Important First Order followed by Zero Order Reaction Formulas PDF

Formulas
Examples
with Units

List of 10
Important First Order followed by Zero Order Reaction Formulas

1) Initial Reactant Concentration in First Order followed by Zero Order Reaction Formula

Evaluate Formula

Formula

$$C_{A0} = \frac{C_{k0}}{\exp\left(- k_I \cdot \Delta t \right)}$$

Example with Units

$$84.6101\,\text{mol/m}^3 = \frac{24\,\text{mol/m}^3}{\exp\left(- 0.42\,\text{s}^{-1} \cdot 3\,\text{s} \right)}$$

2) Initial Reactant Concentration using Intermediate for First Order followed by Zero Order Reaction Formula

Evaluate Formula

Formula

$$[A]_0 = \frac{C_R + \left(k_0 \cdot \Delta t \right)}{1 - \exp\left(- k_I \cdot \Delta t \right)}$$

Example with Units

$$41.1812\,\text{mol/m}^3 = \frac{10\,\text{mol/m}^3 + \left(6.5\,\text{mol/m}^3\text{*s} \cdot 3\,\text{s} \right)}{1 - \exp\left(- 0.42\,\text{s}^{-1} \cdot 3\,\text{s} \right)}$$

3) Intermediate Concentration for First Order followed by Zero Order Reaction Formula

Evaluate Formula

Formula

$$C_{R,1st\ order} = C_{A0} \cdot \left(1 - \exp\left(- k_I \cdot \Delta t \right) - \left(\frac{k_0 \cdot \Delta t}{C_{A0}} \right) \right)$$

Example with Units

$$37.8077\,\text{mol/m}^3 = 80\,\text{mol/m}^3 \cdot \left(1 - \exp\left(- 0.42\,\text{s}^{-1} \cdot 3\,\text{s} \right) - \left(\frac{6.5\,\text{mol/m}^3\text{*s} \cdot 3\,\text{s}}{80\,\text{mol/m}^3} \right) \right)$$

4) Maximum Intermediate Concentration in First Order followed by Zero Order Reaction Formula

Evaluate Formula

Formula

$$C_{R,max} = C_{A0} \cdot \left(1 - \left(\frac{k_0}{C_{A0} \cdot k_I} \cdot \left(1 - \ln\left(\frac{k_0}{C_{A0} \cdot k_I} \right) \right) \right) \right)$$

Example with Units

$$39.1007\,\text{mol/m}^3 = 80\,\text{mol/m}^3 \cdot \left(1 - \left(\frac{6.5\,\text{mol/m}^3\text{*s}}{80\,\text{mol/m}^3 \cdot 0.42\,\text{s}^{-1}} \cdot \left(1 - \ln\left(\frac{6.5\,\text{mol/m}^3\text{*s}}{80\,\text{mol/m}^3 \cdot 0.42\,\text{s}^{-1}} \right) \right) \right) \right)$$

5) Rate Constant for First Order Reaction in First Order followed by Zero Order Reaction Formula

Evaluate Formula

Formula

$$k_I = \left(\frac{1}{\Delta t}\right) \cdot \ln\left(\frac{C_{A0}}{C_{k0}}\right)$$

Example with Units

$$0.4013\,s^{-1} = \left(\frac{1}{3\,s}\right) \cdot \ln\left(\frac{80\,mol/m^3}{24\,mol/m^3}\right)$$

6) Rate Constant for First Order Reaction using Rate Constant for Zero Order Reaction Formula

Evaluate Formula

Formula

$$k_I = \left(\frac{1}{\Delta t}\right) \cdot \ln\left(\frac{C_{A0}}{C_{A0} - \left(k_0 \cdot \Delta t\right) - C_R}\right)$$

Example with Units

$$0.1534\,s^{-1} = \left(\frac{1}{3\,s}\right) \cdot \ln\left(\frac{80\,mol/m^3}{80\,mol/m^3 - \left(6.5\,mol/m^3*s \cdot 3\,s\right) - 10\,mol/m^3}\right)$$

7) Rate Constant for Zero Order Reaction using Rate Constant for First Order Reaction Formula

Evaluate Formula

Formula

$$k_{0,k1} = \left(\frac{C_{A0}}{\Delta t}\right) \cdot \left(1 - \exp\left(\left(-k_I\right) \cdot \Delta t\right) - \left(\frac{C_R}{C_{A0}}\right)\right)$$

Example with Units

$$15.7692\,mol/m^3*s = \left(\frac{80\,mol/m^3}{3\,s}\right) \cdot \left(1 - \exp\left(\left(-0.42\,s^{-1}\right) \cdot 3\,s\right) - \left(\frac{10\,mol/m^3}{80\,mol/m^3}\right)\right)$$

8) Reactant Concentration in First Order followed by Zero Order Reaction Formula

Evaluate Formula

Formula

$$C_{k0} = C_{A0} \cdot \exp\left(-k_I \cdot \Delta t\right)$$

Example with Units

$$22.6923\,mol/m^3 = 80\,mol/m^3 \cdot \exp\left(-0.42\,s^{-1} \cdot 3\,s\right)$$

9) Time at Max Intermediate in First Order followed by Zero Order Reaction Formula

Evaluate Formula

Formula

$$\tau_{R,max} = \left(\frac{1}{k_I}\right) \cdot \ln\left(\frac{k_I \cdot C_{A0}}{k_0}\right)$$

Example with Units

$$3.9112\,s = \left(\frac{1}{0.42\,s^{-1}}\right) \cdot \ln\left(\frac{0.42\,s^{-1} \cdot 80\,mol/m^3}{6.5\,mol/m^3*s}\right)$$

10) Time Interval for First Order Reaction in First Order followed by Zero Order Reaction Formula

Evaluate Formula

Formula

$$\Delta t = \left(\frac{1}{k_I}\right) \cdot \ln\left(\frac{C_{A0}}{C_{k0}}\right)$$

Example with Units

$$2.8666\,\text{s} = \left(\frac{1}{0.42\,\text{s}^{-1}}\right) \cdot \ln\left(\frac{80\,\text{mol/m}^3}{24\,\text{mol/m}^3}\right)$$

Variables used in list of First Order followed by Zero Order Reaction Formulas above

- $[A]_0$ Initial Reactant Concentration using Intermediate *(Mole per Cubic Meter)*
- C_{A0} Initial Reactant Concentration for Multiple Rxns *(Mole per Cubic Meter)*
- C_{k0} Reactant Concentration for Zero Order Series Rxn *(Mole per Cubic Meter)*
- C_R Intermediate Concentration for Series Rxn *(Mole per Cubic Meter)*
- $C_{R,1st\ order}$ Intermediate Conc. for 1st Order Series Rxn *(Mole per Cubic Meter)*
- $C_{R,max}$ Maximum Intermediate Concentration *(Mole per Cubic Meter)*
- k_0 Rate Constant for Zero Order Rxn for Multiple Rxns *(Mole per Cubic Meter Second)*
- $k_{0,k1}$ Rate Constant for Zero Order Rxn using k1 *(Mole per Cubic Meter Second)*
- k_l Rate Constant for First Step First Order Reaction *(1 Per Second)*
- Δt Time Interval for Multiple Reactions *(Second)*
- $\tau_{R,max}$ Time at Maximum Intermediate Concentration *(Second)*

Constants, Functions, Measurements used in list of First Order followed by Zero Order Reaction 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 Cubic Meter (mol/m³)
  Molar Concentration Unit Conversion
- Measurement: **Reaction Rate** in Mole per Cubic Meter Second (mol/m³*s)
  Reaction Rate 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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