Important Factors of Thermodynamics Formulas PDF

Formulas
Examples
with Units

List of 13
Important Factors of Thermodynamics Formulas

1) Absolute Humidity Formula

Evaluate Formula

Formula

$$AH = \frac{W}{V}$$

Example with Units

$$2200 = \frac{55\,\text{kg}}{25\,\text{L}}$$

2) Average Speed of Gases Formula

Evaluate Formula

Formula

$$V_{avg} = \sqrt{\frac{8 \cdot [R] \cdot T_{ga}}{\pi \cdot M_{molar}}}$$

Example with Units

$$147.1356\,\text{m/s} = \sqrt{\frac{8 \cdot 8.3145 \cdot 45\,\text{K}}{3.1416 \cdot 44.01\,\text{g/mol}}}$$

3) Change in Momentum Formula

Evaluate Formula

Formula

$$\Delta U = M \cdot \left(u_{02} - u_{01} \right)$$

Example with Units

$$1260\,\text{kg*m/s} = 12.6\,\text{kg} \cdot \left(250\,\text{m/s} - 150\,\text{m/s} \right)$$

4) Degree of Freedom given Equipartition Energy Formula

Evaluate Formula

Formula

$$F = 2 \cdot \frac{K}{[BoltZ] \cdot T_{gb}}$$

Example with Units

$$1.7E{+}23 = 2 \cdot \frac{107\,\text{J}}{1.4E{-}23\,\text{J/K} \cdot 90\,\text{K}}$$

5) Input Power to Turbine or Power given to Turbine Formula

Evaluate Formula

Formula

$$P = \rho \cdot g \cdot Q \cdot H_w$$

Example with Units

$$37372.545\,\text{W} = 997\,\text{kg/m}^3 \cdot 9.8\,\text{m/s}^2 \cdot 1.5\,\text{m}^3\text{/s} \cdot 2.55\,\text{m}$$

6) Molar Mass of Gas given Average Speed of Gas Formula

Evaluate Formula

Formula

$$M_{molar} = \frac{8 \cdot [R] \cdot T_{ga}}{\pi \cdot V_{avg}^2}$$

Example with Units

$$44.01\,\text{g/mol} = \frac{8 \cdot 8.3145 \cdot 45\,\text{K}}{3.1416 \cdot 147.1356\,\text{m/s}^2}$$

7) Molar Mass of Gas given Most Probable Speed of Gas Formula

Evaluate Formula

Formula

$$M_{molar} = \frac{2 \cdot [R] \cdot T_{ga}}{V_p^2}$$

Example with Units

$$44.01\,\text{g/mol} = \frac{2 \cdot 8.3145 \cdot 45\,\text{K}}{130.3955\,\text{m/s}^2}$$

8) Molar Mass of Gas given RMS Velocity of Gas Formula

Evaluate Formula

Formula

$$M_{molar} = \frac{3 \cdot [R] \cdot T_{ga}}{V_{rms}^2}$$

Example with Units

$$43.9124\,\text{g/mol} = \frac{3 \cdot 8.3145 \cdot 45\,\text{K}}{159.8786\,\text{m/s}^2}$$

9) Most Probable Speed Formula

Evaluate Formula

Formula

$$V_p = \sqrt{\frac{2 \cdot [R] \cdot T_{ga}}{M_{molar}}}$$

Example with Units

$$130.3955\,\text{m/s} = \sqrt{\frac{2 \cdot 8.3145 \cdot 45\,\text{K}}{44.01\,\text{g/mol}}}$$

10) Newton's Law of Cooling Formula

Evaluate Formula

Formula

$$q = h_t \cdot \left(T_w - T_f \right)$$

Example with Units

$$77.7\,\text{W/m}^2 = 13.2\,\text{W/m}^2\text{*K} \cdot \left(305\,\text{K} - 299.113636\,\text{K} \right)$$

11) RMS Speed Formula

Evaluate Formula

Formula

$$V_{rms} = \sqrt{\frac{3 \cdot [R] \cdot T_g}{M_{molar}}}$$

Example with Units

$$159.8786\,\text{m/s} = \sqrt{\frac{3 \cdot 8.3145 \cdot 45.1\,\text{K}}{44.01\,\text{g/mol}}}$$

