Important Entropy Generation Formulas PDF

Formulas
Examples
with Units

List of 16
Important Entropy Generation Formulas

1) Entropy Balance Equation Formula

Evaluate Formula

Formula

$$\delta s = Gsys - Gsurr + TEG$$

Example with Units

$$105\,\text{J/kg*K} = 85\,\text{J/kg*K} - 130.0\,\text{J/kg*K} + 150\,\text{J/kg*K}$$

2) Entropy Change at Constant Pressure Formula

Evaluate Formula

Formula

$$\delta s_{pres} = C_p \cdot \ln\left(\frac{T_2}{T_1}\right) - [R] \cdot \ln\left(\frac{P_2}{P_1}\right)$$

Example with Units

$$396.4722\,\text{J/kg*K} = 1001\,\text{J/(kg*K)} \cdot \ln\left(\frac{151\,\text{K}}{101\,\text{K}}\right) - 8.3145 \cdot \ln\left(\frac{520000\,\text{Pa}}{250000\,\text{Pa}}\right)$$

3) Entropy Change at Constant Volume Formula

Evaluate Formula

Formula

$$\delta s_{vol} = C_v \cdot \ln\left(\frac{T_2}{T_1}\right) + [R] \cdot \ln\left(\frac{v_2}{v_1}\right)$$

Example with Units

$$344.494\,\text{J/kg*K} = 718\,\text{J/(kg*K)} \cdot \ln\left(\frac{151\,\text{K}}{101\,\text{K}}\right) + 8.3145 \cdot \ln\left(\frac{0.816\,\text{m}^3\text{/kg}}{0.001\,\text{m}^3\text{/kg}}\right)$$

4) Entropy Change for Isochoric Process given Pressures Formula

Evaluate Formula

Formula

$$\delta s_{vol} = m_{gas} \cdot C_{vs} \cdot \ln\left(\frac{P_f}{P_i}\right)$$

Example with Units

$$130.1023\,\text{J/kg*K} = 2\,\text{kg} \cdot 530\,\text{J/K*mol} \cdot \ln\left(\frac{96100\,\text{Pa}}{85000\,\text{Pa}}\right)$$

5) Entropy Change for Isochoric Process given Temperature Formula

Evaluate Formula

Formula

$$\delta s_{vol} = m_{gas} \cdot C_{vs} \cdot \ln\left(\frac{T_f}{T_i}\right)$$

Example with Units

$$130.6266\,\text{J/kg*K} = 2\,\text{kg} \cdot 530\,\text{J/K*mol} \cdot \ln\left(\frac{345\,\text{K}}{305\,\text{K}}\right)$$

6) Entropy Change for Isothermal Process given Volumes Formula

Evaluate Formula

Formula

$$\Delta S = m_{gas} \cdot [R] \cdot \ln\left(\frac{V_f}{V_i}\right)$$

Example with Units

$$2.7779\,\text{J/kg*K} = 2\,\text{kg} \cdot 8.3145 \cdot \ln\left(\frac{13\,\text{m}^3}{11.0\,\text{m}^3}\right)$$

7) Entropy Change in Isobaric Process given Temperature Formula

Evaluate Formula

Formula

$$\delta s_{pres} = m_{gas} \cdot C_{pm} \cdot \ln\left(\frac{T_f}{T_i}\right)$$

Example with Units

$$30.0688\,\text{J/kg*K} = 2\,\text{kg} \cdot 122\,\text{J/K*mol} \cdot \ln\left(\frac{345\,\text{K}}{305\,\text{K}}\right)$$

8) Entropy Change in Isobaric Processin Terms of Volume Formula

Evaluate Formula

Formula

$$\delta s_{pres} = m_{gas} \cdot C_{pm} \cdot \ln\left(\frac{V_f}{V_i}\right)$$

Example with Units

$$40.7612\,\text{J/kg*K} = 2\,\text{kg} \cdot 122\,\text{J/K*mol} \cdot \ln\left(\frac{13\,\text{m}^3}{11.0\,\text{m}^3}\right)$$

9) Entropy Change Variable Specific Heat Formula

Evaluate Formula

Formula

$$\delta s = s2^\circ - s1^\circ - [R] \cdot \ln\left(\frac{P_2}{P_1}\right)$$

Example with Units

$$157.5108\,\text{J/kg*K} = 188.8\,\text{J/kg*K} - 25.2\,\text{J/kg*K} - 8.3145 \cdot \ln\left(\frac{520000\,\text{Pa}}{250000\,\text{Pa}}\right)$$

10) Entropy using Helmholtz Free Energy Formula

Evaluate Formula

Formula

$$S = \frac{U - A}{T}$$

Example with Units

$$0.3691\,\text{J/K} = \frac{1.21\,\text{KJ} - 1.1\,\text{KJ}}{298\,\text{K}}$$

11) Gibbs Free Energy Formula

Evaluate Formula

Formula

$$G = H - T \cdot S$$

Example with Units

$$-19.648\,\text{KJ} = 1.51\,\text{KJ} - 298\,\text{K} \cdot 71\,\text{J/K}$$

12) Helmholtz Free Energy Formula

Evaluate Formula

Formula

$$A = U - T \cdot S$$

Example with Units

$$-19.948\,\text{kJ} = 1.21\,\text{kJ} - 298\,\text{K} \cdot 71\,\text{J/K}$$

13) Internal Energy using Helmholtz Free Energy Formula

Evaluate Formula

Formula

$$U = A + T \cdot S$$

Example with Units

$$22.258\,\text{kJ} = 1.1\,\text{kJ} + 298\,\text{K} \cdot 71\,\text{J/K}$$

14) Irreversibility Formula

Evaluate Formula

Formula

$$I_{12} = \left(T \cdot \left(S_2 - S_1 \right) - \frac{Q_{in}}{T_{in}} + \frac{Q_{out}}{T_{out}} \right)$$

