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Important Formulas in Constant and Variable Volume Batch Reactor

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

Important Formulas in Constant and Variable Volume Batch Reactor

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

Open Calculator

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

ex $$0.153846 = \frac{15\text{m}^3 - 13\text{m}^3}{13\text{m}^3}$$

2) Fractional Volume Change in Varying Volume Batch Reactor

Open Calculator

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

ex $$0.192308 = \frac{15\text{m}^3 - 13\text{m}^3}{0.8 \cdot 13\text{m}^3}$$

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

Open Calculator

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

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

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

Open Calculator

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

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

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

Open Calculator

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

ex $$12.82051\text{m}^3 = \frac{15\text{m}^3}{1 + 0.17}$$

6) Initial Reactor Volume in Varying Volume Batch Reactor

Open Calculator

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

ex $$13.20423\text{m}^3 = \frac{15\text{m}^3}{1 + 0.17 \cdot 0.8}$$

7) Net Partial Pressure in Constant Volume Batch Reactor

Open Calculator

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

ex $$60.07199\text{Pa} = 0.017\text{mol/m}^3\text{*s} \cdot [R] \cdot 85\text{K} \cdot 5\text{s}$$

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

Open Calculator

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

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

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

Open Calculator

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

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

10) Partial Pressure of Product in Constant Volume Batch Reactor

Open Calculator

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

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

11) Partial Pressure of Reactant in Constant Volume Batch Reactor

Open Calculator

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

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

12) Reactant Concentration in Constant Volume Batch Reactor

Open Calculator

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

ex $$1.168529\text{mol/m}^3 = \left(\frac{11.934\text{mol}}{10.2\text{m}^3}\right) - \left(\frac{3}{4}\right) \cdot \left(\frac{16\text{mol} - 15.98\text{mol}}{10.2\text{m}^3}\right)$$

13) Reactant Conversion in Varying Volume Batch Reactor

Open Calculator

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

ex $$0.904977 = \frac{15\text{m}^3 - 13\text{m}^3}{0.17 \cdot 13\text{m}^3}$$

14) Reaction Rate in Constant Volume Batch Reactor

Open Calculator

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

$$0.017546\text{mol/m}^3\text{*s} = \frac{62\text{Pa}}{[R] \cdot 85\text{K} \cdot 5\text{s}}$$

15) Temperature in Constant Volume Batch Reactor

Open Calculator

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

$$87.72807\text{K} = \frac{62\text{Pa}}{[R] \cdot 0.017\text{mol/m}^3\text{*s} \cdot 5\text{s}}$$

16) Volume at Complete Conversion in Varying Volume Batch Reactor

Open Calculator

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

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

17) Volume in Varying Volume Batch Reactor

Open Calculator

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

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

Variables Used

- **A** Stoichiometric Coefficient of Reactant
- **C_A** Concentration of Reactant A *(Mole per Cubic Meter)*
- **N_0** 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_{A0}** Initial Partial Pressure of Reactant A *(Pascal)*
- **p_R** Partial Pressure of Product R *(Pascal)*
- **p_{R0}** 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)*
- **V_0** 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)*

- π_0 Initial Total Pressure *(Pascal)*

Constants, Functions, Measurements used

- Constant: **[R]**, 8.31446261815324 Joule / Kelvin * Mole
  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 (m^3)
  Volume Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Molar Concentration** in Mole per Cubic Meter (mol/m^3)
  Molar Concentration Unit Conversion
- Measurement: **Reaction Rate** in Mole per Cubic Meter Second (mol/m^3*s)
  Reaction Rate Unit Conversion

Check other formula lists

- Basics of Chemical Reaction Engineering Formulas
- Basics of Parallel & Single Reactions Formulas
- Basics of Reactor Design and Temperature Dependency from Arrhenius Law Formulas
- Forms of Reaction Rate Formulas
- Important Formulas in Basics of Chemical Reaction Engineering & Forms of Reaction Rate
- Important Formulas in Constant and Variable Volume Batch Reactor
- Important Formulas in Constant Volume Batch Reactor for First, Second & Third Order Reaction
- Important Formulas in Design of Reactors & Recycle Reactors for Single Reactions
- Important Formulas in Potpourri of Multiple Reactions
- Reactor Performance Equations for Constant Volume Reactions Formulas
- Reactor Performance Equations for Variable Volume Reactions Formulas

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