



الدرجة الكلية: 70
زمن الامتحان: ساعتين

امتحان نهاية الفصل الدراسي الثاني
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كلية العلوم
قسم الرياضيات

Answer the following questions:

Question One:

- 1) Compare between the different classes of state variable.
- 2) Define the internal energy and Gibbs free energy.
- 3) Find the relation between C_v and C_p for the ideal gas.

Question Two:

- 1) Write short notes on the wave particle duality and the quantum state principles.
- 2) Prove that the number of microstates of the state (N_1, N_2, \dots, N_m) is $w = \frac{N!}{N_1!N_2!\dots N_m!}$
where $N = \sum_{i=1}^m N_i$.

Question Three:

- 1) Consider a system has a constant large number of identical and distinguishable particles N . The particles are distributed to the energy levels E_1, E_2, \dots , where the number of particles in the i^{th} energy level is N_i . Derive Maxwell-Boltzmann distribution and compute the average, variance and standard deviation of energy.
- 2) An atom has two energy levels 0 and ϵ . Calculate the internal energy for a system consisting of N atoms, using Maxwell-Boltzmann distribution. Then calculate the specific heat.

Question four:

- 1) A system consists of three energy levels $E_1 = 0, E_2 = 100K_B, E_3 = 200K_B$. The degrees of degeneracy are $g_1 = 1, g_2 = 3, g_3 = 5$. Using the Maxwell-Boltzmann distribution, calculate the partition function, and the average energy at $T = 100^\circ k$.
- 2) Derive the Maxwell-Boltzmann velocity distribution function

Best wishes for success and good luck

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