Example with Units

$$28311.5476\,\text{J/kg} = \left(298\,\text{K} \cdot \left(145\,\text{J/kg*K} - 50\,\text{J/kg*K} \right) - \frac{200\,\text{J/kg}}{210\,\text{K}} + \frac{300\,\text{J/kg}}{120\,\text{K}} \right)$$

15) Specific Entropy Formula

Evaluate Formula

Formula

$$G_s = \frac{S}{m}$$

Example with Units

$$2.1515 = \frac{71\,\text{J/K}}{33\,\text{kg}}$$

16) Temperature using Helmholtz Free Energy Formula

Evaluate Formula

Formula

$$T = \frac{U - A}{S}$$

Example with Units

$$1.5493\,\text{K} = \frac{1.21\,\text{kJ} - 1.1\,\text{kJ}}{71\,\text{J/K}}$$

Variables used in list of Entropy Generation Formulas above

- **A** Helmholtz Free Energy *(Kilojoule)*
- C_p Heat Capacity Constant Pressure *(Joule per Kilogram per K)*
- C_{pm} Molar Specific Heat Capacity at Constant Pressure *(Joule Per Kelvin Per Mole)*
- C_v Heat Capacity Constant Volume *(Joule per Kilogram per K)*
- C_{vs} Specific Molar Heat Capacity at Constant Volume *(Joule Per Kelvin Per Mole)*
- **G** Gibbs Free Energy *(Kilojoule)*
- G_s Specific Entropy
- **Gsurr** Entropy of Surrounding *(Joule per Kilogram K)*
- **Gsys** Entropy of System *(Joule per Kilogram K)*
- **H** Enthalpy *(Kilojoule)*
- I_{12} Irreversibility *(Joule per Kilogram)*
- **m** Mass *(Kilogram)*
- m_{gas} Mass of Gas *(Kilogram)*
- P_1 Pressure 1 *(Pascal)*
- P_2 Pressure 2 *(Pascal)*
- P_f Final Pressure of System *(Pascal)*
- P_i Initial Pressure of System *(Pascal)*
- Q_{in} Heat Input *(Joule per Kilogram)*
- Q_{out} Heat Output *(Joule per Kilogram)*
- **S** Entropy *(Joule per Kelvin)*
- S_1 Entropy at Point 1 *(Joule per Kilogram K)*
- S_2 Entropy at Point 2 *(Joule per Kilogram K)*
- $s1^\circ$ Standard Molar Entropy at Point 1 *(Joule per Kilogram K)*
- $s2^\circ$ Standard Molar Entropy at Point 2 *(Joule per Kilogram K)*
- **T** Temperature *(Kelvin)*
- T_1 Temperature of Surface 1 *(Kelvin)*
- T_2 Temperature of Surface 2 *(Kelvin)*

Constants, Functions, Measurements used in list of Entropy Generation Formulas above

- constant(s): **[R]**, 8.31446261815324
  Universal gas constant
- 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: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Volume** in Cubic Meter (m^3)
  Volume Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Energy** in Kilojoule (KJ)
  Energy Unit Conversion
- Measurement: **Heat of Combustion (per Mass)** in Joule per Kilogram (J/kg)
  Heat of Combustion (per Mass) Unit Conversion
- Measurement: **Specific Heat Capacity** in Joule per Kilogram per K (J/(kg*K))
  Specific Heat Capacity Unit Conversion
- Measurement: **Specific Volume** in Cubic Meter per Kilogram (m^3/kg)
  Specific Volume Unit Conversion
- Measurement: **Specific Entropy** in Joule per Kilogram K (J/kg*K)
  Specific Entropy Unit Conversion
- Measurement: **Entropy** in Joule per Kelvin (J/K)
  Entropy Unit Conversion
- Measurement: **Molar Specific Heat Capacity at Constant Pressure** in Joule Per Kelvin Per Mole (J/K*mol)
  Molar Specific Heat Capacity at Constant Pressure Unit Conversion
- Measurement: **Molar Specific Heat Capacity at Constant Volume** in Joule Per Kelvin Per Mole (J/K*mol)

- T_f Final Temperature *(Kelvin)*
- T_i Initial Temperature *(Kelvin)*
- T_{in} Input Temperature *(Kelvin)*
- T_{out} Output Temperature *(Kelvin)*
- **TEG** Total Entropy Generation *(Joule per Kilogram K)*
- **U** Internal Energy *(Kilojoule)*
- V_f Final Volume of System *(Cubic Meter)*
- V_i Initial Volume of System *(Cubic Meter)*
- **δs** Entropy Change Variable Specific Heat *(Joule per Kilogram K)*
- **ΔS** Change in Entropy *(Joule per Kilogram K)*
- δs_{pres} Entropy Change Constant Pressure *(Joule per Kilogram K)*
- δs_{vol} Entropy Change Constant Volume *(Joule per Kilogram K)*
- v_1 Specific Volume at Point 1 *(Cubic Meter per Kilogram)*
- v_2 Specific Volume at Point 2 *(Cubic Meter per Kilogram)*

Molar Specific Heat Capacity at Constant Volume Unit Conversion

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