

Important Formulas in Constant and Variable Volume Batch Reactor PDF



Formulas Examples with Units

List of 17 Important Formulas in Constant and Variable Volume Batch Reactor

1) Fractional Volume Change at Complete Conversion in Varying Volume Batch Reactor

Formula ↻

$$\varepsilon = \frac{V - V_0}{V_0}$$

Example with Units

$$0.1538 = \frac{15 \text{ m}^3 - 13 \text{ m}^3}{13 \text{ m}^3}$$

Evaluate Formula ↻

2) Fractional Volume Change in Varying Volume Batch Reactor Formula ↻

Formula

$$\varepsilon = \frac{V - V_0}{X_A \cdot V_0}$$

Example with Units

$$0.1923 = \frac{15 \text{ m}^3 - 13 \text{ m}^3}{0.8 \cdot 13 \text{ m}^3}$$

Evaluate Formula ↻

3) Initial Partial Pressure of Product in Constant Volume Batch Reactor Formula ↻

Formula

$$p_{R0} = p_R \cdot \left(\frac{R}{\Delta n} \right) \cdot (\pi - \pi_0)$$

Example with Units

$$22.5 \text{ Pa} = 50 \text{ Pa} \cdot \left(\frac{2}{4} \right) \cdot (100 \text{ Pa} - 45 \text{ Pa})$$

Evaluate Formula ↻

4) Initial Partial Pressure of Reactant in Constant Volume Batch Reactor Formula ↻

Formula

$$p_{A0} = p_A + \left(\frac{A}{\Delta n} \right) \cdot (\pi - \pi_0)$$

Example with Units

$$60.25 \text{ Pa} = 19 \text{ Pa} + \left(\frac{3}{4} \right) \cdot (100 \text{ Pa} - 45 \text{ Pa})$$

Evaluate Formula ↻

5) Initial Reactor Volume at Complete Conversion in Varying Volume Batch Reactor Formula

↻

Formula

$$V_0 = \frac{V}{1 + \varepsilon}$$

Example with Units

$$12.8205 \text{ m}^3 = \frac{15 \text{ m}^3}{1 + 0.17}$$

Evaluate Formula ↻



6) Initial Reactor Volume in Varying Volume Batch Reactor Formula

Formula

$$V_0 = \frac{V}{1 + \varepsilon \cdot X_A}$$

Example with Units

$$13.2042 \text{ m}^3 = \frac{15 \text{ m}^3}{1 + 0.17 \cdot 0.8}$$

Evaluate Formula 

7) Net Partial Pressure in Constant Volume Batch Reactor Formula

Formula

$$\Delta p = r \cdot [R] \cdot T \cdot \Delta t$$

Example with Units

$$60.072 \text{ Pa} = 0.017 \text{ mol/m}^3\text{s} \cdot 8.3145 \cdot 85 \text{ K} \cdot 5 \text{ s}$$

Evaluate Formula 

8) Number of Moles of Reactant Fed to Constant Volume Batch Reactor Formula

Formula

$$N_{A0} = V_{\text{solution}} \cdot \left(C_A + \left(\frac{A}{\Delta n} \right) \cdot \left(\frac{N_T - N_0}{V_{\text{solution}}} \right) \right)$$

Example with Units

$$11.235 \text{ mol} = 10.2 \text{ m}^3 \cdot \left(1.1 \text{ mol/m}^3 + \left(\frac{3}{4} \right) \cdot \left(\frac{16 \text{ mol} - 15.98 \text{ mol}}{10.2 \text{ m}^3} \right) \right)$$

Evaluate Formula 

9) Number of Moles of Unreacted Reactant in Constant Volume Batch Reactor Formula

Formula

$$N_A = N_{A0} \cdot (1 - X_A)$$

Example with Units

$$2.3868 \text{ mol} = 11.934 \text{ mol} \cdot (1 - 0.8)$$

Evaluate Formula 

10) Partial Pressure of Product in Constant Volume Batch Reactor Formula

Formula

$$p_R = p_{R0} + \left(\frac{R}{\Delta n} \right) \cdot (\pi - \pi_0)$$

Example with Units

$$50 \text{ Pa} = 22.5 \text{ Pa} + \left(\frac{2}{4} \right) \cdot (100 \text{ Pa} - 45 \text{ Pa})$$

Evaluate Formula 

11) Partial Pressure of Reactant in Constant Volume Batch Reactor Formula

Formula

$$p_A = p_{A0} - \left(\frac{A}{\Delta n} \right) \cdot (\pi - \pi_0)$$

Example with Units

$$18.75 \text{ Pa} = 60 \text{ Pa} - \left(\frac{3}{4} \right) \cdot (100 \text{ Pa} - 45 \text{ Pa})$$

