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Basic Relationship of Thermodynamics Formulas

Calculators! Examples! Conversions!

List of 22 Basic Relationship of Thermodynamics Formulas

Basic Relationship of Thermodynamics

1) Absolute Pressure given Absolute Temperature

Open Calculator

fx $$\mathrm{P}_{\mathrm{abs}} = \rho_{\mathrm{gas}} \cdot \mathrm{R}_{\mathrm{specific}} \cdot \mathrm{T}_{\mathrm{Abs}}$$

ex $$53688.52\mathrm{Pa} = 1.02\mathrm{kg/m^3} \cdot 287\mathrm{J/kg{*}K} \cdot 183.4\mathrm{K}$$

2) Absolute Temperature given Absolute Pressure

Open Calculator

fx $$\mathrm{T}_{\mathrm{Abs}} = \frac{\mathrm{P}_{\mathrm{abs}}}{\rho_{\mathrm{gas}} \cdot \mathrm{R}_{\mathrm{specific}}}$$

ex $$183.3999\mathrm{K} = \frac{53688.5\mathrm{Pa}}{1.02\mathrm{kg/m^3} \cdot 287\mathrm{J/kg{*}K}}$$

3) Change in Internal Energy given Total Heat Supplied to Gas

Open Calculator

fx $$\Delta\mathrm{U} = \mathrm{H} - \mathrm{w}$$

ex $$9400\mathrm{J} = 39.4\mathrm{KJ} - 30\mathrm{KJ}$$

4) Constant for External Work Done in Adiabatic process Introducing Pressure

Open Calculator

fx $$C = \left(\left(\frac{1}{w}\right) \cdot (P_1 \cdot v_1 - P_2 \cdot v_2)\right) + 1$$

ex $$0.522667 = \left(\left(\frac{1}{30\text{KJ}}\right) \cdot (2.5\text{Bar} \cdot 1.64\text{m}^3/\text{kg} - 5.2\text{Bar} \cdot 0.816\text{m}^3/\text{kg})\right) + 1$$

5) Continuity Equation for Compressible Fluids

Open Calculator

fx $$A = \rho_f \cdot A_{cs} \cdot V_{Avg}$$

ex $$991516.5 = 997\text{kg}/\text{m}^3 \cdot 13\text{m}^2 \cdot 76.5\text{m}/\text{s}$$

6) External Work Done by Gas given Total Heat Supplied

Open Calculator

fx $$w = H - \Delta U$$

ex $$30\text{KJ} = 39.4\text{KJ} - 9400\text{J}$$

7) External Work Done by Gas in Adiabatic Process Introducing Pressure

Open Calculator

fx $$w = \left(\frac{1}{C - 1}\right) \cdot (P_1 \cdot v_1 - P_2 \cdot v_2)$$

ex $$28.64\text{KJ} = \left(\frac{1}{0.5 - 1}\right) \cdot (2.5\text{Bar} \cdot 1.64\text{m}^3/\text{kg} - 5.2\text{Bar} \cdot 0.816\text{m}^3/\text{kg})$$

8) Gas Constant given Absolute Pressure

Open Calculator

fx $$R_{specific} = \frac{P_{abs}}{\rho_{gas} \cdot T_{Abs}}$$

ex $$286.9999\text{J/kg*K} = \frac{53688.5\text{Pa}}{1.02\text{kg/m}^3 \cdot 183.4\text{K}}$$

9) Kinetic Energy given Total Energy in Compressible Fluids

Open Calculator

fx $$KE = E_{(Total)} - (PE + E_p + E_m)$$

ex $$75\text{J} = 279\text{J} - (4\text{J} + 50\text{J} + 150\text{J})$$

10) Mass Density given Absolute Pressure

Open Calculator

fx $$\rho_{gas} = \frac{P_{abs}}{R_{specific} \cdot T_{Abs}}$$

ex $$1.02\text{kg/m}^3 = \frac{53688.5\text{Pa}}{287\text{J/kg*K} \cdot 183.4\text{K}}$$

11) Molecular Energy given Total Energy in Compressible Fluids

Open Calculator

fx $$E_m = E_{(Total)} - (KE + PE + E_p)$$

ex $$150\text{J} = 279\text{J} - (75\text{J} + 4\text{J} + 50\text{J})$$

12) Potential Energy given Total Energy in Compressible Fluids

Open Calculator

fx $$PE = E_{(Total)} - (KE + E_p + E_m)$$

ex $$4\text{J} = 279\text{J} - (75\text{J} + 50\text{J} + 150\text{J})$$

13) Pressure Energy given Total Energy in Compressible Fluids

Open Calculator

$$E_p = E_{(Total)} - (KE + PE + E_m)$$

$$50J = 279J - (75J + 4J + 150J)$$

14) Pressure for External Work Done by Gas in Adiabatic Process Introducing Pressure

