

Exp4: Second Order Reaction: Effect of Temperature on Rate

1. 繪圖 $k_0 - k_t / k_t - k_\infty$ 與 $t(\text{min})$ 。

k_0 : NaOH 導電度數據要記得除以 2

k_t : t 分測得導電度數據

k_∞ : NaOAc 導電度數據

2. 計算每個溫度的速率常數 k 。

由 $k = 1/at * (k_0 - k_t / k_t - k_\infty)$ 即 $y = kax$, slope = $m = ka$ 又 $a = 0.01M$

得 $k = ? (M^{-1} \text{min}^{-1})$

3. 繪製 $\ln k$ 對 $1/T$ 的曲線，並計算斜率的活化能 E_a 。

$\ln k$ 對 $1/T$ 作圖

$$\ln k_2/k_1 = - E_a/R * (1/T_2 - 1/T_1)$$

$$\text{slope} = - E_a/R \text{ 又 } R = 8.314 \text{ J/K} \cdot \text{mol}, E_a = ?$$

4. 根據每個溫度的觀察速率常數計算半衰期 $t_{1/2}$ 。

$$x/a(a-x) = kt \text{ -----(4)}$$

$x = 1/2 * a$ 代入

$$t_{1/2} = 1/ak$$

Exp 4

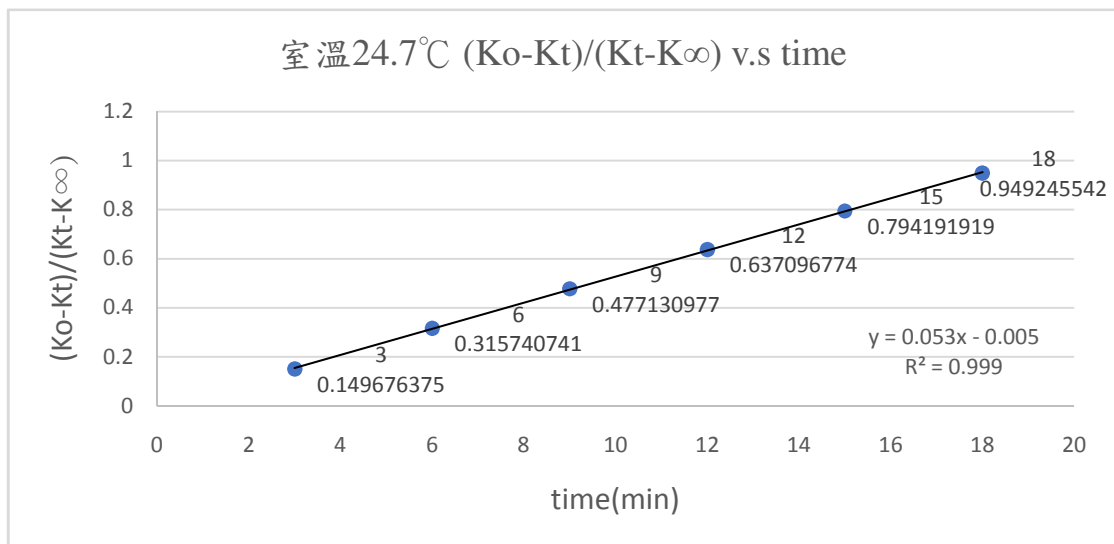
實驗數據

	T _{real} (°C)	(10 ⁻³ S cm ⁻¹)							
		k ₀	k _∞	3	6	9	12	15	18
T _{room}	24.7	4430	794	2030	1874	1756	1662	1586	1523
T ₃₅	35.1	5250	1005	2240	1999	1839	1727	1644	1580
T ₄₅	46	5840	1184	2330	2050	1890	1785	1711	1655

