AS—1475

B.Sc. Part—III (Semester—VI) Examination
PHYSICS
(Statistical Mechanics and Solid State Physics)

Time : Three Hours]   [Maximum Marks : 80

Note :— (1) All questions are compulsory.

(2) Draw neat and well labelled diagrams wherever necessary.

1. (A) Fill in the blanks :

    (i) Number of microstates in a particular macrostate is called _____ .

    (ii) Superconductors are perfectly _____ magnetic.

    (iii) Schottky defects are _____ defects.

    (iv) The reciprocal of specific resistance is known as _____ of the metal.   2

    (B) Choose correct alternative :

    (i) Miller indices are denoted by :

        (a) (h, k, l)   (b) (x, y, z)

        (c) (h^2, k^2, l^2) (d) (x^2, y^2, z^2)

    (ii) The unit of energy is :

        (a) Coulomb   (b) Electron-volt

        (c) Ohm   (d) Farad

    (iii) In diamagnetic substances, the net magnetic moment of atoms is :

        (a) 1   (b) non zero

        (c) zero   (d) 3/2

    (iv) If temperature of superconducting material decreases then its resistivity :

        (a) remains constant   (b) increases

        (c) decreases   (d) decreases and abruptly becomes zero

                                                                                        2

(C) Answer the following in **one** sentence :

    (i)   What is superconductivity ?

    (ii) What is mean free time ?

    (iii) What is the most probable state ?

    (iv) Why atomic dipole moment arises ?   4

EITHER

2. (A) Explain the concept of macrostate and microstate with examples.   6

    (B) By using Maxwell-Boltzmann's distribution, derive molecular speed distribution law.   4

    (C) Find the thermodynamic probability for four distinguishable particles for the macrostate (2, 2).   2

OR

3. (P) State and explain principle of equal a priori probability.   4

    (Q) Show that the root mean square speed of a gas molecule is given by $V_{rms} = \sqrt{\dfrac{3kT}{m}}$.   4

    (R) Explain the terms, energy states and density of energy states.   4

EITHER

4. (A) By assuming thermodynamical probability obtain an expression for B.E. distribution law.   5

    (B) Distinguish between B-E statistics and F-D statistics.   4

    (C) Explain the effect of temperature on fermi function.   3

OR

5. (P) Obtain an expression for probability distribution of particles in Firmi-Dirac statistics.   6

    (Q) What are main postulates of Bose-Einstein statistics ?   4

    (R) What are fermions ? Give examples.   2

EITHER

6. (A) Define unit cell of crystal. Explain primitive and nonprimitive unit cells.   4

    (B) What is point defect in crystals ? State different types of point defects in crystals.   2

    (C) Give names of seven crystal systems and state the parameters of their unit cells.   6

OR

7. (P) What are Miller Indices ? Explain the procedure to find Miller Indices.   3

    (Q) What is line defect in crystal ? Explain the screw dislocation in crystals.   6

    (R) Derive Bragg's law for x-ray diffraction.   3

EITHER

8. (A) Explain the terms :

       (i) Mean free path

       (ii) Electrical conductivity.   4

    (B) Explain qualitatively, formation of energy bands in solid.   5

    (C) Explain Free electron model.   3

OR

9. (P) Explain the term 'Fermi energy'.   3

    (Q) Discuss the classification of materials as insulator, semiconductor and conductor on the basis of Band Theory of Solids.   6

    (R) Explain the effect of temperature on electrical conductivity of metal.   3

EITHER

10. (A) Define :

       (i) Magnetisation

       (ii) Magnetic field strength.   2

    (B) State the properties of diamagnetic material.   4

    (C) State the properties of paramagnetic material.   4

    (D) Explain the Domain Theory of Ferromagnetism.   2

OR

11. (P) What is magnetic dipole moment ? Obtain an expression for orbital magnetic dipole moment. 4

   (Q) What is Hysteresis ? 2

   (R) Derive an expression for diamagnetic susceptibility on the basis of Langevin's theory. 6

EITHER

12. (A) What is a nano material ? 3

   (B) What is Meissner effect ? Explain. 5

   (C) State any four applications of nanomaterials. 4

OR

13. (P) What is nanotechnology ? 3

   (Q) Explain type I and type II superconductors. 5

   (R) State applications of superconductors. 4