Total No. of Printed Pages—4

6 SEM TDC PHY M 1

2016

(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) Statistical mechanics is applicable on

(i) macrosystem

(ii) microstructure

(iii) microsystem

(iv) many particle system

(b) Energy of a particle in a cubical box of length L is given by

(i) $\frac{\hbar^2}{8mL^2}(n_x^2 + n_y^2 + n_z^2)$

(ii) $\frac{\hbar^2}{8mL^3}(n_x^2 + n_y^2 + n_z^2)$

(iii) $\frac{\hbar^2}{3mL^2}(n_x^2 + n_y^2 + n_z^2)$

(iv) $\frac{2\hbar^2}{3L^3}(n_x^2 + n_y^2 + n_z^2)$

(c) The partition function can be expressed as

(i) $z = \Sigma g_i A e^{-\varepsilon_i / kT}$

(ii) $z = \Sigma g_i A e^{\varepsilon_i / kT}$

(iii) $z = \Sigma g_i e^{-\beta\varepsilon_i - 1}$

(iv) $z = \Sigma g_i N e^{\varepsilon_i / kT}$

(d) The average energy of an electron in Fermi gas at 0 K is

(i) $0{\cdot}2\,E_f$

(ii) $0{\cdot}4\,E_f$

(iii) $0{\cdot}6\,E_f$

(iv) $0{\cdot}8\,E_f$

(e) The wavelength at which a blackbody emits maximum amount of radiation is proportional to

(i) T

(ii) $\frac{1}{T}$

(iii) T^4

(iv) T^{-5}

2. Explain the concept of ensemble. Compare between microcanonical and canonical ensembles. 2+4=6

3. Derive Maxwell-Boltzmann distribution law in classical statistical mechanics. 7

4. Give statistical interpretation of entropy. 3

5. Derive thermodynamical potential Helmholtz function and enthalpy in terms of partition function. 6

6. State the basic postulates of quantum statistical mechanics. 3

7. A system of identical non-interacting particles obeys Pauli's principle. Obtain the distribution law. 7

8. In what ways, does the Fermi-Dirac distribution differ from Maxwell-Boltzmann distribution? 4

9. Whether the relation of most probable distribution of the particles among different energy levels for a system of particles obeying Bose-Einstein statistics is

$$n_i = \frac{g_i}{Ae^{\beta\varepsilon_i} - 1}$$ 6

10. What is the condition that Bose-Einstein distribution reduces to Maxwell-Boltzmann distribution? 3

11. Deduce Stefan's law from Bose-Einstein statistics. 6

12. How is Fermi-Dirac statistics used to discuss white dwarf stars? 4

Or

Write short notes on Bose-Einstein condensation and Chandrasekhar limit. 2+2=4

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