Important formulae on Equipartition Principle and Heat Capacity Formulas

List of 20 Important formulae on Equipartition Principle and Heat Capacity Formulas

Important formulae on Equipartition Principle and Heat Capacity

1) Atomicity given Molar Heat Capacity at Constant Pressure and Volume of Linear Molecule

Open Calculator

fx $$N = \frac{\left(2.5 \cdot \left(\frac{C_p}{C_v}\right)\right) - 1.5}{\left(3 \cdot \left(\frac{C_p}{C_v}\right)\right) - 3}$$

ex $$2.640351 = \frac{\left(2.5 \cdot \left(\frac{122\text{J/K*mol}}{103\text{J/K*mol}}\right)\right) - 1.5}{\left(3 \cdot \left(\frac{122\text{J/K*mol}}{103\text{J/K*mol}}\right)\right) - 3}$$

2) Atomicity given Molar Vibrational Energy of Non-Linear Molecule

Open Calculator

fx $$N = \frac{\left(\frac{E_v}{[R] \cdot T}\right) + 6}{3}$$

ex $$2.259411 = \frac{\left(\frac{550\text{J/mol}}{[R] \cdot 85\text{K}}\right) + 6}{3}$$

3) Atomicity given Ratio of Molar Heat Capacity of Linear Molecule

Open Calculator

fx $$N = \frac{(2.5 \cdot \gamma) - 1.5}{(3 \cdot \gamma) - 3}$$

ex $$1.5 = \frac{(2.5 \cdot 1.5) - 1.5}{(3 \cdot 1.5) - 3}$$

4) Atomicity given Vibrational Degree of Freedom in Non-Linear Molecule

Open Calculator

fx $$N = \frac{F + 6}{3}$$

ex $$2.666667 = \frac{2 + 6}{3}$$

5) Average Thermal Energy of Linear Polyatomic Gas Molecule given Atomicity

Open Calculator

fx $$Q_{atomicity} = ((6 \cdot N) - 5) \cdot (0.5 \cdot [BoltZ] \cdot T)$$

ex $$7.6\text{E\^{}-21J} = ((6 \cdot 3) - 5) \cdot (0.5 \cdot [BoltZ] \cdot 85\text{K})$$

6) Average Thermal Energy of Non-linear polyatomic Gas Molecule given Atomicity

Open Calculator

fx $Q_{atomicity} = ((6 \cdot N) - 6) \cdot (0.5 \cdot [BoltZ] \cdot T)$

ex $7E\hat{}\text{-}21J = ((6 \cdot 3) - 6) \cdot (0.5 \cdot [BoltZ] \cdot 85K)$

7) Degree of Freedom given Ratio of Molar Heat Capacity

Open Calculator

fx $F = \frac{2}{\gamma - 1}$

ex $4 = \frac{2}{1.5 - 1}$

8) Internal Molar Energy of Linear Molecule

Open Calculator

fx $U_{molar} = \left(\left(\frac{3}{2}\right) \cdot [R] \cdot T\right) + \left(\left(0.5 \cdot I_y \cdot \left(\omega_y^2\right)\right) + \left(0.5 \cdot I_z \cdot \left(\omega_z^2\right)\right)\right) + ((3 \cdot N) - 5) \cdot ([R] \cdot$

ex $3914.046J = \left(\left(\frac{3}{2}\right) \cdot [R] \cdot 85K\right) + \left(\left(0.5 \cdot 60kg{\cdot}m^2 \cdot \left((35degree/s)^2\right)\right) + \left(0.5 \cdot 65kg{\cdot}m^2 \cdot \left((40degree/s)^2\right)\right)\right.$

9) Internal Molar Energy of Linear Molecule given Atomicity

Open Calculator

fx $U_{molar} = ((6 \cdot N) - 5) \cdot (0.5 \cdot [R] \cdot T)$

ex $4593.741J = ((6 \cdot 3) - 5) \cdot (0.5 \cdot [R] \cdot 85K)$

10) Internal Molar Energy of Non-Linear Molecule

Open Calculator

fx $U_{molar} = \left(\left(\frac{3}{2}\right) \cdot [R] \cdot T\right) + \left(\left(0.5 \cdot I_y \cdot \left(\omega_y^2\right)\right) + \left(0.5 \cdot I_z \cdot \left(\omega_z^2\right)\right) + \left(0.5 \cdot I_x \cdot \left(\omega_x^2\right)\right)\right) + ($

ex $3214.856J = \left(\left(\frac{3}{2}\right) \cdot [R] \cdot 85K\right) + \left(\left(0.5 \cdot 60kg{\cdot}m^2 \cdot \left((35degree/s)^2\right)\right) + \left(0.5 \cdot 65kg{\cdot}m^2 \cdot \left((40degree/s)^2\right)\right)\right.$

11) Internal Molar Energy of Non-Linear Molecule given Atomicity

Open Calculator

fx $U_{molar} = ((6 \cdot N) - 6) \cdot (0.5 \cdot [R] \cdot T)$

ex $4240.376J = ((6 \cdot 3) - 6) \cdot (0.5 \cdot [R] \cdot 85K)$

12) Molar Heat Capacity at Constant Pressure given Compressibility

Open Calculator

fx $$C_p = \left(\frac{K_T}{K_S}\right) \cdot C_v$$

ex $$110.3571\text{J/K*mol} = \left(\frac{75\text{m}^2/\text{N}}{70\text{m}^2/\text{N}}\right) \cdot 103\text{J/K*mol}$$

