Bsc Physic Sem - V

Paper 1(Atomic physics, free electron theory and Statistical physics)

Question Bank

Unit 1

1. What is Zeeman effect ? Explain with neat diagram experimental arrangement of Zeeman effect.
2. What is meant by space quantization of orbits in vector atom model ?
3. Compute the magnetic field gradient of 0.4 m long Stern-Gerlach experiment that would produce a 2 mm separation at the end of the magnet between two components of a beam of silver atoms emitted from an oven at 900ºC. The magnetic dipole moment of silver is due to single l = 0 electron.
4. What is meant by L-S coupling ? Explain with example
5. Calculate the values of L, S and J for p-electron in an atom.
6. State Hund's rule and explain it with the help of suitable example.
7. What is Zeeman effect ? Describe the experimental arrangement for observing Zeeman effect.
8. Explain the quantum numbers associated with an atom.
9. Obtain the possible (n, l, j) values of electrons in first two shells of the atom.
10. Write a note on Stark effect
11. Discuss space quantization of orbits in vector atom model.
12. Explain L-S and J-J coupling schemes.
13. State and explain Pauli's exclusion principle with example
14. Explain normal and anomalous Zeeman effect. Obtain an expression for Zeeman shift.
15. What is Stark effect ? Give its salient features.
16. Calculate the separation between the adjucent components of wavelength 4800 A.U. if it is placed in a magnetic field of density 0.5T.
17. What is Bohr's atomic model ? Give its drawbacks.
18. Describe the experimental arrangement of Stern-Gerlach experiment
19. What are the possible quantum numbers of electrons in the L shell of an atom ?

Unit 2

1. State assumptions of Drude-Lorentz theory. Derive an expression for electrical conductivity of metal on the basis of free electron theory
2. Define Fermi energy. Show that Fermi energy EF is a function of density of free electrons.
3. Explain the concept of hole in solids.
4. Derive expression for density of states for a free electron gas in one dimension.
5. Explain how atomic energy levels split into bands when number of atoms brought together to form crystal.
6. Explain the term mean free path. Obtain an expression for electrical conductivity of metal on the basis of free electron theory.
7. Obtain an expression for the thermal conductivity in terms of mean free path of electrons.
8. A copper wire of length 1 m and diameter 18 mm carries a current of 8 A. Find the current density and resistivity of the material, if potential difference across the wire is 5 V.
9. State and explain Wiedemann-Franz Law for metals
10. The Hall coefficient for copper is 1.05 × 10–10 m3/C and the charge of a hole is 1.6 × 10–19C. Calculate the number of atoms per meter cube in copper
11. What is Hall effect ? Derive an expression for Hall voltage and Hall coefficient in a semiconductor
12. Distinguish between metals, insulators and semiconductors on the basis of band theory of solids.
13. Define Fermi function and explain its significance.
14. Obtain an expression of coefficient of thermal conductivity of an electron on the basis of DrudeLorentz theory
15. Distinguish between conductor, semiconductor and insulators on the basis of Band Theory of Solid
16. What is Hall effect ? Derive an expression for Hall Voltage and Hall Coefficient in a semiconductor.
17. What is Hall effect ? Derive an expression for Hall voltage and Hall co-efficient in a semiconductor
18. Derive an expression for electrical conductivity of metal on the basis of free electron theory.
19. Explain the concept of 'hole' in a semiconductor.

20. Derive an expression for density of states for a free electron gas in one dimension.
21. Discuss the periodic nature of potential in a crystal. State Bloch theorem.

Unit 3

1. Derive Maxwell's law of distribution of speeds for the molecules of an ideal gas, using M.B. energy distribution formula, derive expression for most probable speed.
2. Explain Macro and Microstates.
3. Explain accessible and inaccessible states
4. Show that the smallest volume of unit cell in a phase space is h 3 (h is Planck's constant)
5. What are the limitations of Maxwell-Boltzmann's statistics ?
6. Four molecules are to be distributed in two compartments. Calculate possible number of macrostates and corresponding number of microstates.
7. Obtain an expression for Maxwell-Boltzmann Distribution Law in general form. What are the limitations of Maxwell-Boltzmann statistics ?
8. Explain the terms Macrostate and Microstate with examples
9. Three particles are distributed in three compartments of equal size. Find the number of microstates in macrostate (a) (0 3 0) and (ii) (0, 1, 2).
10. Obtain Boltzmann's entropy relation.
11. Explain μ-space and Gamma space.
12. Write short notes on Accessible and Inaccessible states.
13. What are the limitations of Maxwell-Boltzmann statistics ?
14. Obtain expression for rms speed of gas molecules by using M–B distribution law
15. Write short notes on Accessible and Inaccessible states.
16. What are the limitations of Maxwell-Boltzmann statistics ?
17. Deduce Boltzmann's entropy-probability relation S = k logeW
18. Calculate the probability that we get three heads and two tails in tossing a coin 5 times.
19. Write a short note on Macrostates and Microstates.
20. Obtain an expression for r.m.s. speed of gas molecules by using M-B distribution law.
21. State the fundamental postulates of statistical mechanics.

Unit 4

1. Derive an expression for most probable distribution by using Fermi-Dirac statistics
2. Derive Planck's law of radiation for black body from Bose-Einstein energy distribution law.
3. Fermi energy of conduction of electrons in silver is 5.48 eV. Calculate the number of such electrons per cm3 . (Given : h = 6.62 × 10–27 erg-sec, Mass of electron = 9.1×10–27 kg, 1eV = 1.62 × 1012 erg)
4. Explain Bose-Einstein condensation.
5. Derive an expression for Fermi-energy for free electrons in metal.
6. Distinguish between Bose-Einstein and Fermi-Dirac statistics
7. Three particles are to be distributed in four energy levels a, b, c and d. Calculate all possible ways of this distribution when particles are (a) bosons and (b) fermions.
8. State basic postulates of B.E. Statistics. Show that for the B.E. Distribution Law
9. Explain Bose-Einstein condensation with its characteristics.
10. Find the number of ways in which seven bosons may be distributed in Five Cells.
11. Starting from F.D. Distribution Law, derive the expression for energy distribution of free electron in metal.
12. Explain Fermi level and Fermi temperature in solids
13. The fermi energy for the free electron in a metal is 5.51 eV. Find the mean internal energy of electron of 0K and speed of electron having this energy.
14. What is Fermi function ? Give its importance.
15. Obtain an expression of Fermi energy at absolute temperature.
16. Obtain an expression of Fermi-Dirac distribution for energy of fermions.
17. Derive an expression for most probable distribution by using Fermi-Dirac statistics
18. Explain Bose-Einstein condensation.
19. What are basic postulates of B-E statistics ?
20. Distinguish between classical statistics and quantum statistics.
21. Five bosons are distributed in two compartments, the first having 3 cells and second 4 cells. Find the thermodynamic probability for the macrostate (5, 0)