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NPTEL

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Courses » Statistical Mechanics

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Unit 9 - Week 7

Register for Certification exam

Assignment 7

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-03-20, 23:59 IST.

1) In thermal equilibrium $\beta = (k_B T)^{-1}$, the expression below represents *1 point*

$$\frac{\sum_i E_i \, e^{-\beta E_i}}{\sum_i e^{-\beta E_i}}$$

- average energy of the system.
- partition function of the system.
- probability to find the system in the state E_i .
- a constant of the order unity.

No, the answer is incorrect.
Score: 0

Accepted Answers:
average energy of the system.

2) *1 point*
In the canonical ensemble, the ratio of standard deviation $\sqrt{\langle \mathcal{H}^2 \rangle_c}$ to the mean of inter energy $\langle \mathcal{H} \rangle$ scales as

- N^0.
- $N^{1/2}$.
- $N^{-1/2}$.
- N.

No, the answer is incorrect.
Score: 0

Accepted Answers:
$N^{-1/2}$.

3) *1 point*
The Hamiltonian of N classical harmonic oscillators in 3 dimensions is given as -

$$\mathcal{H}(\{\vec{q}_i, \vec{p}_i\}) = \sum_{i=1}^{N} \frac{p_i^2}{2m} + \frac{1}{2} m \omega^2 q_i^2$$

If the system is maintained at constant temperature, the canonical partition function becor

- $\mathcal{Z}(N, V, T) = (\beta \hbar \omega)^{-3N}$.

Google

Accepted Answers:

$\mathcal{Z}(N,V,T) = (\beta\hbar\omega)^{-3N}$.

4) *1 point*

The Hamiltonian of N independent quantum oscillators in 1 dimension is given as -

$$\mathcal{H}(\{n_i\}) = \sum_{i=1}^{N}\left(n_i + \frac{1}{2}\right)\hbar\omega, \quad \text{excitation } n_i = 0,1,2,\ldots$$

If the system is maintained at constant temperature T, the average energy is given by

- $\langle\mathcal{H}\rangle = \hbar\omega/2$.
- $\langle\mathcal{H}\rangle = N\hbar\omega\left[\frac{1}{2} + \frac{1}{e^{\beta\hbar\omega}-1}\right]$.
- $\langle\mathcal{H}\rangle = 0$.
- $\langle\mathcal{H}\rangle = N\hbar\omega\left[\frac{1}{2} + \frac{1}{e^{-\beta\hbar\omega}-1}\right]$.

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\langle\mathcal{H}\rangle = N\hbar\omega\left[\frac{1}{2} + \frac{1}{e^{\beta\hbar\omega}-1}\right]$.

5) *1 point*

Particles of radius a and mass m are dispersed in water at temperature T. Take gravit acting downwards and the joint probability of finding particles with position $\vec{r}$ and moment $\vec{p} = m\vec{v}$ as

$$\mathcal{P}(\vec{r},\vec{v}) = \frac{e^{-\beta\mathcal{H}(\vec{r},\vec{v})}}{\int\int e^{-\beta\mathcal{H}(\vec{r},\vec{v})}\,\mathrm{d}^3\vec{r}\,\mathrm{d}^3\vec{v}} \quad \text{with } \mathcal{H} = mv^2/2 + mgz$$

The distribution of molecules as a function of depth z is thus given by

- $\mathcal{P}(z) = \beta mg\, e^{-\beta mgz}$.
- $\mathcal{P}(z) = (1/z)\, e^{-\beta mgz}$.
- $\mathcal{P}(z) = (1/z)$.
- $\mathcal{P}(z) = (1/z)\, e^{-(\beta mgz)^2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\mathcal{P}(z) = \beta mg\, e^{-\beta mgz}$.

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