

سوال های پیشنهادی برای درس مکانیک آماری کارشناسی ارشد از فصل ۴

(Reference: Statistical Mechanics, Third Edition, R. K. Pathria)

4.1. Show that the entropy of a system in the grand canonical ensemble can be written as

$$S = -k \sum_{r,s} P_{r,s} \ln P_{r,s},$$

where $P_{r,s}$ is given by equation (4.1.9).

4.10. A surface with N_0 adsorption centers has $N (\leq N_0)$ gas molecules adsorbed on it. Show that the chemical potential of the adsorbed molecules is given by

$$\mu = kT \ln \frac{N}{(N_0 - N)a(T)},$$

where $a(T)$ is the partition function of a single adsorbed molecule. Solve the problem by constructing the grand partition function as well as the partition function of the system. [Neglect the intermolecular interaction among the adsorbed molecules.]

4.11. Study the state of equilibrium between a gaseous phase and an adsorbed phase in a single-component system. Show that the pressure in the gaseous phase is given by the Langmuir equation

$$P_g = \frac{\theta}{1 - \theta} \times (\text{a certain function of temperature}),$$

where θ is the equilibrium fraction of the adsorption sites that are occupied by the adsorbed molecules.

4.12. Show that for a system in the grand canonical ensemble

$$\{(\overline{NE}) - \bar{N} \bar{E}\} = \left(\frac{\partial U}{\partial N} \right)_{T,V} \overline{(\Delta N)^2}.$$