Important PIB Formulas PDF

Formulas
Examples
with Units

List of 18
Important PIB Formulas

1) Force by Gas Molecule on Wall of Box Formula

Evaluate Formula

Formula

$$F_{wall} = \frac{m \cdot (u)^2}{L}$$

Example with Units

$$0.03\,\text{N} = \frac{0.2\,\text{g} \cdot (15\,\text{m/s})^2}{1500\,\text{mm}}$$

2) Length of Box given Force Formula

Evaluate Formula

Formula

$$L_F = \frac{m \cdot (u)^2}{F}$$

Example with Units

$$18\,\text{mm} = \frac{0.2\,\text{g} \cdot (15\,\text{m/s})^2}{2.5\,\text{N}}$$

3) Length of Rectangular Box given Time of Collision Formula

Evaluate Formula

Formula

$$L_{T\_box} = \frac{t \cdot u}{2}$$

Example with Units

$$150000\,\text{mm} = \frac{20\,\text{s} \cdot 15\,\text{m/s}}{2}$$

4) Mass of Each Gas Molecule in 2D Box given Pressure Formula

Evaluate Formula

Formula

$$m_P = \frac{2 \cdot P_{gas} \cdot V}{N_{molecules} \cdot (C_{RMS})^2}$$

Example with Units

$$0.001\,\text{g} = \frac{2 \cdot 0.215\,\text{Pa} \cdot 22.4\,\text{L}}{100 \cdot (10\,\text{m/s})^2}$$

5) Mass of Each Gas Molecule in 3D Box given Pressure Formula

Evaluate Formula

Formula

$$m_P = \frac{3 \cdot P_{gas} \cdot V}{N_{molecules} \cdot (C_{RMS})^2}$$

Example with Units

$$0.0014\,\text{g} = \frac{3 \cdot 0.215\,\text{Pa} \cdot 22.4\,\text{L}}{100 \cdot (10\,\text{m/s})^2}$$

6) Mass of Gas Molecule given Force Formula

Evaluate Formula

Formula

$$m_P = \frac{F \cdot L}{(u)^2}$$

Example with Units

$$16.6667\,\text{g} = \frac{2.5\,\text{N} \cdot 1500\,\text{mm}}{(15\,\text{m/s})^2}$$

7) Mass of Gas Molecule in 1D given Pressure Formula

Evaluate Formula

Formula

$$m_P = \frac{P_{gas} \cdot V_{box}}{(u)^2}$$

Example with Units

$$0.0038\,g = \frac{0.215\,Pa \cdot 4\,L}{(15\,m/s)^2}$$

8) Number of Gas Molecules in 2D Box given Pressure Formula

Evaluate Formula

Formula

$$N_P = \frac{2 \cdot P_{gas} \cdot V}{m \cdot (C_{RMS})^2}$$

Example with Units

$$0.4816 = \frac{2 \cdot 0.215\,Pa \cdot 22.4\,L}{0.2\,g \cdot (10\,m/s)^2}$$

9) Number of Gas Molecules in 3D Box given Pressure Formula

Evaluate Formula

Formula

$$N_P = \frac{3 \cdot P_{gas} \cdot V}{m \cdot (C_{RMS})^2}$$

Example with Units

$$0.7224 = \frac{3 \cdot 0.215\,Pa \cdot 22.4\,L}{0.2\,g \cdot (10\,m/s)^2}$$

10) Number of Moles given Kinetic Energy Formula

Evaluate Formula

Formula

$$N_{KE} = \left(\frac{2}{3}\right) \cdot \left(\frac{KE}{[R] \cdot T}\right)$$

Example with Units

$$0.0377 = \left(\frac{2}{3}\right) \cdot \left(\frac{40\,J}{8.3145 \cdot 85\,K}\right)$$

11) Number of Moles of Gas 1 given Kinetic Energy of both Gases Formula

Evaluate Formula

Formula

$$N_{moles\_KE} = \left(\frac{KE_1}{KE_2}\right) \cdot n_2 \cdot \left(\frac{T_2}{T_1}\right)$$

Example with Units

$$4.2 = \left(\frac{120\,J}{60\,J}\right) \cdot 3\,mol \cdot \left(\frac{140\,K}{200\,K}\right)$$

12) Number of Moles of Gas 2 given Kinetic Energy of both Gases Formula

Evaluate Formula

Formula

$$N_{moles\_KE} = n_1 \cdot \left(\frac{KE_2}{KE_1}\right) \cdot \left(\frac{T_1}{T_2}\right)$$

Example with Units

$$4.2857 = 6\,mol \cdot \left(\frac{60\,J}{120\,J}\right) \cdot \left(\frac{200\,K}{140\,K}\right)$$

