Reaction First Order

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Decomposition of Hydrogen peroxide

The catalytic decomposition of **hydrogen peroxide** is based on a **reaction first order**. Thus the decrease in the concentration of hydrogen peroxide **$[H_2O_2]$** can be described as follows:

$$v = -\frac{d[H_2O_2]}{dt} = k \cdot [H_2O_2] \qquad (1)$$

Rearrangement yields the following:

$$-\frac{d[H_2O_2]}{[H_2O_2]} = k \cdot dt \qquad (2)$$

Equation **(2)** represents the differential form of the rate law. Integration of this equation and determination of the integration constant **C** produces the corresponding integrated law.

Substituting **$c = [H_2O_2]$** into equation **(2)** yields:

$$-\frac{dc}{c} = k \cdot dt \qquad (3)$$

Integrating equation **(3)** leads to::

$$\ln c = -k \cdot t + C \qquad (4)$$

The constant of integration **C** can be evaluated by using boundary conditions. At the beginning of the reaction (**$t = 0$**) the concentration of. benzoylchloride **$c = c_0$** . **c_0** is the initial concentration of hydrogen peroxide.

Substituting into equation **(4)** gives

$$\ln c_0 = -k \cdot (0) + C$$

Therefore:

$$\mathbf{C = \ln c_0} \qquad (5)$$

On that condition

$$-\ln\frac{c}{c_0} = k \cdot t \qquad (6)$$

In the present case the reaction is followed by measuring the volume of oxygen being produced

The volume of oxygen at the end of the reaction $\mathbf{V_\infty}$ is proportional to the initial concentration of hydrogen peroxide:

$$\mathbf{c_0 = V_\infty}$$

Accordingly is obtained:

$$\mathbf{c = V_\infty - V}$$

Thus equation **(6)** becomes:

$$-\ln\frac{V_\infty - V}{V_\infty} = k \cdot t \qquad (7)$$