

- 化學計量中，利用限量試劑決定生成物的量。



滴定前

弱鹼解離

滴定前期

用完

弱鹼

弱鹼鹽

當量點

用完

用完

弱鹼鹽水解

滴定後期

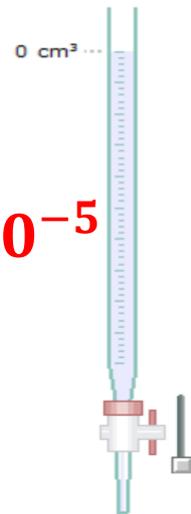
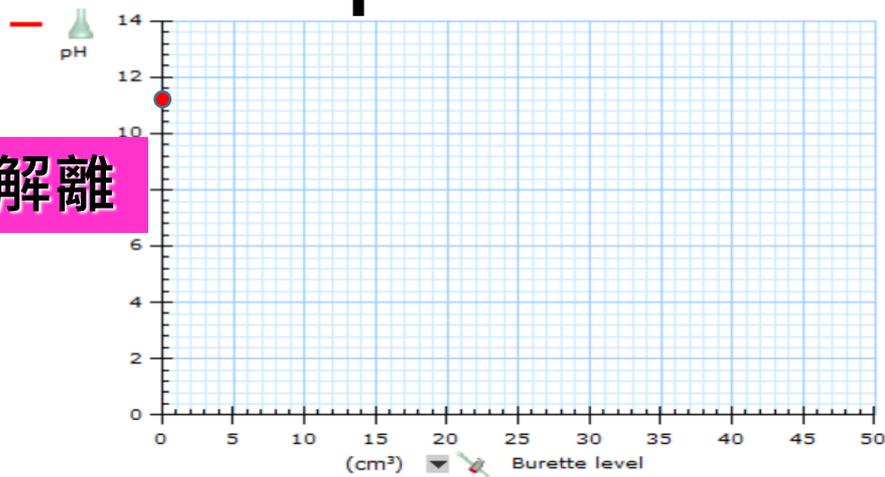
強酸

用完

弱鹼鹽

未滴定前的pH

0.1M弱鹼解離



$$\text{NH}_3 = \underline{25.00} \text{ mL} \quad \text{HCl} = \underline{0.00} \text{ mL} \circ$$

$$\text{NH}_3 = \underline{2.5} \text{ mmol} \quad \text{HCl} = \underline{0.00} \text{ mmol} \circ$$

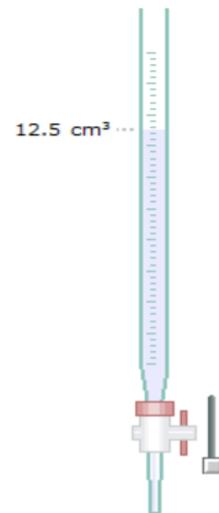
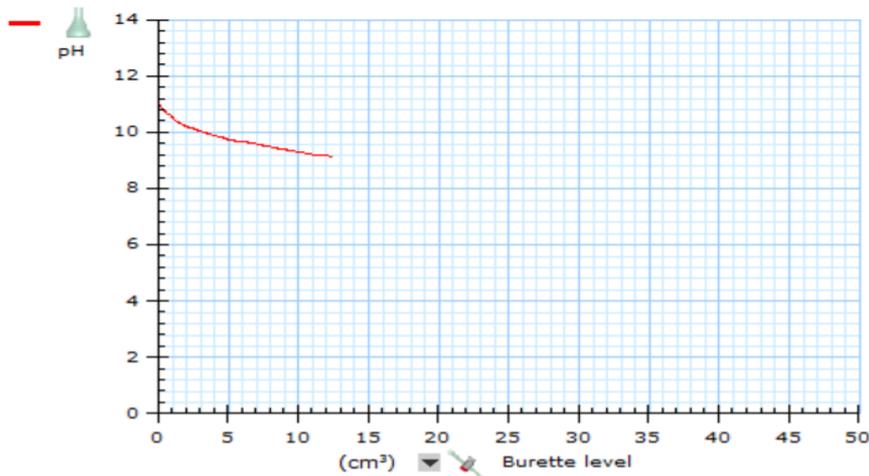
$$[\text{OH}^-] = \sqrt{K_b \times [\text{NH}_3]} = \sqrt{1.6 \times 10^{-5} \times 0.1} \text{ M} = \underline{0.00126} \text{ M}$$

$$\text{pOH} = \underline{2.90} \quad \text{pH} = \underline{11.10} \circ$$

$$\text{pOH} = -\log[\text{OH}^-] = -\log 0.00126$$



滴定前期的pH

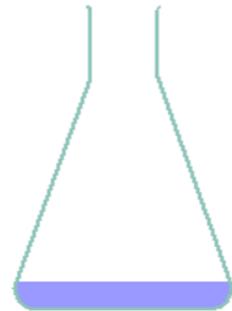


$\text{NH}_3 = \underline{25.00} \text{ mL}$ $\text{HCl} = \underline{12.50} \text{ mL}$ ◦

