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NPTEL

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Courses » Statistical Mechanics

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Unit 10 - Week 8

Register for Certification exam

Course outline

Assignment 8

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

Due on 2019-03-27, 23:59 IST.

1) *1 point*

The partition function of ideal gas in Gibbs canonical ensemble is given by $\mathcal{Z} = \dfrac{1}{(\beta P)^{N+1}\lambda(T)^{3N}}$, where $\beta = \dfrac{1}{k_B T}$ and the thermal wavelength $\lambda(T) = \dfrac{h}{\sqrt{2\pi m k_B T}}$. The chemical potential μ of the system in the thermodynamic limit ($N \to \infty$) is given by

- $\mu = k_B T \ \ln\left[\beta P\left(\dfrac{\beta h^2}{2m\pi}\right)^{3/2}\right]$
- $\mu = k_B T \ \ln\left[\beta P\left(\dfrac{\beta h^2}{2m\pi}\right)^{5/2}\right]$
- $\mu = k_B T \ \ln\left[\beta P\left(\dfrac{\beta h^2}{2m\pi}\right)^{7/2}\right]$
- $\mu = k_B T \ \ln\left[\beta P\left(\dfrac{\beta h^2}{2m\pi}\right)^{9/2}\right]$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\mu = k_B T \ \ln\left[\beta P\left(\dfrac{\beta h^2}{2m\pi}\right)^{3/2}\right]$

2) *1 point*

The isothermal compressibility is defined as $\beta_c = -\dfrac{1}{V}\dfrac{\partial\langle V\rangle}{\partial P}$. The relation between the β the fluctuation (variance) of volume in Gibbs canonical ensemble is given by

- $\langle V^2\rangle_C = k_B T V P \beta_c^2$
- $\langle V^2\rangle_C = k_B T^2 \beta_c / P$
- $\langle V^2\rangle_C = k_B T V \beta_c$
- $\langle V^2\rangle_C = k_B T V / P$

No, the answer is incorrect.
Score: 0

Consider a system of N distinguishable spin $1/2$ particles each with magnetic moment μ in a uniform magnetic field H. If the Hamiltonian is given by $\mathcal{H} = -\sum_{i=1}^{N} n_i \mu H$ with $n_i = \pm 1$, the internal energy of the system is computed to be

- $-N\mu H \sinh(\beta\mu H)$
- $-N\mu H \tanh(\beta\mu H)$
- $-N\mu H \coth(\beta\mu H)$
- $-N\mu H$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-N\mu H \tanh(\beta\mu H)$

4) **1 point**

Consider the previous system of N distinguishable spin $1/2$ particles each with mag moment μ in a uniform magnetic field H. The entropy of the system is given as

- Nk_B
- $-Nk_B\beta\mu H \coth(\beta\mu H)$
- $Nk_B \ln(2\sinh(\beta\mu H))$
- $Nk_B [\ln(2\cosh(\beta\mu H)) - \beta\mu H \tanh(\beta\mu H)]$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$Nk_B [\ln(2\cosh(\beta\mu H)) - \beta\mu H \tanh(\beta\mu H)]$

5) **1 point**

Consider again the system of N distinguishable spin $1/2$ particles each with magnetic mo μ in a uniform magnetic field H. If the zero temperature limits are given as $S_0 = \lim_{T\to 0} S$ $E_0 = \lim_{T\to 0} E$, then

- $E_0 = -N\mu H$ and $S_0 = 0$
- $E_0 = 0$ and $S_0 = k_B \ln 2^N$
- $E_0 = -N\mu H$ and $S_0 = k_B \ln 2^N$
- $E_0 = -N\mu H$ and $S_0 = k_B \ln 4^N$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$E_0 = -N\mu H$ and $S_0 = 0$

6) **1 point**

Consider again the system of N distinguishable spin $1/2$ particles each with magnetic m μ in a uniform magnetic field H. If the instantaneous magnetization $M = \sum_{i=1}^{N} \mu n_i$, the magnetic susceptibility $\chi = \left(\frac{\partial \langle M \rangle}{\partial H}\right)_{\beta,N}$ is computed as

- $N\mu^2\beta \,\mathrm{sech}^2(\beta\mu H)$
- $N\mu^2\beta \cosh^2(\beta\mu H)$
- $N\mu^2\beta \tanh^2(\beta\mu H)$
- $N\mu^2\beta$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$N\mu^2\beta \operatorname{sech}^2(\beta\mu H)$

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