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6 SEM TDC PHY M 1

2014

(May)

PHYSICS

(Major)

Course : 601

(Statistical Mechanics)

Full Marks : 60
Pass Marks : 24

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct option : 1×5=5

(a) "With microscopic variables held fixed, the member of an ensemble are neither created nor destroyed."

The above statement is related to

(i) micro-canonical ensemble

(ii) canonical ensemble

(iii) Liouville's theorem

(iv) grand canonical ensemble

(b) Gibbs function in terms of partition function (Z) is

(i) $VT - NkT\log Z$

(ii) $RT - NkT\log Z$

(iii) $RT - NPT\log Z$

(iv) $PT - NkT\log Z$

the symbols represent their usual meanings.

(c) Which of the following particles is not a boson?

(i) Photon

(ii) Alpha particle

(iii) Helium

(iv) Electron

(d) Fermions are

(i) indistinguishable and spinless particles

(ii) distinguishable and spin half-particles

(iii) indistinguishable, spin half-particles and obey Pauli's exclusive principle

(iv) indistinguishable, spinless particles but does not obey Pauli's exclusive principle

(e) White dwarfs are

(i) last stage of a star having mass below Chandrasekhar limit

(ii) last stage of a star having mass above Chandrasekhar limit

(iii) previous stage of a black hole

(iv) None of the above

2. Explain what you mean by phase space, micro-canonical ensembles and grand canonical ensembles. 2+5=7

3. Discuss Maxwell-Boltzmann distribution law and derive the relation

$$n_i = g_i e^{(-\alpha-\beta E_i)}$$ 7

4. What do you mean by partition function? 3

5. Express internal energy of N particle system in terms of partition function. 6

Or

Derive Boltzmann relation between entropy and probability.

6. (a) Write limitations of Maxwell-Boltzmann statistics. 3

(b) What are the differences between Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics? 3

(c) Write the basic postulates of Bose-Einstein statistics. 4

7. (a) Deduce the Fermi-Dirac distribution laws for fermions. 9

Or

Deduce Fermi-Dirac distribution laws for classical particles.

(b) Write the condition when Fermi-Dirac distribution and Bose-Einstein statistics reduces to Maxwell-Boltzmann statistics. 3

8. (a) Derive Stefan's law from Bose-Einstein distribution law. 5

(b) Write short note on any *one* of the following : 5

(i) Chandrasekhar limit

(ii) White dwarfs

(iii) Bose-Einstein condensation

★★★