

Answer on Question #57283 – Chemistry – Inorganic Chemistry

Question

The decomposition of NO_2 is a 1st order reaction. At room temperature it takes 32mins for 0.05M NO_2 to decrease to 0.025M. How long will it take 0.025M NO_2 to decrease to 0.0125M?

Solution

Speed of reaction of the first order is described by the equation

$$w = -\frac{dC_A}{dt} = k_1 \cdot C_A \quad (1)$$

We will divide variables in the equation (1)

$$-\frac{dC_A}{C_A} = k_1 dt$$

we will integrate the last equation

$$\int_{C_0}^C \left(-\frac{dC_A}{C_A}\right) = \int_{C_0}^C -d \ln C_A = \int_{t=0}^t k_1 dt,$$

where C_0 is initial concentration of substance A in an initial timepoint of $t = 0$,

The resultant equation has an appearance:

$$\ln C = \ln C_0 - k_1 t, \quad (2)$$

or

$$\ln\left(\frac{C_0}{C}\right) = k_1 t$$

From here, $C = C_0 \cdot e^{-k_1 t}$,

Semi-transformation time for reaction of the first order doesn't depend on initial concentration of substance

$$t_{1/2} = \frac{1}{k_1} \ln \frac{C_0}{0.5 \cdot C_0} = \frac{\ln 2}{k_1}$$

0,025M is a half from 0,05M. and 0,0125M is a half from 0,025M

Answer: 32mins