$\text{NH}_3 = \underline{2.5} \text{ mmol}$ $\text{HCl} = \underline{1.25} \text{ mmol}$ ◦

$[\text{OH}^-] = \underline{\hspace{2cm}}$ M

$\text{pOH} = \underline{\hspace{1cm}}$ $\text{pH} = \underline{\hspace{1cm}}$ ◦



滴定前期的pH

寫出酸鹼中和平衡方程式

算已知物莫耳數



同離子效應

原有

$$0.1\text{M} \times 12.5\text{mL} \\ = 1.25 \text{ mmol}$$

$$0.1\text{M} \times 25\text{mL} \\ = 2.5 \text{ mmol}$$

變化

$$-1.25 \text{ mmol}$$

$$-1.25 \text{ mmol}$$

$$+ 1.25 \text{ mmol}$$

後

$$0 \text{ mmol}$$

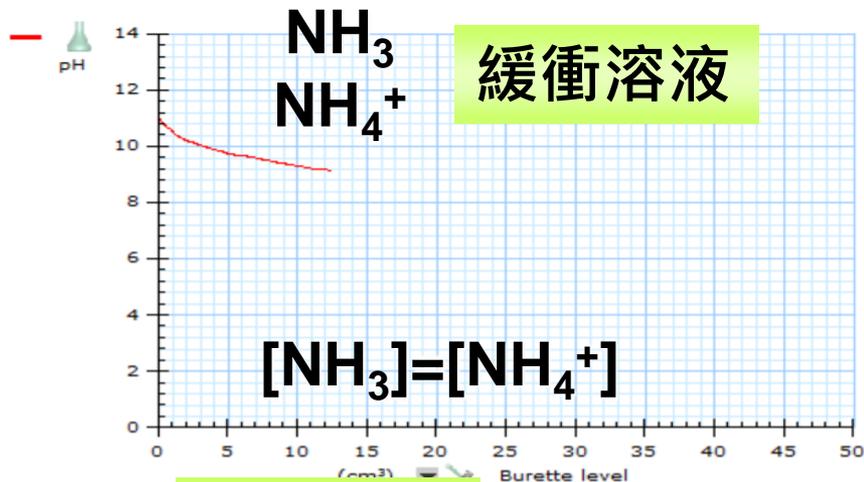
$$1.25 \text{ mmol}$$

$$1.25 \text{ mmol}$$

緩衝溶液

$$[\text{OH}^-] = K_b \times \frac{[\text{NH}_3]}{[\text{NH}_4^+]} \quad [\text{OH}^-] = 1.6 \times 10^{-5} \times \frac{1.25}{\frac{37.5}{1.25}} \quad [\text{OH}^-] = 1.6 \times 10^{-5}$$

滴定前期的pH



半當量點

$$[\text{OH}^-] = K_b$$

$$\text{NH}_3 = \underline{25.00} \text{ mL} \quad \text{HCl} = \underline{12.50} \text{ mL} \circ$$

$$\text{NH}_3 = \underline{2.5} \text{ mmol} \quad \text{HCl} = \underline{1.25} \text{ mmol} \circ$$

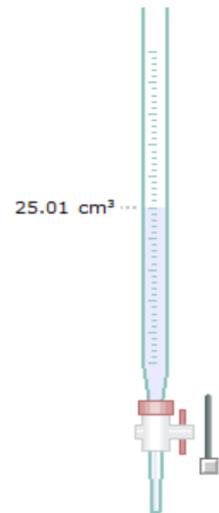
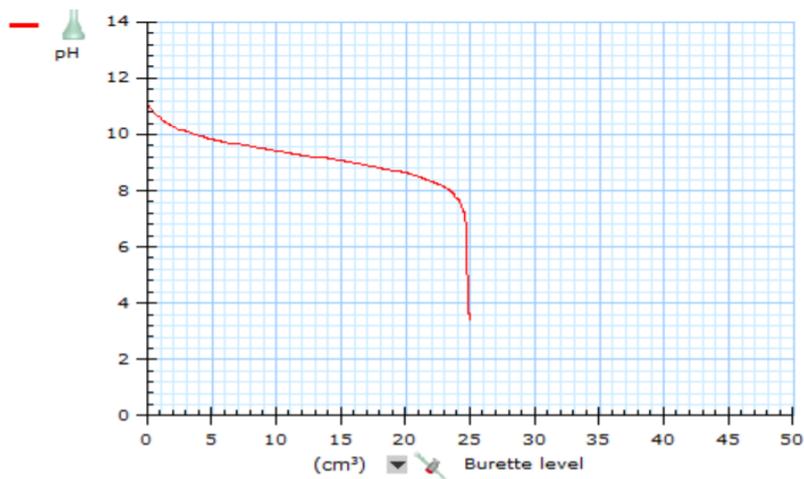
$$[\text{OH}^-] = \underline{1.6 \times 10^{-5}} \text{ M}$$

