

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=mc²

1. The reaction $2A + B \rightarrow \text{products}$ 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⁻¹s⁻¹?

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

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

$$[A]_t = 0.0042 \text{ M}$$

2. Given that E_a for a certain biological reaction is 48 kJ/mol and that the rate constant is 2.5 × 10⁻² s⁻¹ at 15°C, what is the rate constant at 37°C?

$$\ln \frac{k_2}{k_1} = \frac{E_a}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$\ln \frac{k_2}{2.5 \times 10^{-2}} = \frac{48 \times 10^3 \text{ J/mol}}{8.314 \text{ J/mol}\cdot\text{K}} \left(\frac{1}{288} - \frac{1}{310} \right)$$

$$\ln \frac{k_2}{2.5 \times 10^{-2}} = 1.422 \dots$$

$$k_2 = 0.124 \text{ or } 1.0 \times 10^{-1} \text{ s}^{-1}$$

3. The reaction $2A \rightarrow \text{products}$ 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)?

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

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

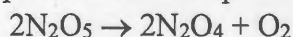
4. The first-order decomposition, $A \rightarrow \text{products}$, has a rate constant of 0.150 s⁻¹. Starting with [A]₀ = 0.350 M, how much time is required for [A]_t = 0.125 M?

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

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

$$t = 6.86 \text{ s}$$

5. Nitrogen pentoxide decomposes by a first-order process yielding N₂O₄ and oxygen.



At a given temperature, the half-life of N₂O₅ is 0.90 hr. What is the first-order rate constant for N₂O₅ decomposition?

$$t_{1/2} = \frac{0.693}{k}$$

$$k = \frac{0.693}{0.90 \text{ hr}} = 0.77 \text{ hr}^{-1}$$