Important Temperature and Pressure Effects Formulas PDF

Formulas Examples with Units

List of 9
Important Temperature and Pressure Effects Formulas

1) Adiabatic Heat of Equilibrium Conversion Formula

Evaluate Formula

Formula

$$\Delta H_{r1} = \left(- \frac{\left(C' \cdot \Delta T \right) + \left(\left(C'' - C' \right) \cdot \Delta T \right) \cdot X_A}{X_A} \right)$$

Example with Units

$$-886.6667\,\text{J/mol} = \left(- \frac{\left(7.98\,\text{J/(kg*K)} \cdot 50\,\text{K} \right) + \left(\left(14.63\,\text{J/(kg*K)} - 7.98\,\text{J/(kg*K)} \right) \cdot 50\,\text{K} \right) \cdot 0.72}{0.72} \right)$$

2) Equilibrium Conversion of Reaction at Final Temperature Formula

Evaluate Formula

Formula

$$K_2 = K_1 \cdot \exp\left(- \left(\frac{\Delta H_r}{[R]} \right) \cdot \left(\frac{1}{T_2} - \frac{1}{T_1} \right) \right)$$

Example with Units

$$0.6299 = 0.6 \cdot \exp\left(- \left(\frac{-955\,\text{J/mol}}{8.3145} \right) \cdot \left(\frac{1}{368\,\text{K}} - \frac{1}{436\,\text{K}} \right) \right)$$

3) Equilibrium Conversion of Reaction at Initial Temperature Formula

Evaluate Formula

Formula

$$K_1 = \frac{K_2}{\exp\left(- \left(\frac{\Delta H_r}{[R]} \right) \cdot \left(\frac{1}{T_2} - \frac{1}{T_1} \right) \right)}$$

Example with Units

$$0.6001 = \frac{0.63}{\exp\left(- \left(\frac{-955\,\text{J/mol}}{8.3145} \right) \cdot \left(\frac{1}{368\,\text{K}} - \frac{1}{436\,\text{K}} \right) \right)}$$

4) Final Temperature for Equilibrium Conversion Formula

Evaluate Formula

Formula

$$T_2 = \frac{-\left(\Delta H_r\right) \cdot T_1}{\left(T_1 \cdot \ln\left(\frac{K_2}{K_1}\right) \cdot [R]\right) + \left(-\left(\Delta H_r\right)\right)}$$

Example with Units

$$367.8693\,\text{K} = \frac{-\left(-955\,\text{J/mol}\right) \cdot 436\,\text{K}}{\left(436\,\text{K} \cdot \ln\left(\frac{0.63}{0.6}\right) \cdot 8.3145\right) + \left(-\left(-955\,\text{J/mol}\right)\right)}$$

5) Heat of Reaction at Equilibrium Conversion Formula

Evaluate Formula

Formula

$$\Delta H_r = \left(-\frac{\ln\left(\frac{K_2}{K_1}\right) \cdot [R]}{\frac{1}{T_2} - \frac{1}{T_1}}\right)$$

Example with Units

$$-957.1761\,\text{J/mol} = \left(-\frac{\ln\left(\frac{0.63}{0.6}\right) \cdot 8.3145}{\frac{1}{368\,\text{K}} - \frac{1}{436\,\text{K}}}\right)$$

6) Initial Temperature for Equilibrium Conversion Formula

Evaluate Formula

Formula

$$T_1 = \frac{-\left(\Delta H_r\right) \cdot T_2}{-\left(\Delta H_r\right) - \left(\ln\left(\frac{K_2}{K_1}\right) \cdot [R] \cdot T_2\right)}$$

Example with Units

$$436.1837\,\text{K} = \frac{-\left(-955\,\text{J/mol}\right) \cdot 368\,\text{K}}{-\left(-955\,\text{J/mol}\right) - \left(\ln\left(\frac{0.63}{0.6}\right) \cdot 8.3145 \cdot 368\,\text{K}\right)}$$

7) Non Adiabatic Heat of Equilibrium Conversion Formula

Evaluate Formula

Formula

$$Q = \left(X_A \cdot \Delta H_{r2}\right) + \left(C' \cdot \Delta T\right)$$

Example with Units

$$1908.12\,\text{J/mol} = \left(0.72 \cdot 2096\,\text{J/mol}\right) + \left(7.98\,\text{J/(kg*K)} \cdot 50\,\text{K}\right)$$

8) Reactant Conversion at Adiabatic Conditions Formula

Evaluate Formula

Formula

$$X_A = \frac{C' \cdot \Delta T}{-\Delta H_{r1} - \left(C'' - C'\right) \cdot \Delta T}$$

Example with Units

$$0.7222 = \frac{7.98\,\text{J/(kg*K)} \cdot 50\,\text{K}}{-\text{-}885\,\text{J/mol} - \left(14.63\,\text{J/(kg*K)} - 7.98\,\text{J/(kg*K)}\right) \cdot 50\,\text{K}}$$

9) Reactant Conversion at Non Adiabatic Conditions Formula

Evaluate Formula

Formula

$$X_A = \frac{\left(C' \cdot \Delta T\right) - Q}{-\Delta H_{r2}}$$

Example with Units

$$0.7185 = \frac{\left(7.98\,\text{J/(kg*K)} \cdot 50\,\text{K}\right) - 1905\,\text{J/mol}}{-2096\,\text{J/mol}}$$

Variables used in list of Temperature and Pressure Effects Formulas above

- ΔT Change in Temperature *(Kelvin)*
- C' Mean Specific Heat of Unreacted Stream *(Joule per Kilogram per K)*
- C'' Mean Specific Heat of Product Stream *(Joule per Kilogram per K)*
- K_1 Thermodynamic Constant at Initial Temperature
- K_2 Thermodynamic Constant at Final Temperature
- Q Total Heat *(Joule Per Mole)*
- T_1 Initial Temperature for Equilibrium Conversion *(Kelvin)*
- T_2 Final Temperature for Equilibrium Conversion *(Kelvin)*
- X_A Reactant Conversion
- ΔH_r Heat of Reaction per Mole *(Joule Per Mole)*
- ΔH_{r1} Heat of Reaction at Initial Temperature *(Joule Per Mole)*
- ΔH_{r2} Heat of Reaction per Mole at Temperature T2 *(Joule Per Mole)*

Constants, Functions, Measurements used in list of Temperature and Pressure Effects Formulas above

- constant(s): **[R]**, 8.31446261815324
  Universal gas constant
- 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: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Temperature Difference** in Kelvin (K)
  Temperature Difference Unit Conversion
- Measurement: **Specific Heat Capacity** in Joule per Kilogram per K (J/(kg*K))
  Specific Heat Capacity Unit Conversion
- Measurement: **Energy Per Mole** in Joule Per Mole (J/mol)
  Energy Per Mole Unit Conversion

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