B.Sc. II Paper - III A.

Kinetics of inversion of cane sugar :—

Experimental determination of rate constant for inversion of cane sugar :—

Hydrolysis of sucrose in presence of mineral acid is given by chemical reaction.

$$C_{12}H_{12}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$

This reaction is also called inversion of sugar. Here the compound sucrose, glucose and fructose are optically acid compound. Sucrose is dexorotatory, glucose is also dextrorotatory while fructose is Laevo-rotatory. The fructose is more (-92^0) rotatory than dextrorotatory of glucose ($+52.5^0$) and equimolecular mixture of glucose and fructose is Laevo-rotatory.

Thus on hydrolysis, the dextro-rotatory sucrose gradually changes into Laevo-rotatory. It is the reason that the reaction is called inversion of sucrose.

The reaction is studied by the rotation at different temperature interval of time with help of polarimeter.

[P.T.O]

Let reading of polarimeter at $t=0$ time $= r_0$

reading of polarimeter at time $t = r_t$

reading of polarimeter at $t\infty = r_\infty$

Here infinity time can be taken as one day or two day. so that sucrose is fully converted into glucose and fructose.

i.e.

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$

$t=0$	a	0	0
$t=t$	$(a-x)$	x	x
		Dextro rotating	Laevo rotatory

Angle of rotation at time $t = r_0 - r_t$

This is proportional to x

$$\therefore x \propto (r_0 - r_t) \quad \text{---(1)}$$

Angle of rotation at time $t_\infty = r_0 - r_\infty$

This is proportional to concentration 'a' as at infinity whole sucrose is converted into glucose and fructose.

i.e $a \propto (r_0 - r_\infty)$ ---(11)

on from equation (1) and (11)

$$\therefore (a-x) \propto (r_0 - r_\infty) - (r_0 - r_t)$$

$\Rightarrow (a-x) \propto (r_t - r_\infty)$

The value of a or $a-x$ is substituted in integral equation of first order and k is calculated. k is found constant at different interval of time. Hence inversion of cane sugar is first order reaction.

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

or $$\boxed{k = \frac{2.303}{t} \log \frac{r_0 - r_\infty}{r_t - r_\infty}}$$

This is equation for kinetics of inversion of sugar.