

In the name of God

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ADVANCED STATISTICAL PHYSICS I

Exercise Set 1

(Date Due: 1393/07/03)

1. For binomial distribution as:

$$P_k = \frac{N!}{k!(N-k)!} p^k q^{N-k}$$

compute $\langle k \rangle$ and $\sigma_k^2 = \langle (k - \langle x \rangle)^2 \rangle$.

Show that for $N \rightarrow \infty$ mention distribution will be a Gaussian PDF.

2. Zero law of thermodynamics: suppose that A, B and C are in thermal equilibrium. For A and C, we have:

$$P_A V_A - n_A r_A P_A - P_C V_C = 0$$

and for B and C, we have:

$$P_B V_B - P_C V_C + \frac{n_B r_B P_C V_C}{V_B} = 0$$

Find 3 state equations of this system which are in thermal equilibrium.

3. Prove that Carnot engine has maximum efficiency.
4. A refrigerator with power equates to 100W and a heater with 100W are in a room. Which system makes more heat in the room. Explain your answer.
5. Prove Clausius theorem: $\oint dQ \leq 0$.
6. In a box isolated from environment its volume is V . We divided it into two parts with xV and $(1-x)V$. Pressures and temperatures in both partition are equal. There are xn and $(1-x)n$ in left and right parts, respectively. Now we remove the partition, how many changes will be occurred in Entropy?

Good luck, Movahed
