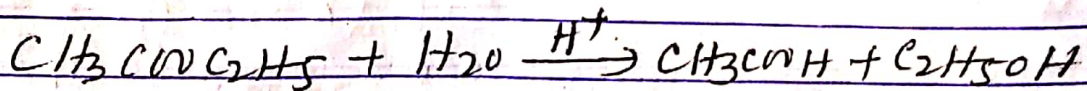


# B.Sc. II - PAPER - IIIA

## Kinetics of Hydrolysis of Ester:

The acid catalysed hydrolysis reaction of ethyl acetate is given below.



At  $t=0$                    $a$      $0$                    $0$

At  $t$                            $a-x$      $x$                    $x$

In the above reaction  $\text{CH}_3\text{COOH}$  is acetic acid and its amount can be determined by titrating the above mixture with alkali  $\text{NaOH}$ . The reaction is acid catalysed and hence amount of ~~acid~~ mineral acid is also determined with titration in titration.

Let us consider the following process during titration

(1)  $\left. \begin{array}{l} \text{Volume of NaOH solution} \\ \text{used in the beginning} \\ \text{i.e. at } t=0 \text{ is } V_0 \end{array} \right\} \alpha \left\{ \begin{array}{l} \text{Amount of} \\ \text{mineral acid} \\ \text{used at catalysis} \\ \text{as } \text{CH}_3\text{COOH} \text{ is} \\ \text{not for product} \\ \text{at } t=0 \end{array} \right.$

(ii) Volume of NaOH used at the time  $t$  is  $V_t$  }  $\propto$  { Amount of acid present + amount of  $\text{CH}_3\text{COOH}$  formed at time  $t$  is

Difference of (i) and (ii) give

(iii) —  $V_t - V_0 \propto$  amount of acetic acid formed at time  $t$ .

~~This volume will be equal to~~  
 This amount will be equal correspondingly to mole of ester decomposed. i.e.

(iv)  $V_t - V_0 \propto$  amount of  $\text{CH}_3\text{COOCH}_2\text{CH}_3$  decomposed i.e.  $x$

or  $V_t - V_0 \propto x$

At infinite time  $t \rightarrow \infty$ , the whole ~~of~~  $\text{CH}_3\text{COOCH}_2\text{CH}_3$  will decompose to  $\text{CH}_3\text{COOH}$  hence

(v) —  $V_\infty \propto$  amount of  $\text{CH}_3\text{COOH}$  corresponding to decomposition of whole amount of Ester and mineral acid present.

(VI)

Maximum amount of  $\text{CH}_3\text{COOH}$  formed during reaction

$$\propto V_{\infty} - V_0$$

and this amount of  $\text{CH}_3\text{COOH}$  will correspond to the amount of Ester taken at  $t=0$  i.e.  $a$ .

(VII)

hence

$$V_{\infty} - V_0 \propto a$$

Difference of (VII) and (IV) we get

(VIII)

$$V_{\infty} - V_0 - V_t + V_0 \propto a - x$$

$$\text{or } (V_{\infty} - V_t) \propto (a - x)$$

putting the value of  $(a-x)$  and

$a$  correspond to  $V_{\infty} - V_t$  and  $V_{\infty} - V_0$  in first order kinetics integral equation 'rate constant  $k$  is calculated'

$$k = \frac{2.303}{t} \log \frac{a}{a-x}$$

$$\text{or } k = \frac{2.303}{t} \log \frac{V_{\infty} - V_0}{V_{\infty} - V_t}$$