Important Basics of Potpourri Reactions Formulas PDF

Formulas
Examples
with Units

List of 16
Important Basics of Potpourri Reactions Formulas

1) Initial Reactant Concentration for First Order Rxn for MFR using Intermediate Concentration Formula

Evaluate Formula

Formula

$$C_{A0} = \frac{C_R \cdot \left(1 + \left(k_I \cdot \tau_m\right)\right) \cdot \left(1 + \left(k_2 \cdot \tau_m\right)\right)}{k_I \cdot \tau_m}$$

Example with Units

$$23.4889\,\text{mol/m}^3 = \frac{10\,\text{mol/m}^3 \cdot \left(1 + \left(0.42\,\text{s}^{-1} \cdot 12\,\text{s}\right)\right) \cdot \left(1 + \left(0.08\,\text{s}^{-1} \cdot 12\,\text{s}\right)\right)}{0.42\,\text{s}^{-1} \cdot 12\,\text{s}}$$

2) Initial Reactant Concentration for First Order Rxn in MFR at Maximum Intermediate Concentration Formula

Evaluate Formula

Formula

$$C_{A0} = C_{R,max} \cdot \left(\left(\left(\left(\frac{k_2}{k_I}\right)^{\frac{1}{2}}\right) + 1\right)^2\right)$$

Example with Units

$$82.5339\,\text{mol/m}^3 = 40\,\text{mol/m}^3 \cdot \left(\left(\left(\left(\frac{0.08\,\text{s}^{-1}}{0.42\,\text{s}^{-1}}\right)^{\frac{1}{2}}\right) + 1\right)^2\right)$$

3) Initial Reactant Concentration for First Order Rxn in Series for Maximum Intermediate Concentration Formula

Evaluate Formula

Formula

$$C_{A0} = \frac{C_{R,max}}{\left(\frac{k_I}{k_2}\right)^{\frac{k_2}{k_2 - k_I}}}$$

Example with Units

$$59.0894\,\text{mol/m}^3 = \frac{40\,\text{mol/m}^3}{\left(\frac{0.42\,\text{s}^{-1}}{0.08\,\text{s}^{-1}}\right)^{\frac{0.08\,\text{s}^{-1}}{0.08\,\text{s}^{-1} - 0.42\,\text{s}^{-1}}}}$$

4) Initial Reactant Concentration for First Order Rxn in Series for MFR using Product Concentration Formula

Evaluate Formula

Formula

$$C_{A0} = \frac{C_S \cdot \left(1 + \left(k_I \cdot \tau_m\right)\right) \cdot \left(1 + \left(k_2 \cdot \tau_m\right)\right)}{k_I \cdot k_2 \cdot \left(\tau_m^{\ 2}\right)}$$

Example with Units

$$48.9352\,\text{mol/m}^3 = \frac{20\,\text{mol/m}^3 \cdot \left(1 + \left(0.42\,\text{s}^{-1} \cdot 12\,\text{s}\right)\right) \cdot \left(1 + \left(0.08\,\text{s}^{-1} \cdot 12\,\text{s}\right)\right)}{0.42\,\text{s}^{-1} \cdot 0.08\,\text{s}^{-1} \cdot \left(12\,\text{s}^{\ 2}\right)}$$

5) Initial Reactant Concentration for Two Steps First Order Irreversible Reaction in Series Formula

Evaluate Formula

Formula

$$C_{A0} = \frac{C_R \cdot \left(k_2 - k_I\right)}{k_I \cdot \left(\exp\left(-k_I \cdot \tau\right) - \exp\left(-k_2 \cdot \tau\right)\right)}$$

Example with Units

$$89.2386\,\text{mol/m}^3 = \frac{10\,\text{mol/m}^3 \cdot \left(0.08\,\text{s}^{-1} - 0.42\,\text{s}^{-1}\right)}{0.42\,\text{s}^{-1} \cdot \left(\exp\left(-0.42\,\text{s}^{-1} \cdot 30\,\text{s}\right) - \exp\left(-0.08\,\text{s}^{-1} \cdot 30\,\text{s}\right)\right)}$$

