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Dept. of Chemistry

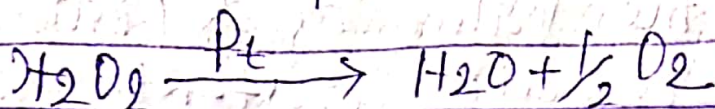
Garhware College, Orissa

Doc - I (H) - Chemical - Kinetics

Topics - Kinetics of decomposition of H_2O_2 & Inversion of Cane-Sugar.

Decomposition of H_2O_2 :-

Decomposition of H_2O_2 in aqueous solution takes place as



The Kinetics of above reaction is studied by titrating against $KMnO_4$ solution. Equal amounts of H_2O_2 solution are titrated against the same $KMnO_4$ solution at regular interval of time

Experimental Observation

Volume of $KMnO_4$ solution used before the start of reaction (at zero time) is V_0 . $V_0 \propto$ Initial concentration of $H_2O_2(a)$ — (1)

again Volume of $KMnO_4$ solution used at any instant of time (t), $V_t \propto$ Amount of H_2O_2 present at that time is $(a-x)$ — (2)

Putting the above value in first order rate-constant expression

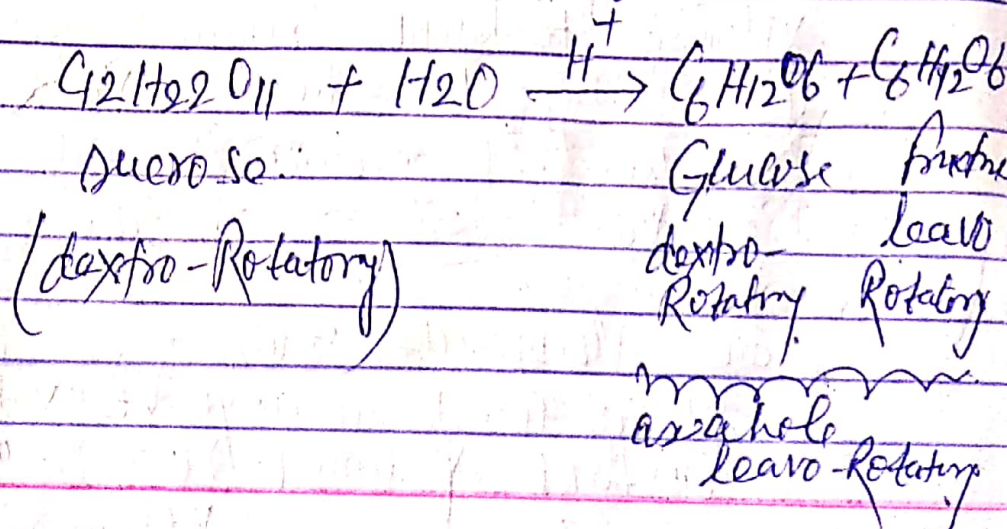
$$K = \frac{2.303}{t} \log \frac{a}{a-x}$$

$$\text{or } K = \frac{2.303}{t} \log \frac{V_0}{V_t}$$

By applying the above expression the value of K (rate-constant) remain constant which shows that it follows first order Kinetics.

Inversion of Cane-Sugar:-

The hydrolysis of Cane-Sugar (Sucrose) in presence of mineral-acid takes place is expressed by following reaction



Leavo-Rotation of fructose (-92°) is more negative than the dextro-rotation of glucose ($+52.5^\circ$). Thus the mixture as a whole is leavo-rotatory. Thus upon hydrolysis the dextro-rotatory sucrose gradually changes into the leavo-rotatory mixture called Inversion of Sucrose.

Experimental - Observation

Kinetics measurement can be studied on the basis of observing the angle of rotation at different intervals of time with the help of polarimeter.

Reading of Polarimeter

- (I) At zero-time $= \alpha_0$
- (II) At any instant of time t $= \alpha_t$
- (III) At infinite time $= \alpha_\infty$

It was observed that the reading at zero-time will be positive & it regularly decreases with passage of time & finally it becomes negative.

Calculation

Angle of rotation at any instant of time $(\alpha_0 - \alpha_t)$ $\propto$ the amount of surface hydroxyl amount (N) .

$$\text{or, } (\alpha_0 - \alpha_t) \propto N \quad \text{--- (I)}$$

Angle of Rotation at infinite time $(\alpha_0 - \alpha_\infty)$ $\propto$ the initial concentration of surface (a)

$$(\alpha_0 - \alpha_\infty) \propto a \quad \text{--- (II)}$$

From (I) & (II), we get

$$(a - N) \propto (\alpha_0 - \alpha_\infty) - (\alpha_0 - \alpha_t) \\ \propto (\alpha_t - \alpha_\infty)$$

Putting the value of a & $(a - N)$ in first order rate expression we get

$$K = \frac{2.303}{t} \log \frac{a}{(a - N)}$$

$$= \frac{2.303}{t} \log \frac{(\alpha_0 - \alpha_\infty)}{(\alpha_t - \alpha_\infty)}$$

$$K = \frac{2.303}{t} \log \frac{\alpha_0 - \alpha_\infty}{\alpha_t - \alpha_\infty}$$

→ X