Important Zero Order followed by First Order Reaction Formulas PDF

Formulas
Examples
with Units

List of 9
Important Zero Order followed by First Order Reaction Formulas

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

Evaluate Formula

Formula

$$C_{A0} = C_A + k_0 \cdot \Delta t$$

Example with Units

$$80\,\text{mol/m}^3 = 44\,\text{mol/m}^3 + 12\,\text{mol/m}^3\text{*s} \cdot 3\,\text{s}$$

2) Initial Reactant Concentration by Intermediate Conc. for Zero Order followed by First Order Rxn Formula

Evaluate Formula

Formula

$$C_{A0} = \frac{C_R}{\frac{1}{K} \cdot \left(1 - \exp\left(-\left(k_1 \cdot \Delta t\right)\right)\right)}$$

Example with Units

$$84.1007\,\text{mol/m}^3 = \frac{10\,\text{mol/m}^3}{\frac{1}{1.593\,\text{mol/m}^3\text{*s}} \cdot \left(1 - \exp\left(-\left(0.07\,\text{mol/m}^3\text{*s} \cdot 3\,\text{s}\right)\right)\right)}$$

3) Initial Reactant Concentration using Intermediate Conc. for Zero Order followed by First Order Rxn Formula

Evaluate Formula

Formula

$$C_{a0} = \frac{C_R}{\frac{1}{K} \cdot \left(\exp\left(K - k_1 \cdot \Delta t\right) - \exp\left(-k_1 \cdot \Delta t\right)\right)}$$

Example with Units

$$5.0153\,\text{mol/m}^3 = \frac{10\,\text{mol/m}^3}{\frac{1}{1.593\,\text{mol/m}^3\text{*s}} \cdot \left(\exp\left(1.593\,\text{mol/m}^3\text{*s} - 0.07\,\text{mol/m}^3\text{*s} \cdot 3\,\text{s}\right) - \exp\left(-0.07\,\text{mol/m}^3\text{*s} \cdot 3\,\text{s}\right)\right)}$$

4) Intermediate Concentration for Zero Order followed by First Order with Greater Rxn Time Formula

Evaluate Formula

Formula

$$C_R = \frac{C_0}{K} \cdot \left(\exp\left(K - k_1 \cdot \Delta t'' \right) - \exp\left(- k_1 \cdot \Delta t'' \right) \right)$$

Example with Units

$$10.2968\,\text{mol/m}^3 = \frac{5.5\,\text{mol/m}^3}{1.593\,\text{mol/m}^3\text{*s}} \cdot \left(\exp\left(1.593\,\text{mol/m}^3\text{*s} - 0.07\,\text{mol/m}^3\text{*s} \cdot 3.9\,\text{s} \right) - \exp\left(- 0.07\,\text{mol/m}^3\text{*s} \cdot 3.9\,\text{s} \right) \right)$$

5) Intermediate Concentration for Zero Order followed by First Order with Less Rxn Time Formula

Evaluate Formula

Formula

$$C_R = \left(\frac{C_{A0}}{K} \right) \cdot \left(1 - \exp\left(- \left(k_1 \cdot \Delta t' \right) \right) \right)$$

Example with Units

$$9.4839\,\text{mol/m}^3 = \left(\frac{80\,\text{mol/m}^3}{1.593\,\text{mol/m}^3\text{*s}} \right) \cdot \left(1 - \exp\left(- \left(0.07\,\text{mol/m}^3\text{*s} \cdot 2.99\,\text{s} \right) \right) \right)$$

6) Maximum Intermediate Concentration in Zero Order followed by First Order Formula

Evaluate Formula

Formula

$$C_{R,max} = \left(\frac{C_{A0} \cdot \left(1 - \exp\left(- K \right) \right)}{K} \right)$$

Example with Units

$$40.0093\,\text{mol/m}^3 = \left(\frac{80\,\text{mol/m}^3 \cdot \left(1 - \exp\left(- 1.593\,\text{mol/m}^3\text{*s} \right) \right)}{1.593\,\text{mol/m}^3\text{*s}} \right)$$

7) Rate Constant of Zero Order Reaction in Zero Order Reaction followed by First Order Reaction Formula

Evaluate Formula

Formula

$$k_0 = \frac{C_{A0} - C_A}{\Delta t}$$

Example with Units

$$12\,\text{mol/m}^3\text{*s} = \frac{80\,\text{mol/m}^3 - 44\,\text{mol/m}^3}{3\,\text{s}}$$

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

Evaluate Formula

Formula

$$C_A = \left(C_{A0} - \left(k_0 \cdot \Delta t \right) \right)$$

Example with Units

$$44\,\text{mol/m}^3 = \left(80\,\text{mol/m}^3 - \left(12\,\text{mol/m}^3\text{*s} \cdot 3\,\text{s} \right) \right)$$

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

Evaluate Formula

Formula

$$\tau_{R,max} = \frac{C_{A0}}{k_0}$$

Example with Units

$$6.6667\,\text{s} = \frac{80\,\text{mol/m}^3}{12\,\text{mol/m}^3\text{*s}}$$

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

- C_0 Initial Conc. of Reactant for Intermediate Conc. *(Mole per Cubic Meter)*
- C_A Reactant Concentration for Multiple Rxns *(Mole per Cubic Meter)*
- C_{a0} Initial Reactant Concentration using Intermediate *(Mole per Cubic Meter)*
- C_{A0} Initial Concentration of Reactant for Series Rxn *(Mole per Cubic Meter)*
- C_R Intermediate Concentration for Series Rxn *(Mole per Cubic Meter)*
- $C_{R,max}$ Maximum Intermediate Concentration *(Mole per Cubic Meter)*
- **K** Overall Rate of Reaction *(Mole per Cubic Meter Second)*
- k_0 Rate Constant for Zero Order Rxn *(Mole per Cubic Meter Second)*
- k_1 Rate Constant for 1st Order 2nd Step *(Mole per Cubic Meter Second)*
- **Δt** Time Interval *(Second)*
- **Δt'** Time Interval for Less Reaction Time *(Second)*
- **Δt''** Time Interval for Greater Reaction Time *(Second)*
- $\tau_{R,max}$ Time at Maximum Intermediate Concentration *(Second)*

Constants, Functions, Measurements used in list of Zero Order followed by First 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.
- 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

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