1. 以 T_{room}=24.7°C、3mins 為例

$$\frac{k_0 - k_t}{k_t - k_\infty} = \frac{4430 - 2030}{2030 - 794} = 0.1497$$

2. 以 T_{room}=24.7°C 為例



$$\text{由 } k = \frac{1}{at} \left(\frac{k_0 - k_t}{k_t - k_\infty} \right)$$

$y = (ka)x \rightarrow a$ 為乙酸乙脂濃度

$m(\text{斜率}) = ka$

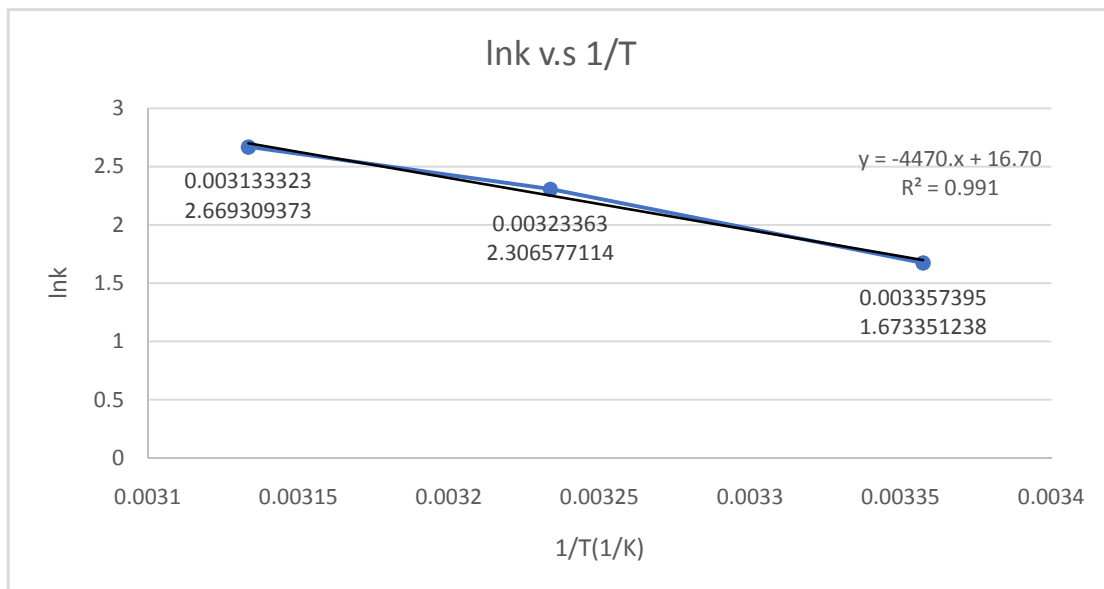
$$a = 0.01 \text{ M} \rightarrow k = \frac{m}{0.01}$$

由上圖可知 $m = 0.0533$

$$k = \frac{0.0533}{0.01} = 5.33 \text{ (M}^{-1}\text{min}^{-1}\text{)}$$

3. 計算

溫度(°C)	溫度(K)	1/T(1/K)	k(1/[M*min])	lnk
24.7	297.85	0.003357	5.33	1.673351
36.1	309.25	0.003234	10.04	2.306577
46	319.15	0.003133	14.43	2.669309



$$y = -4470.6 x + 16.708$$

$$\ln k = -4470.6 x + 16.708$$

$$\ln \frac{k_2}{k_1} = -\frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

$$-\frac{E_a}{R} = -4470.6$$

$$E_a = 4470.6 \times 8.314 = 37.17 \text{ kJ/mol}$$

$$4. \frac{dx}{dt} = k(a-x)(b-x) \rightarrow \frac{1}{a(x-a)} = kt$$

$$t_{1/2} = \frac{1}{k(a-x)} = \frac{x}{k_a(a-x)} = \frac{1}{k_a}$$

$$a = 0.01\text{M}$$

$$T = 24.7 \text{ }^\circ\text{C}, k = 5.33, t_{1/2} = \frac{1}{5.33 \times 0.01} = 18.76 \text{ min}$$