Important Density of Gas Formulas PDF

Formulas
Examples
with Units

List of 13
Important Density of Gas Formulas

1) Density given Relative Size of Fluctuations in Particle Density Formula

Evaluate Formula

Formula

$$\rho_{fluctuation} = \sqrt{\frac{\left(\frac{\Delta N^2}{V_T}\right)}{[BoltZ] \cdot K_T \cdot T}}$$

Example with Units

$$1.6E{+}10\,\text{kg/m}^3 = \sqrt{\frac{\left(\frac{15}{0.63\,\text{m}^3}\right)}{1.4E{-}23\,\text{J/K} \cdot 75\,\text{m}^2\text{/N} \cdot 85\,\text{K}}}$$

2) Density given Thermal Pressure Coefficient, Compressibility Factors and Cp Formula

Evaluate Formula

Formula

$$\rho_{TPC} = \frac{\left(\Lambda^2\right) \cdot T}{\left(\left(\frac{1}{K_S}\right) - \left(\frac{1}{K_T}\right)\right) \cdot \left(C_p - [R]\right)}$$

Example with Units

$$0.0785\,\text{kg/m}^3 = \frac{\left(0.01\,\text{Pa/K}^2\right) \cdot 85\,\text{K}}{\left(\left(\frac{1}{70\,\text{m}^2\text{/N}}\right) - \left(\frac{1}{75\,\text{m}^2\text{/N}}\right)\right) \cdot \left(122\,\text{J/K*mol} - 8.3145\right)}$$

3) Density given Thermal Pressure Coefficient, Compressibility Factors and Cv Formula

Evaluate Formula

Formula

$$\rho_{TPC} = \frac{\left(\Lambda^2\right) \cdot T}{\left(\left(\frac{1}{K_S}\right) - \left(\frac{1}{K_T}\right)\right) \cdot C_v}$$

Example with Units

$$0.0867\,\text{kg/m}^3 = \frac{\left(0.01\,\text{Pa/K}^2\right) \cdot 85\,\text{K}}{\left(\left(\frac{1}{70\,\text{m}^2\text{/N}}\right) - \left(\frac{1}{75\,\text{m}^2\text{/N}}\right)\right) \cdot 103\,\text{J/K*mol}}$$

4) Density given Volumetric Coefficient of Thermal Expansion, Compressibility Factors and Cp Formula

Evaluate Formula

Formula

$$\rho_{VC} = \frac{\left(\alpha^2\right) \cdot T}{\left(K_T - K_S\right) \cdot C_p}$$

Example with Units

$$87.0902\,\text{kg/m}^3 = \frac{\left(25\,\text{K}^{-1\,2}\right) \cdot 85\,\text{K}}{\left(75\,\text{m}^2\text{/N} - 70\,\text{m}^2\text{/N}\right) \cdot 122\,\text{J/K*mol}}$$

5) Density given Volumetric Coefficient of Thermal Expansion, Compressibility Factors and Cv Formula

Evaluate Formula

Formula

$$\rho_{vC} = \frac{\left(\alpha^2\right) \cdot T}{\left(K_T - K_S\right) \cdot \left(C_v + [R]\right)}$$

Example with Units

$$95.4503\,\text{kg/m}^3 = \frac{\left(25\,\text{K}^{-1\,2}\right) \cdot 85\,\text{K}}{\left(75\,\text{m}^2/\text{N} - 70\,\text{m}^2/\text{N}\right) \cdot \left(103\,\text{J/K*mol} + 8.3145\right)}$$

6) Density of Gas given Average Velocity and Pressure Formula

Evaluate Formula

Formula

$$\rho_{AV\_P} = \frac{8 \cdot P_{gas}}{\pi \cdot \left(\left(C_{av}\right)^2\right)}$$

Example with Units

$$0.0219\,\text{kg/m}^3 = \frac{8 \cdot 0.215\,\text{Pa}}{3.1416 \cdot \left(\left(5\,\text{m/s}\right)^2\right)}$$

7) Density of Gas given Average Velocity and Pressure in 2D Formula

Evaluate Formula

Formula

$$\rho_{AV\_P} = \frac{\pi \cdot P_{gas}}{2 \cdot \left(\left(C_{av}\right)^2\right)}$$

Example with Units

$$0.0135\,\text{kg/m}^3 = \frac{3.1416 \cdot 0.215\,\text{Pa}}{2 \cdot \left(\left(5\,\text{m/s}\right)^2\right)}$$

