Ideal Gas Law: Moles, Mass and Density of a Gas

Amount, mass, density and normal volume of a gas in a vessel from its pressure, temperature, volume and molar mass by pV = ZnRT.

Method: Ideal gas law with compressibility factor; CODATA 2018 gas constant

Input parameters

Unit system: SI

Parameter	Value	Unit
Pressure (absolute)	8.0000	bar
Temperature	30.000	°C
Volume	2.0000	m³
Molar mass	28.960	kg/kmol
Compressibility factor (1 = ideal gas)	1.0000	

Calculated results

Parameter	Value	Unit
Amount of gas	0.63479	kmol
Mass of gas	18.383	kg
Density	9.1917	kg/m³
Volume at normal conditions (0 °C, 1.01325 bar)	14.228	m³

Formula and method

$$pV = ZnRT$$

$$m = nM, \quad \rho = m/V$$

$$V_n = n\,V_{m,n} \ \ (0\ °C,\ 1.01325\ \text{bar})$$

Variables

p	absolute pressure	Pa
T	temperature	K
V	volume	m³
M	molar mass	kg/kmol
Z	compressibility factor	-
R	gas constant 8.314 J/(mol·K)	J/(mol·K)
$V_{m,n}$	molar volume at normal conditions	m³/mol
n	amount of gas	mol
m	mass	kg
ρ	density	kg/m³
V_n	volume at normal conditions	m³

Method and standards

The ideal gas law with a compressibility factor; R is the exact CODATA 2018 value.

Assumptions and limits

- Single phase gas; Z supplied for non-ideal behaviour.

References

- Ideal gas law with compressibility factor
- CODATA 2018 gas constant

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/gas-mixtures/ideal-gas-law

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Reopens the calculator with the inputs of this report.