13) Molar Vibrational Energy of Linear Molecule

Open Calculator

fx $$E_{viv} = ((3 \cdot N) - 5) \cdot ([R] \cdot T)$$

ex $$2826.917\text{J/mol} = ((3 \cdot 3) - 5) \cdot ([R] \cdot 85\text{K})$$

14) Molar Vibrational Energy of Non-Linear Molecule

Open Calculator

fx $$E_{viv} = ((3 \cdot N) - 6) \cdot ([R] \cdot T)$$

ex $$2120.188\text{J/mol} = ((3 \cdot 3) - 6) \cdot ([R] \cdot 85\text{K})$$

15) Number of Modes in Non-Linear Molecule

Open Calculator

fx $$N_{modes} = (6 \cdot N) - 6$$

ex $$12 = (6 \cdot 3) - 6$$

16) Ratio of Molar Heat Capacity given Degree of Freedom

Open Calculator

fx $$\gamma = 1 + \left(\frac{2}{F}\right)$$

ex $$2 = 1 + \left(\frac{2}{2}\right)$$

17) Ratio of Molar Heat Capacity of Linear Molecule

Open Calculator

fx $$\gamma = \frac{(((3 \cdot N) - 2.5) \cdot [R]) + [R]}{((3 \cdot N) - 2.5) \cdot [R]}$$

ex $$1.153846 = \frac{(((3 \cdot 3) - 2.5) \cdot [R]) + [R]}{((3 \cdot 3) - 2.5) \cdot [R]}$$

18) Total Kinetic Energy

Open Calculator

fx $$E_{total} = E_T + E_{rot} + E_{vf}$$

ex $$850\text{J} = 600\text{J} + 150\text{J} + 100\text{J}$$

19) Translational Energy

Open Calculator

fx $$E_T = \left(\frac{p_x^2}{2 \cdot Mass_{flight\ path}}\right) + \left(\frac{p_y^2}{2 \cdot Mass_{flight\ path}}\right) + \left(\frac{p_z^2}{2 \cdot Mass_{flight\ path}}\right)$$

ex $$512.6939J = \left(\frac{(105kg*m/s)^2}{2 \cdot 35.45kg}\right) + \left(\frac{(110kg*m/s)^2}{2 \cdot 35.45kg}\right) + \left(\frac{(115kg*m/s)^2}{2 \cdot 35.45kg}\right)$$

20) Vibrational Mode of Linear Molecule

Open Calculator

fx $$N_{vib} = (3 \cdot N) - 5$$

ex $$4 = (3 \cdot 3) - 5$$

Variables Used

- **C_p** 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)*
- **E_{rot}** Rotational Energy *(Joule)*
- **E_T** Translational Energy *(Joule)*
- **E_{total}** Total Energy *(Joule)*
- **E_v** Molar Vibrational Energy *(Joule Per Mole)*
- **E_{vf}** Vibrational Energy *(Joule)*
- **E_{viv}** Vibrational Molar Energy *(Joule Per Mole)*
- **F** Degree of Freedom
- **I_x** Moment of Inertia along X-axis *(Kilogram Square Meter)*
- **I_y** Moment of Inertia along Y-axis *(Kilogram Square Meter)*
- **I_z** Moment of Inertia along Z-axis *(Kilogram Square Meter)*
- **K_S** Isentropic Compressibility *(Square Meter per Newton)*
- **K_T** Isothermal Compressibility *(Square Meter per Newton)*
- **$Mass_{flight\ path}$** Mass *(Kilogram)*
- **N** Atomicity
- **N_{modes}** Number of Normal modes for Non Linear
- **N_{vib}** Number of Normal modes
- **p_x** Momentum along X-axis *(Kilogram Meter per Second)*
- **p_y** Momentum along Y-axis *(Kilogram Meter per Second)*
- **p_z** Momentum along Z-axis *(Kilogram Meter per Second)*
- **$Q_{atomicity}$** Thermal Energy given Atomicity *(Joule)*
- **T** Temperature *(Kelvin)*
- **U_{molar}** Molar Internal Energy *(Joule)*
- **γ** Ratio of Molar Heat Capacity
- **ω_x** Angular Velocity along X-axis *(Degree per Second)*
- **ω_y** Angular Velocity along Y-axis *(Degree per Second)*
- **ω_z** Angular Velocity along Z-axis *(Degree per Second)*

Constants, Functions, Measurements used

- Constant: **[BoltZ]**, 1.38064852E-23 Joule/Kelvin
  Boltzmann constant
- Constant: **[R]**, 8.31446261815324 Joule / Kelvin * Mole
  Universal gas constant
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Angular Velocity** in Degree per Second (degree/s)
  Angular Velocity Unit Conversion
- Measurement: **Moment of Inertia** in Kilogram Square Meter (kg·m²)
  Moment of Inertia Unit Conversion
- Measurement: **Momentum** in Kilogram Meter per Second (kg*m/s)
  Momentum Unit Conversion
- Measurement: **Energy Per Mole** in Joule Per Mole (J/mol)
  Energy Per Mole Unit Conversion
- Measurement: **Compressibility** in Square Meter per Newton (m²/N)
  Compressibility 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

Check other formula lists

- **Acentric Factor Formulas**
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