$$\text{pOH} = \underline{4.80} \quad \text{pH} = \underline{9.20} \circ$$

$$\text{pOH} = -\log[\text{OH}^-] = -\log 1.6 \times 10^{-5}$$



當量點的pH



$\text{NH}_3 = \underline{25.00} \text{ mL}$ $\text{HCl} = \underline{25.00} \text{ mL}$ ◦

$\text{NH}_3 = \underline{2.5} \text{ mmol}$ $\text{HCl} = \underline{2.5} \text{ mmol}$ ◦

$[\text{H}^+] = \underline{\hspace{2cm}}$ M

$\text{pH} = \underline{\hspace{1cm}}$ ◦



當量點的pH

寫出酸鹼中和平衡方程式



算已知物莫耳數



原有

$$0.1\text{M} \times 25\text{mL} \\ = 2.5 \text{ mmol}$$

$$0.1\text{M} \times 25\text{mL} \\ = 2.5 \text{ mmol}$$

鹽的水解

變化

$$-2.5 \text{ mmol}$$

$$-2.5 \text{ mmol}$$

$$+ 2.5 \text{ mmol}$$

後

$$0 \text{ mmol}$$

$$0 \text{ mmol}$$

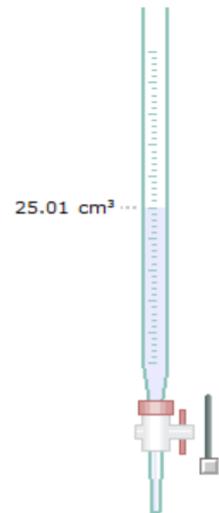
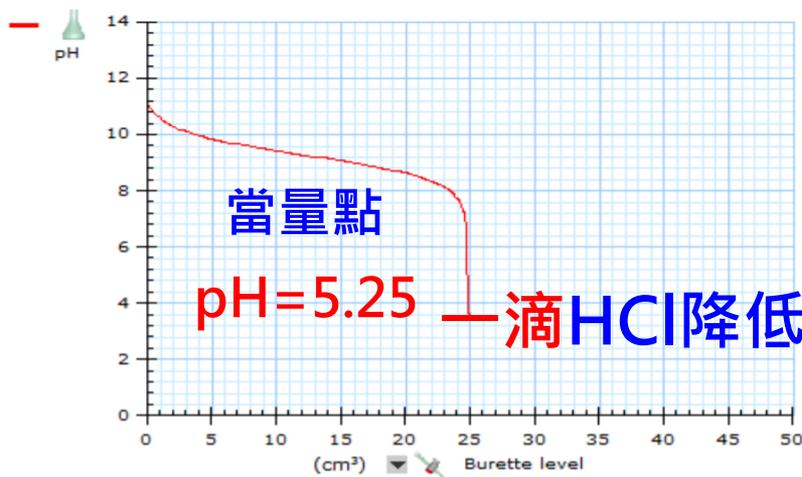
$$2.5 \text{ mmol}$$

$$\text{NH}_3 \text{ 的 } K_b = 1.6 \times 10^{-5}$$

$$\text{NH}_4^+ \text{ 的 } K_a = \frac{1 \times 10^{-14}}{1.6 \times 10^{-5}} = 6.3 \times 10^{-10}$$

$$[\text{H}^+] = \sqrt{K_a \times [\text{NH}_4^+]} \quad [\text{H}^+] = \sqrt{6.3 \times 10^{-10} \times \frac{2.5}{50}} \quad [\text{H}^+] = 5.6 \times 10^{-6}$$

當量點的pH



$$\text{NH}_3 = \underline{25.00} \text{ mL} \quad \text{HCl} = \underline{25.00} \text{ mL} \circ$$

$$\text{NH}_3 = \underline{2.5} \text{ mmol} \quad \text{HCl} = \underline{2.5} \text{ mmol} \circ$$