12) Specific Gas Constant Formula

Evaluate Formula

Formula

$$R = \frac{[R]}{M_{molar}}$$

Example with Units

$$188.9221\,\text{J/(kg*K)} = \frac{8.3145}{44.01\,\text{g/mol}}$$

13) Van der Waals Equation Formula

Evaluate Formula

Formula

$$p = [R] \cdot \frac{T}{V_m - b} - \frac{R_a}{V_m^2}$$

Example with Units

$$22.0848\,\text{Pa} = 8.3145 \cdot \frac{85\,\text{K}}{32\,\text{m}^3/\text{mol} - 30.52\text{e-}6\,\text{m}^3/\text{mol}} - \frac{5.47\text{e-}1\,\text{J/kg*K}}{32\,\text{m}^3/\text{mol}^2}$$

Variables used in list of Factors of Thermodynamics Formulas above

- **AH** Absolute Humidity
- **b** Gas Constant b *(Cubic Meter per Mole)*
- **F** Degree of Freedom
- **g** Acceleration due to Gravity *(Meter per Square Second)*
- h_t Heat Transfer Coefficient *(Watt per Square Meter per Kelvin)*
- H_w Head *(Meter)*
- **K** Equipartition Energy *(Joule)*
- **M** Mass of Body *(Kilogram)*
- M_{molar} Molar Mass *(Gram Per Mole)*
- **p** Van der Waals Equation *(Pascal)*
- **P** Power *(Watt)*
- **q** Heat Flux *(Watt per Square Meter)*
- **Q** Discharge *(Cubic Meter per Second)*
- **R** Specific Gas Constant *(Joule per Kilogram per K)*
- R_a Gas Constant a *(Joule per Kilogram K)*
- **T** Temperature *(Kelvin)*
- T_f Temperature of Characteristic Fluid *(Kelvin)*
- T_g Temperature of Gas *(Kelvin)*
- T_{ga} Temperature of Gas A *(Kelvin)*
- T_{gb} Temperature of Gas B *(Kelvin)*
- T_w Surface Temperature *(Kelvin)*
- u_{01} Initial Velocity at Point 1 *(Meter per Second)*
- u_{02} Initial Velocity at Point 2 *(Meter per Second)*
- **V** Volume of Gas *(Liter)*
- V_{avg} Average Speed of Gas *(Meter per Second)*
- V_m Molar Volume *(Cubic Meter per Mole)*
- V_p Most Probable Speed *(Meter per Second)*
- V_{rms} Root Mean Square Velocity *(Meter per Second)*
- **W** Weight *(Kilogram)*

Constants, Functions, Measurements used in list of Factors of Thermodynamics Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **[BoltZ]**, 1.38064852E-23 *Boltzmann constant*
- constant(s): **[R]**, 8.31446261815324 *Universal gas constant*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Weight** in Kilogram (kg) *Weight Unit Conversion*
- Measurement: **Temperature** in Kelvin (K) *Temperature Unit Conversion*
- Measurement: **Volume** in Liter (L) *Volume Unit Conversion*
- Measurement: **Pressure** in Pascal (Pa) *Pressure Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s) *Speed Unit Conversion*
- Measurement: **Acceleration** in Meter per Square Second (m/s²) *Acceleration Unit Conversion*
- Measurement: **Energy** in Joule (J) *Energy Unit Conversion*
- Measurement: **Power** in Watt (W) *Power Unit Conversion*
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s) *Volumetric Flow Rate Unit Conversion*
- Measurement: **Specific Heat Capacity** in Joule per Kilogram per K (J/(kg*K)) *Specific Heat Capacity Unit Conversion*
- Measurement: **Heat Flux Density** in Watt per Square Meter (W/m²) *Heat Flux Density Unit Conversion*

- **ΔU** Change in Momentum *(Kilogram Meter per Second)*
- **ρ** Density *(Kilogram per Cubic Meter)*

- Measurement: **Heat Transfer Coefficient** in Watt per Square Meter per Kelvin (W/m²*K)
  Heat Transfer Coefficient Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Specific Entropy** in Joule per Kilogram K (J/kg*K)
  Specific Entropy Unit Conversion
- Measurement: **Molar Mass** in Gram Per Mole (g/mol)
  Molar Mass Unit Conversion
- Measurement: **Molar Magnetic Susceptibility** in Cubic Meter per Mole (m³/mol)
  Molar Magnetic Susceptibility Unit Conversion
- Measurement: **Momentum** in Kilogram Meter per Second (kg*m/s)
  Momentum Unit Conversion

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