B.SC. II – PAPER – III A

Kinetics of Hydrolysis of Ester:→

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

$$CH_3COOC_2H_5 + H_2O \xrightarrow{H^+} CH_3COOH + C_2H_5OH$$

At $t=0$ a 0 0

At t $a-x$ x x.

In the above reaction CH_3COOH is acetic acid and its amount can be determined by titrating the above mixture with alkali NaOH. The reaction is acid catalysed and hence amount of ~~acid~~ mineral acid is also determined with ~~titrati~~ in titration.

Let us consider the following process during titration

(I) – Volume of NaOH solution used in the beginning i.e at t_0 is V_0 } $\propto$ { Amount of mineral acid used at catalyst as CH_3COOH is not ~~for~~ produce at $t =$ zero

(ii) Volume of NaOH used at the time t is V_t } $\propto$ { Amount of acid present + amount of CH_3COOH 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 corresponds to mole of ester decomposed. i.e.

(iv) $V_t - V_0 \propto$ amount of $CH_3COOC_2H_5$ decomposed i.e x

or $V_t - V_0 \propto x$.

At infinite time t_∞, the whole $CH_3COOC_2H_5$ will decompose to CH_3COOH hence

(V) — $V_\infty \propto$ { amount of CH_3COOH corresponding to decomposition of whole amount of Ester and mininermal acid present.

(vi) – Maximum amount of CH_3COOH formed during reaction } $\propto V_\infty - V_0$

and this amount of CH_3COOH 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) – $V_\infty - V_0 - V_t + V_0 \propto a - x$

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

putting the value of $(a-x)$ and a corresponding to $V_\infty - V_t$ and $V_\infty - V_0$ in first order kinetics integral equation rate constant K is calculated

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

or

$$K = \frac{2.303}{t} \log \frac{V_\infty - V_0}{V_\infty - V_t}$$