Important Consecutive Reactions Formulas PDF

Formulas
Examples
with Units

List of 9
Important Consecutive Reactions Formulas

1) Conc. of Intermediate B provided Reactant A Conc. at time t given k2 much greater than k1 Formula

Evaluate Formula

Formula

$$[B] = A \cdot \left(\frac{k_1}{k_2 - k_1} \right)$$

Example with Units

$$0.0644\,\text{mol/L} = 101\,\text{mol/L} \cdot \left(\frac{0.00000567\,\text{s}^{-1}}{0.0089\,\text{s}^{-1} - 0.00000567\,\text{s}^{-1}} \right)$$

2) Concentration of Intermediate B in First Order Consecutive Reaction Formula

Evaluate Formula

Formula

$$[B] = A_0 \cdot \left(\frac{k_1}{k_2 - k_1} \right) \cdot \left(\exp\left(-k_1 \cdot t \right) - \exp\left(-k_2 \cdot t \right) \right)$$

Example with Units

$$0.0625\,\text{mol/L} = 100\,\text{mol/L} \cdot \left(\frac{0.00000567\,\text{s}^{-1}}{0.0089\,\text{s}^{-1} - 0.00000567\,\text{s}^{-1}} \right) \cdot \left(\exp\left(-0.00000567\,\text{s}^{-1} \cdot 3600\,\text{s} \right) - \exp\left(-0.0089\,\text{s}^{-1} \cdot 3600\,\text{s} \right) \right)$$

3) Concentration of Product C in First Order Consecutive Reaction Formula

Evaluate Formula

Formula

$$[C] = A_0 \cdot \left(1 - \left(\frac{1}{k_2 - k_1} \cdot \left(k_2 \cdot \left(\exp\left(-k_1 \cdot t \right) \right) - k_1 \cdot \exp\left(-k_2 \cdot t \right) \right) \right) \right)$$

Example with Units

$$1.958\,\text{mol/L} = 100\,\text{mol/L} \cdot \left(1 - \left(\frac{1}{0.0089\,\text{s}^{-1} - 0.00000567\,\text{s}^{-1}} \cdot \left(0.0089\,\text{s}^{-1} \cdot \left(\exp\left(-0.00000567\,\text{s}^{-1} \cdot 3600\,\text{s} \right) \right) - 0.00000567\,\text{s}^{-1} \cdot \exp\left(-0.0089\,\text{s}^{-1} \cdot 3600\,\text{s} \right) \right) \right) \right)$$

4) Concentration of Product C when k2 much greater than k1 in 1st Order Consecutive Reaction Formula

Evaluate Formula

Formula

$$[C] = A_0 \cdot \left(1 - \exp\left(-k_1 \cdot t \right) \right)$$

Example with Units

$$2.0205\,\text{mol/L} = 100\,\text{mol/L} \cdot \left(1 - \exp\left(-0.00000567\,\text{s}^{-1} \cdot 3600\,\text{s} \right) \right)$$

5) Concentration of Reactant A in First Order Consecutive Reaction Formula

Evaluate Formula

Formula

$$A = A_0 \cdot \exp\left(-k_1 \cdot t \right)$$

Example with Units

$$97.9795\,\text{mol/L} = 100\,\text{mol/L} \cdot \exp\left(-0.00000567\,\text{s}^{-1} \cdot 3600\,\text{s} \right)$$

6) Maximum Concentration of Intermediate B in First Order Consecutive Reaction Formula

Evaluate Formula

Formula

$$[B] = A_0 \cdot \left(\frac{k_2}{k_1} \right)^{\frac{k_2}{k_1 - k_2}}$$

Example with Units

$$0.0634\,\text{mol/L} = 100\,\text{mol/L} \cdot \left(\frac{0.0089\,\text{s}^{-1}}{0.00000567\,\text{s}^{-1}} \right)^{\frac{0.0089\,\text{s}^{-1}}{0.00000567\,\text{s}^{-1} - 0.0089\,\text{s}^{-1}}}$$

7) Secular Eqm- Ratio of Conc. of A to B given of half-lives provided k2 much greater than k1 Formula

Evaluate Formula

Formula

$$R_{A:B} = \frac{t_{1/2,B}}{t_{1/2,A}}$$

Example with Units

$$0.8 = \frac{800\,\text{s}}{1000\,\text{s}}$$

8) Time required to form Maximum Concentration of Intermediate B in First Order Consecutive Reaction Formula

Evaluate Formula

Formula

$$t_{maxB} = \frac{1}{k_1 - k_2} \cdot \ln\left(\frac{k_1}{k_2} \right)$$

Example with Units

$$827.338\,\text{s} = \frac{1}{0.00000567\,\text{s}^{-1} - 0.0089\,\text{s}^{-1}} \cdot \ln\left(\frac{0.00000567\,\text{s}^{-1}}{0.0089\,\text{s}^{-1}} \right)$$

9) Transient Eqm- Ratio of B by A when k2 much greater than k1 for 1st Order Consecutive Rxn Formula

Evaluate Formula

Formula

$$R_{B:A} = \frac{k_1}{k_2 - k_1}$$

Example with Units

$$0.0006 = \frac{0.00000567\ s^{-1}}{0.0089\ s^{-1} - 0.00000567\ s^{-1}}$$

Variables used in list of Consecutive Reactions Formulas above

- **[B]** Concentration of B at Time t *(Mole per Liter)*
- **[C]** Concentration of C at Time t *(Mole per Liter)*
- **A** Concentration of A at Time t *(Mole per Liter)*
- A_0 Initial Concentration of Reactant A *(Mole per Liter)*
- k_1 Reaction Rate Constant 1 *(1 Per Second)*
- k_2 Rate Constant of Reaction 2 *(1 Per Second)*
- $R_{A:B}$ A to B Ratio
- $R_{B:A}$ B to A Ratio
- **t** Time *(Second)*
- $t_{1/2,A}$ Half life of A *(Second)*
- $t_{1/2,B}$ Half life of B *(Second)*
- t_{maxB} Time at maxB *(Second)*

Constants, Functions, Measurements used in list of Consecutive Reactions Formulas above

- Functions: **exp**, exp(Number)
  n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Functions: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Molar Concentration** in Mole per Liter (mol/L)
  Molar Concentration Unit Conversion
- Measurement: **First Order Reaction Rate Constant** in 1 Per Second (s^{-1})
  First Order Reaction Rate Constant Unit Conversion

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