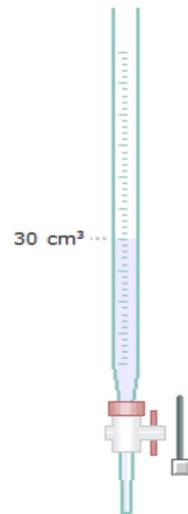
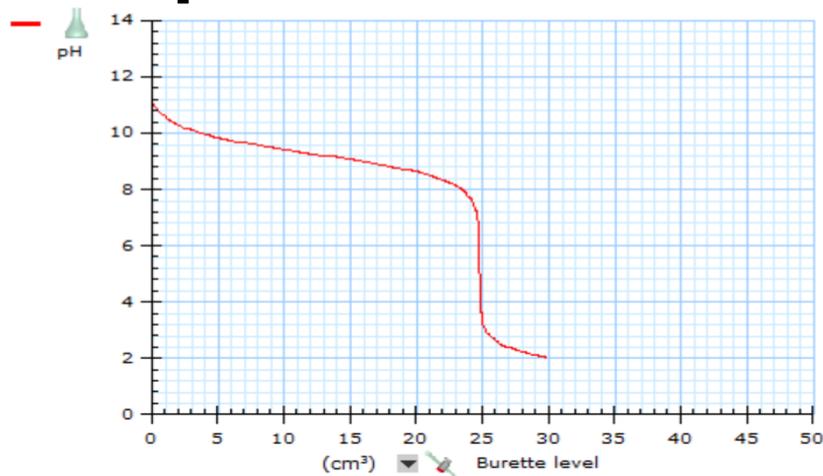
$$[\text{H}^+] = \underline{5.6 \times 10^{-6}} \text{ M}$$

$$\text{pH} = \underline{5.25} \circ$$

$$\text{pH} = -\log[\text{H}^+] = -\log 5.6 \times 10^{-6}$$



當量點後的pH



$\text{NH}_3 = \underline{25.00} \text{ mL}$ $\text{HCl} = \underline{30.00} \text{ mL}$ °

$\text{NH}_3 = \underline{2.5} \text{ mmol}$ $\text{HCl} = \underline{3.0} \text{ mmol}$ °

$[\text{H}^+] = \underline{\hspace{2cm}}$ M

$\text{pH} = \underline{\hspace{1cm}}$ °



當量點後的pH

寫出酸鹼中和平衡方程式

算已知物莫耳數



原有

$$0.1\text{M} \times 30.0\text{mL} \\ = 3.0 \text{ mmol}$$

$$0.1\text{M} \times 2 \\ = 2.5 \text{ mmol}$$

同離子效應

變化

$$-2.5 \text{ mmol}$$

$$-2.5 \text{ mmol}$$

$$+ 2.5 \text{ mmol}$$

後

$$0.5 \text{ mmol}$$

$$0 \text{ mmol}$$

$$2.5 \text{ mmol}$$

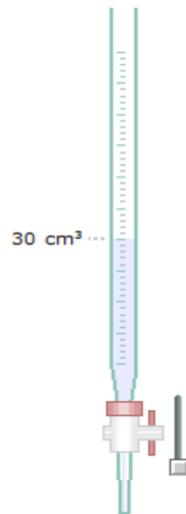
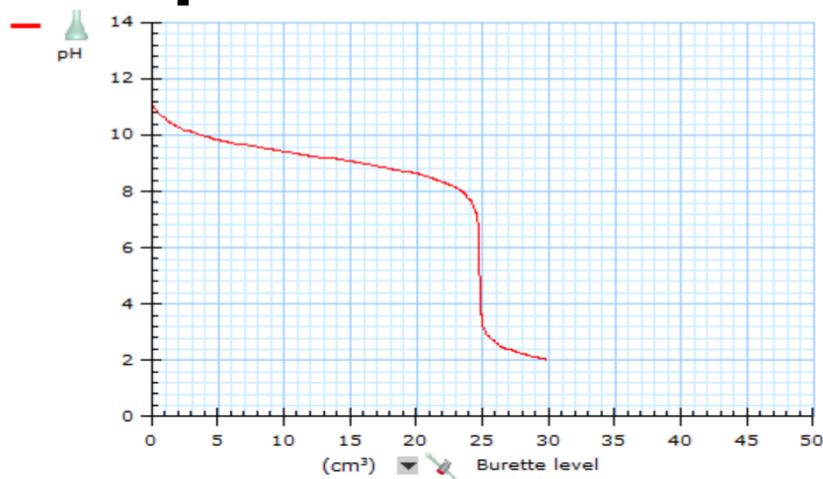
只要計算強酸解[H⁺]

$$[\text{H}^+] = [\text{HCl}]$$

$$[\text{H}^+] = \frac{0.5}{55}$$

$$[\text{H}^+] = 9.1 \times 10^{-3}$$

當量點後的pH



$$\text{NH}_3 = \underline{25.00} \text{ mL HCl} = \underline{30.00} \text{ mL} \circ$$

$$\text{NH}_3 = \underline{2.5} \text{ mmol HCl} = \underline{3.0} \text{ mmol} \circ$$

