CHM 152 Quiz #2a 25 Pts Spring 2015 Name: Key

rate = k rate = k[A] rate = k[A]^2 $[A]_t = -kt + [A]_0$ $\ln[A]_t = -kt + \ln[A]_0$ R= 8.314 J/(mol•K)

$1/[A]_t = kt + 1/[A]_0$ $t_{1/2} = [A]_0/2k$ $t_{1/2} = 0.693/k$ $t_{1/2} = 1/k[A]_0$ $\ln\frac{k_1}{k_2} = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$ $e=mc^2$

1. The reaction 2A + B → *products* is second order with respect to A and zero-order with respect to B. Starting with 0.135 M of A, what is the concentration of A after 35 min if the rate constant is 0.11 $M^{-1}s^{-1}$?

$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$ $\frac{1}{[A]_t} = (0.11\ M^{-1}s^{-1})(2100\ s) + \frac{1}{0.135\ M}$

$\frac{1}{[A]_t} = 238.4\ M^{-1}$

$[A]_t = 0.0042\ M$

2. Given that E_a for a certain biological reaction is 48 kJ/mol and that the rate constant is $2.5 \times 10^{-2}\ s^{-1}$ at 15°C, what is the rate constant at 37°C?

$\ln\frac{k_1}{2.5\times10^{-2}} = \frac{48\times10^3\ J/mol}{8.314\ J/(mol\cdot K)}\left(\frac{1}{288} - \frac{1}{310}\right)K^{-1}$

$\ln\frac{k_1}{2.5\times10^{-2}} = 1.422\ldots$

$k_1 = 0.104$ or $1.0\times10^{-1}\ s^{-1}$

3. The reaction 2A → *products* is second order with respect to A. If the concentration of A drops from 1.05 M to 0.815 M in a time of 15.0 min, what is the rate constant for this reaction (the same time units may be used)?

$\frac{1}{[A]_t} = kt + \frac{1}{[A]_0}$ $\frac{1}{0.815} = k(15\ min) + \frac{1}{1.05}$

$k = 0.0183\ M^{-1}\cdot min^{-1}$

4. The first-order decomposition, A → *products*, has a rate constant of 0.150 s^{-1}. Starting with $[A]_0$ = 0.350 M, how much time is required for $[A]_t$ = 0.125 M?

$\ln[A]_t = -kt + \ln[A]_0$ $\ln\left(\frac{0.125}{0.350}\right) = -0.150\ s^{-1}(t)$

or $\ln\frac{[A]_t}{[A]_0} = kt$

$t = 6.86\ s$

5. Nitrogen pentoxide decomposes by a first-order process yielding N_2O_4 and oxygen.

$2N_2O_5 \rightarrow 2N_2O_4 + O_2$

At a given temperature, the half-life of N_2O_5 is 0.90 hr. What is the first-order rate constant for N_2O_5 decomposition?

$t_{1/2} = \frac{0.693}{k}$ $k = \frac{0.693}{0.90\ hr} = 0.77\ hr^{-1}$