Important Thermodynamics Factor Formulas PDF

Formulas
Examples
with Units

List of 12
Important Thermodynamics Factor Formulas

1) Entropy Change for Isochoric Process given Pressures Formula

Evaluate Formula

Formula

$$\Delta S_{CV} = m_{gas} \cdot C_v \cdot \ln\left(\frac{P_f}{P_i}\right)$$

Example with Units

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

2) Entropy Change for Isochoric Process given Temperature Formula

Evaluate Formula

Formula

$$\Delta S_{CV} = m_{gas} \cdot C_v \cdot \ln\left(\frac{T_f}{T_i}\right)$$

Example with Units

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

3) 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

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

4) Entropy Change in Isobaric Process given Temperature Formula

Evaluate Formula

Formula

$$\Delta S_{CP} = m_{gas} \cdot C_{pm} \cdot \ln\left(\frac{T_f}{T_i}\right)$$

Example with Units

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

5) Entropy Change in Isobaric Processin Terms of Volume Formula

Evaluate Formula

Formula

$$\Delta S_{CP} = m_{gas} \cdot C_{pm} \cdot \ln\left(\frac{V_f}{V_i}\right)$$

Example with Units

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

6) Heat Transfer at Constant Pressure Formula

Evaluate Formula

Formula

$$Q_p = m_{gas} \cdot C_{pm} \cdot \left(T_f - T_i\right)$$

Example with Units

$$9.76\,\text{kJ/kg} = 2\,\text{kg} \cdot 122\,\text{J/K*mol} \cdot \left(345\,\text{K} - 305\,\text{K}\right)$$

7) Isobaric Work for given Mass and Temperatures Formula

Evaluate Formula

Formula

$$W_b = N \cdot [R] \cdot \left(T_f - T_i \right)$$

Example with Units

$$16628.9252\,\text{J} = 50\,\text{mol} \cdot 8.3145 \cdot \left(345\,\text{K} - 305\,\text{K} \right)$$

8) Isobaric Work for given Pressure and Volumes Formula

Evaluate Formula

Formula

$$W_b = P_{abs} \cdot \left(V_f - V_i \right)$$

Example with Units

$$200000\,\text{J} = 100000\,\text{Pa} \cdot \left(13\,\text{m}^3 - 11.0\,\text{m}^3 \right)$$

9) Mass Flow Rate in Steady Flow Formula

Evaluate Formula

Formula

$$m = A \cdot \frac{u_f}{v}$$

Example with Units

$$19.6364\,\text{kg/s} = 24\,\text{m}^2 \cdot \frac{9\,\text{m/s}}{11\,\text{m}^3\text{/kg}}$$

10) Specific Heat Capacity at Constant Pressure Formula

Evaluate Formula

Formula

$$C_{pm} = [R] + C_v$$

Example with Units

$$538.3145\,\text{J/K*mol} = 8.3145 + 530\,\text{J/K*mol}$$

11) Specific Heat Capacity at Constant Pressure using Adiabatic Index Formula

Evaluate Formula

Formula

$$C_p = \frac{\gamma \cdot [R]}{\gamma - 1}$$

Example with Units

$$0.0291\,\text{kJ/kg*K} = \frac{1.4 \cdot 8.3145}{1.4 - 1}$$

12) Work Done in Adiabatic Process given Adiabatic Index Formula

Evaluate Formula

Formula

$$W = \frac{m_{gas} \cdot [R] \cdot \left(T_i - T_f \right)}{\gamma - 1}$$

Example with Units

$$-1662.8925\,\text{J} = \frac{2\,\text{kg} \cdot 8.3145 \cdot \left(305\,\text{K} - 345\,\text{K} \right)}{1.4 - 1}$$

Variables used in list of Thermodynamics Factor Formulas above

- **A** Cross Sectional Area *(Square Meter)*
- **C_p** Specific Heat Capacity at Constant Pressure *(Kilojoule per Kilogram per K)*
- **C_{pm}** Molar Specific Heat Capacity at Constant Pressure *(Joule Per Kelvin Per Mole)*
- **C_v** Molar Specific Heat Capacity at Constant Volume *(Joule Per Kelvin Per Mole)*
- **m** Mass Flow Rate *(Kilogram per Second)*
- **m_{gas}** Mass of Gas *(Kilogram)*
- **N** Amount of Gaseous Substance in Moles *(Mole)*
- **P_{abs}** Absolute Pressure *(Pascal)*
- **P_f** Final Pressure of System *(Pascal)*
- **P_i** Initial Pressure of System *(Pascal)*
- **Q_p** Heat Transfer *(Kilojoule per Kilogram)*
- **T_f** Final Temperature *(Kelvin)*
- **T_i** Initial Temperature *(Kelvin)*
- **u_f** Fluid Velocity *(Meter per Second)*
- **v** Specific Volume *(Cubic Meter per Kilogram)*
- **V_f** Final Volume of System *(Cubic Meter)*
- **V_i** Initial Volume of System *(Cubic Meter)*
- **W** Work *(Joule)*
- **W_b** Isobaric Work *(Joule)*
- **γ** Heat Capacity Ratio
- **ΔS** Change in Entropy *(Joule per Kilogram K)*
- **$ΔS_{CP}$** Entropy Change Constant Pressure *(Joule per Kilogram K)*
- **$ΔS_{CV}$** Entropy Change Constant Volume *(Joule per Kilogram K)*

Constants, Functions, Measurements used in list of Thermodynamics Factor 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: **Amount of Substance** in Mole (mol)
  Amount of Substance Unit Conversion
- Measurement: **Volume** in Cubic Meter (m³)
  Volume Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Heat of Combustion (per Mass)** in Kilojoule per Kilogram (kJ/kg)
  Heat of Combustion (per Mass) Unit Conversion
- Measurement: **Specific Heat Capacity** in Kilojoule per Kilogram per K (kJ/kg*K)
  Specific Heat Capacity Unit Conversion
- Measurement: **Mass Flow Rate** in Kilogram per Second (kg/s)
  Mass Flow Rate Unit Conversion
- Measurement: **Specific Volume** in Cubic Meter per Kilogram (m³/kg)
  Specific Volume Unit Conversion
- Measurement: **Specific Entropy** in Joule per Kilogram K (J/kg*K)
  Specific 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)
  Molar Specific Heat Capacity at Constant Volume Unit Conversion

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