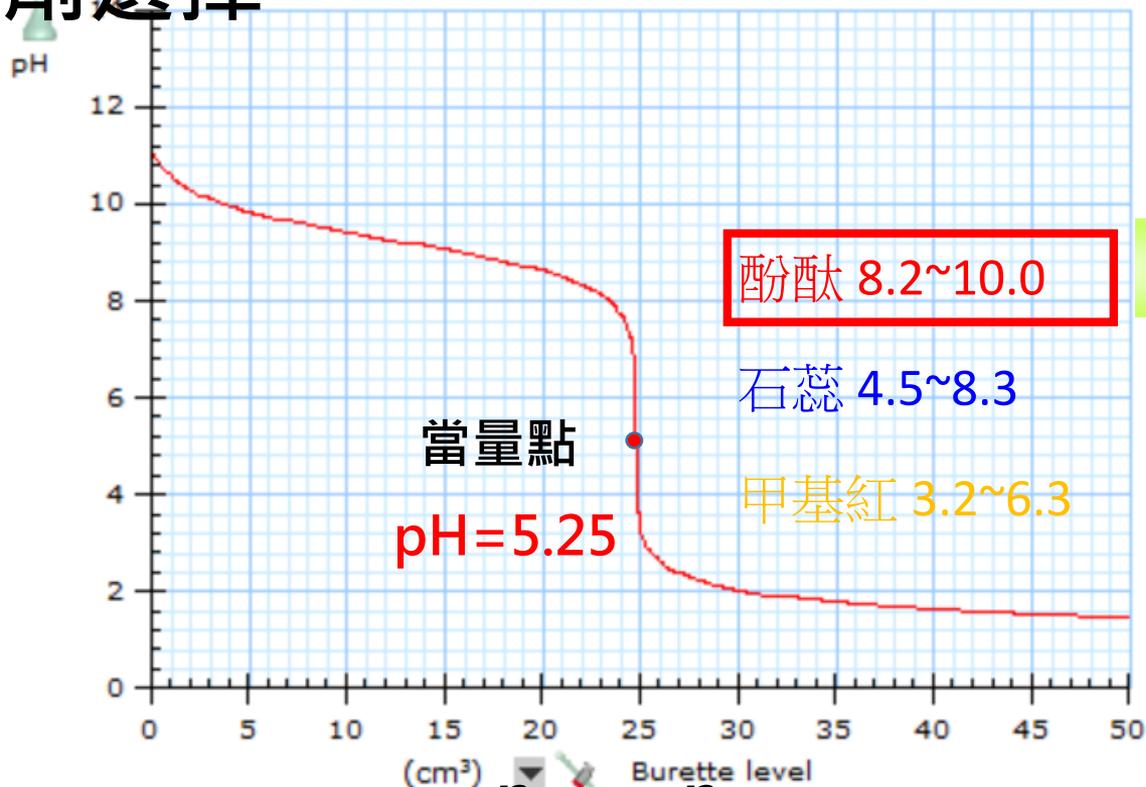
$$[\text{H}^+] = \underline{9.1 \times 10^{-3}} \text{ M}$$

$$\text{pH} = \underline{2.04} \circ$$

$$\text{pH} = -\log[\text{H}^+] = -\log 9.1 \times 10^{-3}$$



指示劑選擇



不可使用

$$n_{H^+} = n_{OH^-}$$

$$C_{M(\text{酸})} \times V_{(\text{酸})} \times a = C_{M(\text{鹼})} \times V_{(\text{鹼})} \times b$$

當量點後的 pH及指示劑選擇

- 強酸的解離
- pH=3到7變色均可

重點 回顧

未滴定前的 pH

- 弱鹼的解離
- $[\text{OH}^-] = \sqrt{K_b \times [\text{BOH}]}$

當量點的pH

- 鹽的水解
- 鹽的 $K_a = \frac{K_w}{K_b(\text{共軛鹼})}$
- $[\text{H}^+] = \sqrt{K_a \times [\text{B}^+]}$

滴定前期的 pH

- 同離子效應
- $[\text{OH}^-] = K_b \times \frac{[\text{BOH}]}{[\text{B}^+]}$