PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Kinetic theory of Gases - CSIR NET Physics PYQs

Thermodynamics . All PYQs (2015-2025) with answer key

9 questions . Answer key included

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Q1. [Dec 2016] . 3.5 marks

Thermodynamics > Kinetic theory of Gases

CSIR NET	2016 Dec	3.5M

A silica particle of radius 0.1μ m is put in a container of water at $T = 300$ K. The densities of silica and water are $2000\,\mathrm{kg/m^3}$ and $1000\,\mathrm{kg/m^3}$, respectively. Due to thermal fluctuations, the particle is not always at the bottom of the container. The average height of the particle above the base of the container is approximately

1. 10^{-3} m
2. 3×10^{-4} m
3. 10^{-4} m
4. 5×10^{-5} m

Q2. [June 2016] . 3.5 marks
Thermodynamics > Kinetic theory of Gases

CSIR NET	2016 June	3.5M

The specific heat per molecule of a gas of diatomic molecules at high temperatures is

1. $8k_B$
2. $3.5k_B$
3. $4.5k_B$
4. $3k_B$

Q3. [June 2016] . 3.5 marks
Thermodynamics > Kinetic theory of Gases

CSIR NET	2016 June	3.5M

A box of volume V containing N molecules of an ideal gas, is divided by a wall with a hole into two compartments. If the volume of the smaller compartment is $V/3$, the variance of the number of particles in it, is

1. $N/3$
2. $2N/9$
3. $\sqrt{N}$
4. $\sqrt{N}/3$

Q4. [Dec 2019] . 5.0 marks

Thermodynamics > Kinetic theory of Gases

CSIR NET	2019 Dec	5M

The pressure p of a gas depends on the number density ρ of particles and the temperature T as $P = k_B T\rho - B_2\rho^2 + B_3\rho^3$ where B_2 and B_3 are positive constants. Let T_c, ρ_c and p_c denote the critical temperature, critical number density and critical pressure, respectively. The ratio $\rho_c k_B T_c/p_c$ is equal to

1. $\frac{1}{3}$
2. 3
3. $\frac{8}{3}$
4. 4

Q5. [June 2019] . 3.5 marks

Thermodynamics > Kinetic theory of Gases

CSIR NET	2019 June	3.5M

The Hamiltonian of a classical nonlinear one dimensional oscillator is $H = \frac{1}{2m}p^2 + \lambda x^4$, where $\lambda > 0$ is a constant. The specific heat of a collection of a collection of N independent such oscillators is

1. $\frac{3Nk_B}{2}$
2. $\frac{3Nk_B}{4}$
3. Nk_B
4. $\frac{Nk_B}{2}$

Q6. [June 2020] . 3.5 marks

Thermodynamics > Kinetic theory of Gases

CSIR NET	2020 June	3.5M

The Hamiltonian of a system of N non-interacting particles, each of mass m, in one dimension is

$$H = \sum_{i=1}^{N} \left(\frac{p_i^2}{2m} + \frac{\lambda}{4} x_i^4 \right)$$

where $\lambda > 0$ is a constant and p_i and x_i are the momentum and position respectively of the i-th particle. The average internal energy of the system is

1. $\frac{4}{3} k_B T$
2. $\frac{3}{4} k_B T$
3. $\frac{3}{2} k_B T$
4. $\frac{1}{3} k_B T$

Q7. [June 2021] . 3.5 marks

Thermodynamics > Kinetic theory of Gases

CSIR NET	2021 June	3.5M

The ratio c_p/c_v of the specific heats at constant pressure and volume of a monatomic ideal gas in two dimensions is

1. 3/2
2. 2
3. 5/3
4. 5/2

Q8. [Dec 2025] . 3.5 marks

Thermodynamics > Kinetic theory of Gases

CSIR NET	2025 Dec	3.5M	Thermal

A classical mono-atomic ideal gas is in thermal equilibrium at temperature T. The velocity of a molecule of this gas, of mass m, is $\vec{v} = v_x\hat{x} + v_y\hat{y} + v_z\hat{z}$. The value of the ensemble average $\langle v_x^2 v_y^2 \rangle$ is

1. $\left(\frac{k_B T}{2m}\right)^2$
2. $\left(\frac{k_B T}{m}\right)^2$
3. $\left(\frac{3k_B T}{2m}\right)^2$
4. $\left(\frac{2k_B T}{m}\right)^2$

Q9. [June 2025] . 3.5 marks

Thermodynamics > Kinetic theory of Gases

CSIR NET	2025 June	3.5M	Thermal

Consider one mole of an ideal diatomic gas molecule at temperature T such that $k_B T \gg h\nu$, where ν is the frequency of its vibrational mode. If C_p and C_v are specific heats of this gas at constant pressure and volume respectively, then the ratio $\gamma = \frac{c_p}{c_v}$, is

1. 2
2. $\frac{7}{5}$
3. $\frac{5}{3}$
4. $\frac{9}{7}$

Answer Key

9 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Thermodynamics	Kinetic theory of Gases	**3**
Q2	Thermodynamics	Kinetic theory of Gases	**2**
Q3	Thermodynamics	Kinetic theory of Gases	**2**
Q4	Thermodynamics	Kinetic theory of Gases	**2**
Q5	Thermodynamics	Kinetic theory of Gases	**2**
Q6	Thermodynamics	Kinetic theory of Gases	**2**
Q7	Thermodynamics	Kinetic theory of Gases	**2**
Q8	Thermodynamics	Kinetic theory of Gases	**2**
Q9	Thermodynamics	Kinetic theory of Gases	**4**

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