6) Initial Reactant Concentration for Two Steps First Order Reaction for Mixed Flow Reactor Formula

Evaluate Formula

Formula

$$C_{A0} = C_{k1} \cdot \left(1 + \left(k_I \cdot \tau_m\right)\right)$$

Example with Units

$$80.332\,\text{mol/m}^3 = 13.3\,\text{mol/m}^3 \cdot \left(1 + \left(0.42\,\text{s}^{-1} \cdot 12\,\text{s}\right)\right)$$

7) Intermediate Concentration for First Order Reaction for Mixed Flow Reactor Formula

Evaluate Formula

Formula

$$C_R = \frac{C_{A0} \cdot k_I \cdot \tau_m}{\left(1 + \left(k_I \cdot \tau_m\right)\right) \cdot \left(1 + \left(k_2 \cdot \tau_m\right)\right)}$$

Example with Units

$$34.0587\,\text{mol/m}^3 = \frac{80\,\text{mol/m}^3 \cdot 0.42\,\text{s}^{-1} \cdot 12\,\text{s}}{\left(1 + \left(0.42\,\text{s}^{-1} \cdot 12\,\text{s}\right)\right) \cdot \left(1 + \left(0.08\,\text{s}^{-1} \cdot 12\,\text{s}\right)\right)}$$

8) Intermediate Concentration for Two Steps First Order Irreversible Reaction in Series Formula

Evaluate Formula

Formula

$$C_R = C_{A0} \cdot \left(\frac{k_I}{k_2 - k_I} \right) \cdot \left(\exp\left(-k_I \cdot \tau \right) - \exp\left(-k_2 \cdot \tau \right) \right)$$

Example with Units

$$8.9647\,\text{mol/m}^3 = 80\,\text{mol/m}^3 \cdot \left(\frac{0.42\,\text{s}^{-1}}{0.08\,\text{s}^{-1} - 0.42\,\text{s}^{-1}} \right) \cdot \left(\exp\left(-0.42\,\text{s}^{-1} \cdot 30\,\text{s} \right) - \exp\left(-0.08\,\text{s}^{-1} \cdot 30\,\text{s} \right) \right)$$

9) Maximum Intermediate Concentration for First Order Irreversible Reaction in MFR Formula

Evaluate Formula

Formula

$$C_{R,max} = \frac{C_{A0}}{\left(\left(\left(\frac{k_2}{k_I} \right)^{\frac{1}{2}} \right) + 1 \right)^2}$$

Example with Units

$$38.7719\,\text{mol/m}^3 = \frac{80\,\text{mol/m}^3}{\left(\left(\left(\frac{0.08\,\text{s}^{-1}}{0.42\,\text{s}^{-1}} \right)^{\frac{1}{2}} \right) + 1 \right)^2}$$

10) Maximum Intermediate Concentration for First Order Irreversible Reaction in Series Formula

Evaluate Formula

Formula

$$C_{R,max} = C_{A0} \cdot \left(\frac{k_I}{k_2} \right)^{\frac{k_2}{k_2 - k_I}}$$

Example with Units

$$54.1553\,\text{mol/m}^3 = 80\,\text{mol/m}^3 \cdot \left(\frac{0.42\,\text{s}^{-1}}{0.08\,\text{s}^{-1}} \right)^{\frac{0.08\,\text{s}^{-1}}{0.08\,\text{s}^{-1} - 0.42\,\text{s}^{-1}}}$$

11) Product Concentration for First Order Reaction for Mixed Flow Reactor Formula

Evaluate Formula

Formula

$$C_S = \frac{C_{A0} \cdot k_I \cdot k_2 \cdot \left({\tau_m}^2 \right)}{\left(1 + \left(k_I \cdot \tau_m \right) \right) \cdot \left(1 + \left(k_2 \cdot \tau_m \right) \right)}$$

Example with Units

$$32.6963\,\text{mol/m}^3 = \frac{80\,\text{mol/m}^3 \cdot 0.42\,\text{s}^{-1} \cdot 0.08\,\text{s}^{-1} \cdot \left(12\,\text{s}^2 \right)}{\left(1 + \left(0.42\,\text{s}^{-1} \cdot 12\,\text{s} \right) \right) \cdot \left(1 + \left(0.08\,\text{s}^{-1} \cdot 12\,\text{s} \right) \right)}$$