8) Density of Gas given Most Probable Speed Pressure Formula

Evaluate Formula

Formula

$$\rho_{MPS} = \frac{2 \cdot P_{gas}}{\left(C_{mp}\right)^2}$$

Example with Units

$$0.0011\,\text{kg/m}^3 = \frac{2 \cdot 0.215\,\text{Pa}}{\left(20\,\text{m/s}\right)^2}$$

9) Density of Gas given Most Probable Speed Pressure in 2D Formula

Evaluate Formula

Formula

$$\rho_{MPS} = \frac{P_{gas}}{\left(C_{mp}\right)^2}$$

Example with Units

$$0.0005\,\text{kg/m}^3 = \frac{0.215\,\text{Pa}}{\left(20\,\text{m/s}\right)^2}$$

10) Density of Gas given Root Mean Square Speed and Pressure Formula

Evaluate Formula

Formula

$$\rho_{RMS\_P} = \frac{3 \cdot P_{gas}}{\left(C_{RMS}\right)^2}$$

Example with Units

$$0.0064\,\text{kg/m}^3 = \frac{3 \cdot 0.215\,\text{Pa}}{\left(10\,\text{m/s}\right)^2}$$

11) Density of Gas given Root Mean Square Speed and Pressure in 1D Formula

Evaluate Formula

Formula

$$\rho_{RMS\_P} = \frac{P_{gas}}{\left(C_{RMS}\right)^2}$$

Example with Units

$$0.0022\,\mathrm{kg/m^3} = \frac{0.215\,\mathrm{Pa}}{\left(10\,\mathrm{m/s}\right)^2}$$

12) Density of Gas given Root Mean Square Speed and Pressure in 2D Formula

Evaluate Formula

Formula

$$\rho_{RMS\_P} = \frac{2 \cdot P_{gas}}{\left(C_{RMS}\right)^2}$$

Example with Units

$$0.0043\,\mathrm{kg/m^3} = \frac{2 \cdot 0.215\,\mathrm{Pa}}{\left(10\,\mathrm{m/s}\right)^2}$$

13) Density of Material given Isentropic Compressibility Formula

Evaluate Formula

Formula

$$\rho_{IC} = \frac{1}{K_S \cdot \left(c^2\right)}$$

Example with Units

$$1.2\text{E-}7\,\mathrm{kg/m^3} = \frac{1}{70\,\mathrm{m^2/N} \cdot \left(343\,\mathrm{m/s}^2\right)}$$

Variables used in list of Density of Gas Formulas above

- **c** Speed of Sound *(Meter per Second)*
- C_{av} Average Velocity of Gas *(Meter per Second)*
- C_{mp} Most Probable Velocity *(Meter per Second)*
- C_p Molar Specific Heat Capacity at Constant Pressure *(Joule Per Kelvin Per Mole)*
- C_{RMS} Root Mean Square Speed *(Meter per Second)*
- C_v Molar Specific Heat Capacity at Constant Volume *(Joule Per Kelvin Per Mole)*
- K_S Isentropic Compressibility *(Square Meter per Newton)*
- K_T Isothermal Compressibility *(Square Meter per Newton)*
- P_{gas} Pressure of Gas *(Pascal)*
- **T** Temperature *(Kelvin)*
- V_T Volume *(Cubic Meter)*
- α Volumetric Coefficient of Thermal Expansion *(1 Per Kelvin)*
- ΔN^2 Relative Size of Fluctuations
- Λ Thermal Pressure Coefficient *(Pascal per Kelvin)*
- ρ_{AV_P} Density of Gas given AV and P *(Kilogram per Cubic Meter)*
- $\rho_{fluctuation}$ Density given fluctuations *(Kilogram per Cubic Meter)*
- ρ_{IC} Density given IC *(Kilogram per Cubic Meter)*
- ρ_{MPS} Density of Gas given MPS *(Kilogram per Cubic Meter)*
- ρ_{RMS_P} Density of Gas given RMS and P *(Kilogram per Cubic Meter)*
- ρ_{TPC} Density given TPC *(Kilogram per Cubic Meter)*
- ρ_{VC} Density given VC *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Density of Gas 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: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Volume** in Cubic Meter (m³)
  Volume Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Compressibility** in Square Meter per Newton (m²/N)
  Compressibility Unit Conversion
- Measurement: **Slope of Coexistence Curve** in Pascal per Kelvin (Pa/K)
  Slope of Coexistence Curve Unit Conversion
- Measurement: **Thermal Expansion** in 1 Per Kelvin (K⁻¹)
  Thermal Expansion 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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