TDC (CBCS) Even Semester Exam., 2023

PHYSICS

(Honours)

(6th Semester)

Course No. : PHSHCC-602T

(Statistical Mechanics)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer any *ten* questions from the following : 2×10=20

1. Define most probable microstate.

2. What is partition function?

3. What is Gibbs Paradox and how is it resolved?

4. State two properties of thermal radiation.

5. What is ultraviolet catastrophe?

6. What do you understand by Wien's law of energy distribution?

7. Discuss Saha's ionization formula.

8. State two basic assumptions of Bose-Einstein statistics.

9. What is the equation of state for relativistic Fermi gas?

10. What is liquid helium?

11. What is degeneracy of Bose gas?

12. Explain in brief about Fermi energy.

13. What are white dwarf stars?

14. What is free-electron gas model of metals?

15. Discuss Chandrasekhar mass limit.

SECTION—B

Answer any *five* questions from the following : 6×5=30

16. *(a)* What are the three postulates of Maxwell-Boltzmann distribution law?

(b) Derive Maxwell-Boltzmann distribution law. 2+4=6

17. *(a)* What does the Sackur-Tetrode equation describe?

(b) Calculate the entropy of a mole of argon gas by using Sackur-Tetrode equation. 2+4=6

18. Explain the terms 'emissive power' and 'absorptive power'. Prove that at any temperature the ratio of emissive power to the absorptive power of a substance is constant and is equal to the emissive power of a perfectly black body. 1+1+4=6

19. What is Stefan-Boltzmann law? Explain. How do you use the Stefan-Boltzmann equation? 4+2=6

20. *(a)* Discuss Planck's law of black body radiation. 3

(b) Give the experimental verification of Planck's radiation law. 3

21. *(a)* Starting from Planck's radiation law, deduce Wien's displacement law. 4

(b) Deduce Rayleigh-Jeans law from Planck's law. 2

22. Derive an expression for the most probable distribution of particles of a system obeying Bose-Einstein statistics.

23. What is photon gas? Write the difference between photon gas and phonon gas. What is the equation for photon gas? 2+2+2=6

24. *(a)* Use Fermi-Dirac statistics to calculate the energy of free electrons inside a metal. 4

(b) At what condition Fermi-Dirac distributions reduce to Maxwell-Boltzmann distribution? 2

25. *(a)* Determine whether the electron gas in copper atom (atomic mass 63·5 and density 8·94 gm/cc) at room temperature is degenerate or not. Assume that each copper atom donates one conduction electron. 2

(b) Consider a gas where the molecules can move on the surface of a plane and thus are restricted to two-dimensional motion. Find the partition function and internal energy for two-dimensional system. 4

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