12) Rate Constant for First Step First Order Reaction for MFR at Maximum Intermediate Concentration Formula

Evaluate Formula

Formula

$$k_I = \frac{1}{k_2 \cdot \left({\tau_{R,max}}^2 \right)}$$

Example with Units

$$0.2785\,\text{s}^{-1} = \frac{1}{0.08\,\text{s}^{-1} \cdot \left(6.7\,\text{s}^2 \right)}$$

13) Rate Constant for Second Step First Order Reaction for MFR at Maximum Intermediate Concentration Formula

Evaluate Formula

Formula

$$k_2 = \frac{1}{k_I \cdot \left(\tau_{R,max}{}^2\right)}$$

Example with Units

$$0.053\,\mathrm{s^{-1}} = \frac{1}{0.42\,\mathrm{s^{-1}} \cdot \left(6.7\,\mathrm{s}^{\,2}\right)}$$

14) Reactant Concentration for Two Steps First Order Reaction for Mixed Flow Reactor Formula

Evaluate Formula

Formula

$$C_{k0} = \frac{C_{A0}}{1 + \left(k_I \cdot \tau_m\right)}$$

Example with Units

$$13.245\,\mathrm{mol/m^3} = \frac{80\,\mathrm{mol/m^3}}{1 + \left(0.42\,\mathrm{s^{-1}} \cdot 12\,\mathrm{s}\right)}$$

15) Time at Maximum Intermediate Concentration for First Order Irreversible Reaction in Series Formula

Evaluate Formula

Formula

$$\tau_{R,max} = \frac{\ln\left(\frac{k_2}{k_I}\right)}{k_2 - k_I}$$

Example with Units

$$4.8771\,\mathrm{s} = \frac{\ln\left(\frac{0.08\,\mathrm{s^{-1}}}{0.42\,\mathrm{s^{-1}}}\right)}{0.08\,\mathrm{s^{-1}} - 0.42\,\mathrm{s^{-1}}}$$

16) Time at Maximum Intermediate Concentration for First Order Irreversible Reaction in Series in MFR Formula

Evaluate Formula

Formula

$$\tau_{R,max} = \frac{1}{\sqrt{k_I \cdot k_2}}$$

Example with Units

$$5.4554\,\mathrm{s} = \frac{1}{\sqrt{0.42\,\mathrm{s^{-1}} \cdot 0.08\,\mathrm{s^{-1}}}}$$

Variables used in list of Basics of Potpourri Reactions Formulas above

- 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_{k1} Reactant Concentration for 1st Order Series Rxns *(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)*
- C_S Final Product Concentration *(Mole per Cubic Meter)*
- k_2 Rate Constant for Second Step First Order Reaction *(1 Per Second)*
- k_I Rate Constant for First Step First Order Reaction *(1 Per Second)*
- τ Space Time for PFR *(Second)*
- τ_m Space Time for Mixed Flow Reactor *(Second)*
- $\tau_{R,max}$ Time at Maximum Intermediate Concentration *(Second)*

Constants, Functions, Measurements used in list of Basics of Potpourri 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.
- Functions: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Molar Concentration** in Mole per Cubic Meter (mol/m^3)
  Molar Concentration Unit Conversion
- Measurement: **First Order Reaction Rate Constant** in 1 Per Second (s^{-1})
  First Order Reaction Rate Constant Unit Conversion

Download other Important Potpourri of Multiple Reactions PDFs

- **Important First Order followed by Zero Order Reaction Formulas**
- **Important Zero Order followed by First Order Reaction Formulas**

Try our Unique Visual Calculators

- **Percentage growth**
- **LCM calculator**
- **Divide fraction**

Please SHARE this PDF with someone who needs it!

This PDF can be downloaded in these languages

English Spanish French German Russian Italian Portuguese Polish Dutch

7/10/2024 | 3:52:38 AM UTC