Open Calculator

$$P_2 = -\frac{(w \cdot (C - 1)) - (P_1 \cdot v_1)}{v_2}$$

$$5.208333Bar = -\frac{(30KJ \cdot (0.5 - 1)) - (2.5Bar \cdot 1.64m^3/kg)}{0.816m^3/kg}$$

15) Pressure given Constant

Open Calculator

$$p_c = \frac{R_a}{v}$$

$$0.049727Pa = \frac{5.47e\text{-}1J/kg{*}K}{11m^3/kg}$$

16) Specific Volume for External Work Done in Adiabatic Process Introducing Pressure

Open Calculator

$$v_1 = \frac{(w \cdot (C - 1)) + (P_2 \cdot v_2)}{P_1}$$

$$1.63728m^3/kg = \frac{(30KJ \cdot (0.5 - 1)) + (5.2Bar \cdot 0.816m^3/kg)}{2.5Bar}$$

17) Total Energy in Compressible Fluids

fx $$\mathrm{E_{(Total)}} = \mathrm{KE} + \mathrm{PE} + \mathrm{E_p} + \mathrm{E_m}$$

Open Calculator

ex $$279\mathrm{J} = 75\mathrm{J} + 4\mathrm{J} + 50\mathrm{J} + 150\mathrm{J}$$

18) Total Heat Supplied to Gas

fx $$\mathrm{H} = \Delta\mathrm{U} + \mathrm{w}$$

Open Calculator

ex $$39.4\mathrm{KJ} = 9400\mathrm{J} + 30\mathrm{KJ}$$

Boyle's law

19) Boyle's Law According to Adiabatic Process

fx $$\mathrm{R_a} = \mathrm{p_c} \cdot \left(\mathrm{v}^{\mathrm{C}}\right)$$

Open Calculator

ex $$198.9975\mathrm{J/kg{*}K} = 60\mathrm{Pa} \cdot \left(\left(11\mathrm{m^3/kg}\right)^{0.5}\right)$$

20) Boyle's Law According to Isothermal Process

fx $$\mathrm{R_a} = \mathrm{p_c} \cdot \mathrm{v}$$

Open Calculator

ex $$660\mathrm{J/kg{*}K} = 60\mathrm{Pa} \cdot 11\mathrm{m^3/kg}$$

21) Boyle's Law given Mass Density

fx $$\mathrm{R_a} = \frac{\mathrm{p_c}}{\rho_{\mathrm{f}}^{\mathrm{C}}}$$

Open Calculator

ex $$1.900219\mathrm{J/kg{*}K} = \frac{60\mathrm{Pa}}{\left(997\mathrm{kg/m^3}\right)^{0.5}}$$

22) Boyle's Law given Weight Density in Adiabatic Process

Open Calculator

$$R_a = \frac{p_c}{\omega^C}$$

ex
$$0.268328\text{J/kg*K} = \frac{60\text{Pa}}{(0.05\text{g/mm}^3)^{0.5}}$$

Variables Used

- **A** Constant A1
- A_{cs} Cross-Sectional Area of Flow Channel *(Square Meter)*
- **C** Heat Capacity Ratio
- $E_{(Total)}$ Total Energy in Compressible Fluids *(Joule)*
- E_m Molecular Energy *(Joule)*
- E_p Pressure Energy *(Joule)*
- **H** Total Heat *(Kilojoule)*
- **KE** Kinetic Energy *(Joule)*
- P_1 Pressure 1 *(Bar)*
- P_2 Pressure 2 *(Bar)*
- P_{abs} Absolute Pressure by Fluid Density *(Pascal)*
- p_c Pressure of Compressible Flow *(Pascal)*
- **PE** Potential Energy *(Joule)*
- R_a Gas Constant a *(Joule per Kilogram K)*
- $R_{specific}$ Ideal Gas Constant *(Joule per Kilogram K)*
- T_{Abs} Absolute Temperature of Compressible Fluid *(Kelvin)*
- **v** Specific Volume *(Cubic Meter per Kilogram)*
- v_1 Specific Volume for Point 1 *(Cubic Meter per Kilogram)*
- v_2 Specific Volume for Point 2 *(Cubic Meter per Kilogram)*
- V_{Avg} Average Velocity *(Meter per Second)*
- **w** Work Done *(Kilojoule)*
- **ΔU** Change in Internal Energy *(Joule)*
- ρ_f Mass Density of Fluid *(Kilogram per Cubic Meter)*

- **ρ_{gas}** Mass Density of Gas *(Kilogram per Cubic Meter)*
- **ω** Weight Density *(Gram per Cubic Millimeter)*

Constants, Functions, Measurements used

- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Area** in Square Meter (m^2)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa), Bar (Bar)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Energy** in Joule (J), Kilojoule (KJ)
  Energy Unit Conversion
- Measurement: **Mass Concentration** in Kilogram per Cubic Meter (kg/m^3)
  Mass Concentration Unit Conversion
- Measurement: **Density** in Gram per Cubic Millimeter (g/mm^3)
  Density 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

Check other formula lists

- **Basic Relationship of Thermodynamics Formulas**

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