Experiment 4: Determination of Reaction Rate, Order and Molecularity of Hydrolysis of Ethyl Acetate

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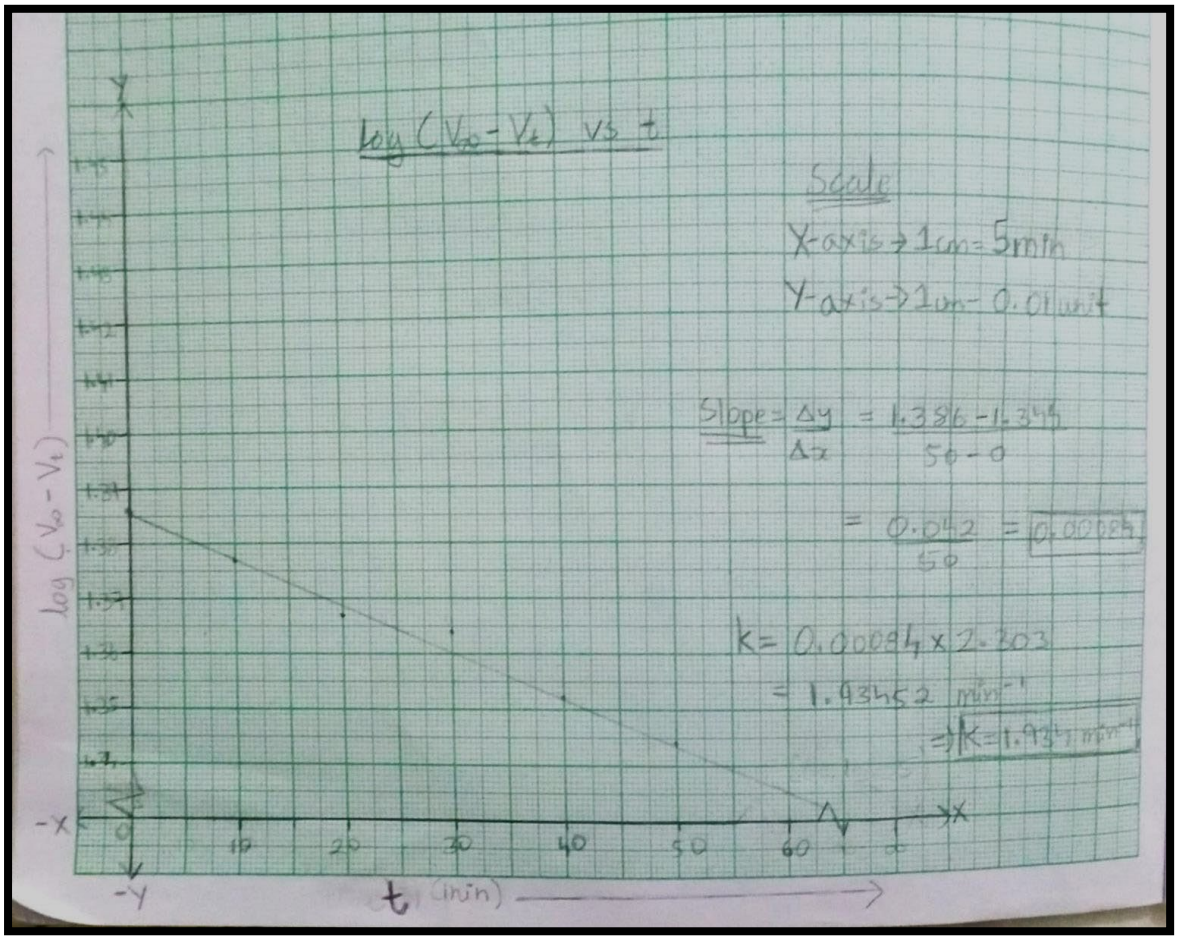
Observation Table:

S. No.	Time (t) (min)	Volume of 0.2N NaOH (mL)	$(V_\infty - V_t)$ (mL)	$log(V_\infty - V_t)$	$k = \frac{2.303}{t} log \frac{(V_\infty - V_0)}{(V_\infty - V_t)}$ (min^{-1})
1.	0	27.3	24.3	1.386	–
2.	10	27.8	23.8	1.377	0.00208
3.	20	28.3	23.3	1.367	0.00210
4.	30	28.5	23.1	1.364	0.00169
5.	40	29.1	22.5	1.352	0.00192
6.	50	29.5	22.1	1.344	0.00189
7.	60	–	–	–	–
8.	∞	51.6	0	–	–

Graph: $log(V_\infty - V_t)$ vs t



Calculations for the Observation Table:

(i) 0 min

$V_\infty - V_t = 51.6\,mL - 27.3\,mL = \boxed{24.3\,mL}$

$\log(V_\infty - V_t) = \log(24.3) = 1.385606274\,mL = \boxed{1.386\,mL}$

$k \Rightarrow$ not defined

(ii) 10 min:

$V_\infty - V_t = 51.6\,mL - 27.8\,mL = \boxed{23.8\,mL}$

$\log(V_\infty - V_t) = \log(23.8) = 1.376576957\,mL = \boxed{1.377\,mL}$

$k = \frac{2.303}{t} \log\frac{(V_\infty - V_0)}{(V_\infty - V_t)} = \frac{2.303}{10} \log\left(\frac{24.3}{23.8}\right)$

$\Rightarrow k = 0.002079454516\ min^{-1} = \boxed{0.00208\ min^{-1}}$

(iii) 20 min:

$V_\infty - V_t = 51.6\,mL - 28.3\,mL = \boxed{23.3\,mL}$

$\log(V_\infty - V_t) = 1.367355921\,mL = \boxed{1.367\,mL}$

$k = \frac{2.303}{20} \times \log\left(\frac{24.3}{23.3}\right)$

$\Rightarrow k = 0.002101528099\ min^{-1} = \boxed{0.00210\ min^{-1}}$

(iv) 30 min:

$V_\infty - V_t = 51.6\,mL - 28.5\,mL = \boxed{23.1\,mL}$

$\log(V_\infty - V_t) = \log(23.1) = 1.36361198\,mL = \boxed{1.364\,mL}$

$k = \frac{2.303}{30} \log\left(\frac{24.3}{23.1}\right)$

$\Rightarrow k = 0.00168842861\,min^{-1} = \boxed{0.00169\,min^{-1}}$

(v) 40 min:

$V_\infty - V_t = 51.6\,mL - 29.1\,mL = \boxed{22.5\,mL}$

$\log(V_\infty - V_t) = \log(22.5) = 1.352182518\,mL = \boxed{1.352\,mL}$

$k = \frac{2.303}{40} \log\left(\frac{24.3}{22.5}\right)$

$\Rightarrow k = 0.00192437272\,min^{-1} = \boxed{0.00192\,min^{-1}}$

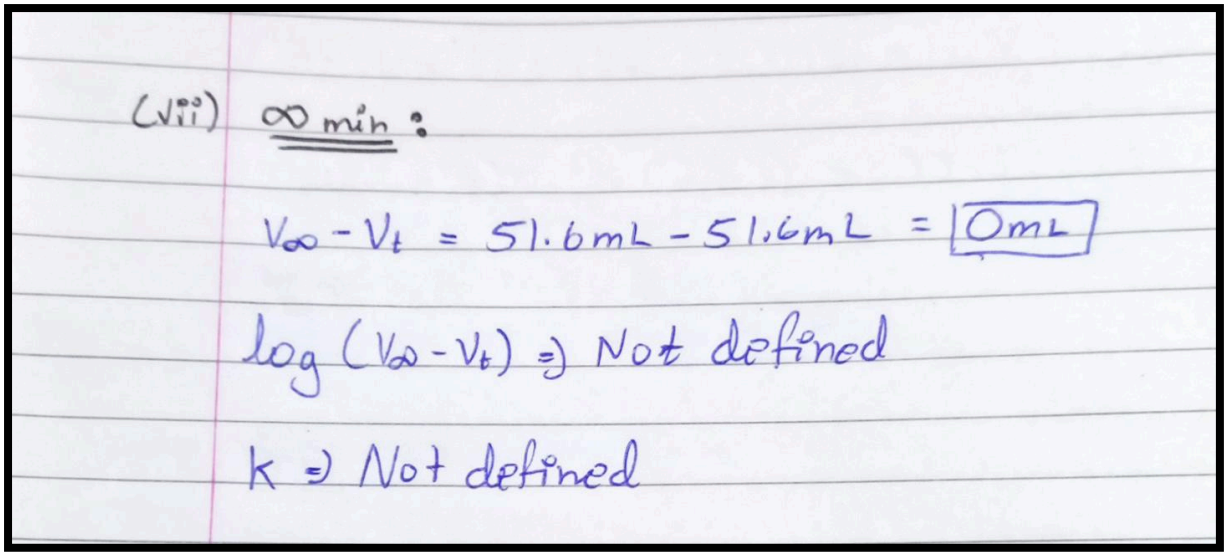
(vi) 60 min:

$V_\infty - V_t = 51.6\,mL - 29.5\,mL = \boxed{22.1\,mL}$

$\log(V_\infty - V_t) = \log(22.1) = 1.34439227\,mL = \boxed{1344\,mL}$

$k = \frac{2.303}{50} \log\left(\frac{24.3}{22.1}\right)$

$\Rightarrow k = 0.00189831686\,min^{-1} = \boxed{0.001898\,min^{-1}}$



Result:

The Rate Constant for the hydrolysis of an ester from:

1. Calculated Value = $\mathbf{1.938 \times 10^{-3}}$ **min**$^{-1}$ $\approx \mathbf{1.9 \times 10^{-3}}$ **min**$^{-1}$
2. Graphical Value = $\mathbf{1.934 \times 10^{-3}}$ **min**$^{-1}$ $\approx \mathbf{1.9 \times 10^{-3}}$ **min**$^{-1}$

Molecularity of the reaction: **1**

Order of the reaction: **1**