Lecture 4.5. Applications of Integrated Rate Equations

Note Title 1/5/2012

$\ln[X]_t = -kt + \ln[X]_0$ $\quad t_{1/2} = \frac{\ln(2)}{k}$

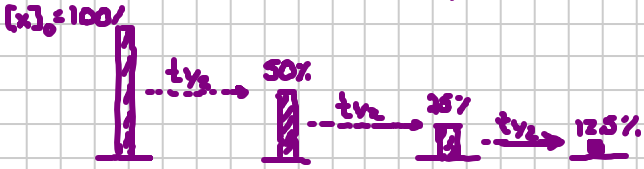
Example. The half life ($t_{1/2}$) of a particular first order reaction is 4881 seconds.

a) Determine a value for the reaction rate constant

$t_{1/2} = \frac{\ln(2)}{k} \ldots k = \frac{\ln(2)}{t_{1/2}} = \frac{0.6931}{4881\,s} = 1.42009\times10^{-4}\,s^{-1}$ $\quad (s^{-1})$

$= 1.420\times10^{-4}\,s^{-1}$

b) What percent of the original reactant is left after 14643 seconds (i.e. three half lives)



12.5% remains
100 − 12.5% = 87.5% used up.

c) How much time is required for 75% of the original reactant to be used up?

75% used up... 25% remains

$\ln[X]_t = -k\cdot t + \ln[X]_0$

$t = \frac{\ln[X]_0 - \ln[X]_t}{k}$ $\quad [X]_0 = 100\%$, $[X]_t = 25\%$, $k = 1.42009\times10^{-4}\,s^{-1}$

$t = \frac{\ln(100) - \ln(25)}{1.42009\times10^{-4}\,s^{-1}} = \frac{4.605 - 3.218}{1.42009\times10^{-4}\,s^{-1}} = 9.762\times10^{3}\,s$

$= 98\times10^{3}\,s$

... what is this time in hours...

$\frac{9.762\times10^{3}\,s}{1}\cdot\frac{1\,min}{60\,s}\cdot\frac{1\,hr}{60\,min} = 27\,hours.$