13) Pressure Exerted by Single Gas Molecule in 1D Formula

Evaluate Formula

Formula

$$P_{gas\_1D} = \frac{m \cdot (u)^2}{V_{box}}$$

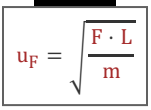
Example with Units

$$11.25\,Pa = \frac{0.2\,g \cdot (15\,m/s)^2}{4\,L}$$

14) Speed of Gas Molecule given Force Formula

Evaluate Formula

Formula



$$u_F = \sqrt{\frac{F \cdot L}{m}}$$

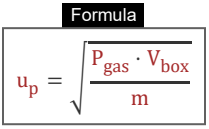
Example with Units

$$136.9306\,\text{m/s} = \sqrt{\frac{2.5\,\text{N} \cdot 1500\,\text{mm}}{0.2\,\text{g}}}$$

15) Speed of Gas Molecule in 1D given Pressure Formula

Evaluate Formula

Formula



$$u_p = \sqrt{\frac{P_{gas} \cdot V_{box}}{m}}$$

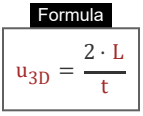
Example with Units

$$2.0736\,\text{m/s} = \sqrt{\frac{0.215\,\text{Pa} \cdot 4\,\text{L}}{0.2\,\text{g}}}$$

16) Speed of Particle in 3D Box Formula

Evaluate Formula

Formula



$$u_{3D} = \frac{2 \cdot L}{t}$$

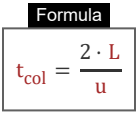
Example with Units

$$0.15\,\text{m/s} = \frac{2 \cdot 1500\,\text{mm}}{20\,\text{s}}$$

17) Time between Collisions of Particle and Walls Formula

Evaluate Formula

Formula



$$t_{col} = \frac{2 \cdot L}{u}$$

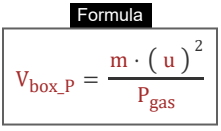
Example with Units

$$0.2\,\text{s} = \frac{2 \cdot 1500\,\text{mm}}{15\,\text{m/s}}$$

18) Volume of Box having Gas Molecule given Pressure Formula

Evaluate Formula

Formula



$$V_{box\_P} = \frac{m \cdot (u)^2}{P_{gas}}$$

Example with Units

$$209.3023\,\text{L} = \frac{0.2\,\text{g} \cdot (15\,\text{m/s})^2}{0.215\,\text{Pa}}$$

Variables used in list of PIB Formulas above

- C_{RMS} Root Mean Square Speed *(Meter per Second)*
- **F** Force *(Newton)*
- F_{wall} Force on a wall *(Newton)*
- **KE** Kinetic Energy *(Joule)*
- KE_1 Kinetic Energy of Gas 1 *(Joule)*
- KE_2 Kinetic Energy of Gas 2 *(Joule)*
- **L** Length of Rectangular Section *(Millimeter)*
- L_F Length of Rectangular box *(Millimeter)*
- L_{T_box} Length of Rectangular box given T *(Millimeter)*
- **m** Mass per Molecule *(Gram)*
- m_F Mass per Molecule given F *(Gram)*
- m_P Mass per Molecule given P *(Gram)*
- n_1 Number of Moles of Gas 1 *(Mole)*
- n_2 Number of Moles of Gas 2 *(Mole)*
- N_{KE} Number of Moles given KE
- $N_{molecules}$ Number of Molecules
- N_{moles_KE} Number of Moles given KE of Two Gases
- N_P Number of Molecules given P
- P_{gas} Pressure of Gas *(Pascal)*
- P_{gas_1D} Pressure of Gas in 1D *(Pascal)*
- **t** Time between Collision *(Second)*
- **T** Temperature *(Kelvin)*
- T_1 Temperature of Gas 1 *(Kelvin)*
- T_2 Temperature of Gas 2 *(Kelvin)*
- t_{col} Time of Collision *(Second)*
- **u** Speed of Particle *(Meter per Second)*
- u_{3D} Speed of Particle given in 3D *(Meter per Second)*
- u_F Speed of Particle given F *(Meter per Second)*
- u_p Speed of Particle given P *(Meter per Second)*

Constants, Functions, Measurements used in list of PIB Formulas above

- 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 Millimeter (mm)
  Length Unit Conversion
- Measurement: **Weight** in Gram (g)
  Weight Unit Conversion
- Measurement: **Time** in Second (s)
  Time 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 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: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion

- **V** Volume of Gas *(Liter)*
- V_{box} Volume of Rectangular Box *(Liter)*
- V_{box_P} Volume of Rectangular Box given P *(Liter)*

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