Evaluate Formula 



12) Reactant Concentration in Constant Volume Batch Reactor Formula

Formula

$$C_A = \left(\frac{N_{A0}}{V_{\text{solution}}} \right) - \left(\frac{A}{\Delta n} \right) \cdot \left(\frac{N_T - N_0}{V_{\text{solution}}} \right)$$

Evaluate Formula 

Example with Units

$$1.1685 \text{ mol/m}^3 = \left(\frac{11.934 \text{ mol}}{10.2 \text{ m}^3} \right) - \left(\frac{3}{4} \right) \cdot \left(\frac{16 \text{ mol} - 15.98 \text{ mol}}{10.2 \text{ m}^3} \right)$$

13) Reactant Conversion in Varying Volume Batch Reactor Formula

Formula

$$X_A = \frac{V - V_0}{\varepsilon \cdot V_0}$$

Example with Units

$$0.905 = \frac{15 \text{ m}^3 - 13 \text{ m}^3}{0.17 \cdot 13 \text{ m}^3}$$

Evaluate Formula 

14) Reaction Rate in Constant Volume Batch Reactor Formula

Formula

$$r = \frac{\Delta p}{[R] \cdot T \cdot \Delta t}$$

Example with Units

$$0.0175 \text{ mol/m}^3\text{s} = \frac{62 \text{ Pa}}{8.3145 \cdot 85 \text{ K} \cdot 5 \text{ s}}$$

Evaluate Formula 

15) Temperature in Constant Volume Batch Reactor Formula

Formula

$$T = \frac{\Delta p}{[R] \cdot r \cdot \Delta t}$$

Example with Units

$$87.7281 \text{ K} = \frac{62 \text{ Pa}}{8.3145 \cdot 0.017 \text{ mol/m}^3\text{s} \cdot 5 \text{ s}}$$

Evaluate Formula 

16) Volume at Complete Conversion in Varying Volume Batch Reactor Formula

Formula

$$V = V_0 \cdot (1 + \varepsilon)$$

Example with Units

$$15.21 \text{ m}^3 = 13 \text{ m}^3 \cdot (1 + 0.17)$$

Evaluate Formula 

17) Volume in Varying Volume Batch Reactor Formula

Formula

$$V = V_0 \cdot (1 + \varepsilon \cdot X_A)$$

Example with Units

$$14.768 \text{ m}^3 = 13 \text{ m}^3 \cdot (1 + 0.17 \cdot 0.8)$$

Evaluate Formula 



Variables used in list of Important Formulas in Constant and Variable Volume Batch Reactor above





- **A** Stoichiometric Coefficient of Reactant
- **C_A** Concentration of Reactant A (Mole per Cubic Meter)
- **N₀** Total Number of Moles Initially (Mole)
- **N_A** Number of Moles of Unreacted Reactant-A (Mole)
- **N_{AO}** Number of Moles of Reactant-A Fed (Mole)
- **N_T** Total Number of Moles (Mole)
- **P_A** Partial Pressure of Reactant A (Pascal)
- **P_{AO}** Initial Partial Pressure of Reactant A (Pascal)
- **P_R** Partial Pressure of Product R (Pascal)
- **P_{RO}** Initial Partial Pressure of Product R (Pascal)
- **r** Reaction Rate (Mole per Cubic Meter Second)
- **R** Stoichiometric Coefficient of Product
- **T** Temperature (Kelvin)
- **V** Volume in Varying Volume Batch Reactor (Cubic Meter)
- **V₀** Initial Reactor Volume (Cubic Meter)
- **V_{solution}** Volume of Solution (Cubic Meter)
- **X_A** Reactant Conversion
- **Δn** Net Stoichiometric Coefficient
- **Δp** Net Partial Pressure (Pascal)
- **Δt** Time Interval (Second)
- **ε** Fractional Volume Change
- **π** Total Pressure (Pascal)
- **π₀** Initial Total Pressure (Pascal)

Constants, Functions, Measurements used in list of Important Formulas in Constant and Variable Volume Batch Reactor above

- **constant(s): [R]**, 8.31446261815324
Universal gas constant
- **Measurement: Time** in Second (s)
Time Unit Conversion ↻
- **Measurement: Temperature** in Kelvin (K)
Temperature Unit Conversion ↻
- **Measurement: Amount of Substance** in Mole (mol)
Amount of Substance Unit Conversion ↻
- **Measurement: Volume** in Cubic Meter (m³)
Volume Unit Conversion ↻
- **Measurement: Pressure** in Pascal (Pa)
Pressure 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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