2021

Time : 3 hours

Full Marks : 100

Pass Marks : 45

Candidates are required to give their answers in their own words as far as practicable.

The questions are of equal value.

*Answer any **five** questions, selecting at least **one** question from each group in which Q. No. 1 is compulsory.*

1. Choose the correct option of the following :

   (a) The materials, whose valence band are half filled, are called as :

      (i) Conductors

      (ii) Semi-conductor

      (iii) Insulators

      (iv) All of these

(b) In n-type semiconductor, the Fermi energy is situated :

(i) Just below the V.B.

(ii) Just above V.B.

(iii) Just below of C.B.

(iv) Just above the C.B.

(c) A neutrino is emitted in :

(i) α-decay

(ii) β-decay

(iii) γ-decay

(iv) All of these

(d) The average binding energy of a nucleus is :

(i) 8 ev

(ii) 8 kev

(iii) 8 Mev

(iv) 8 Bev

(e) Ionosphere is a :

(i) Cold plasma

(ii) Hot plasma

(iii) Both Cold and Hot plasma

(iv) None of these

(f) The Debye length D is :

(i) $D = \left(\frac{\epsilon_0 KT}{2N_0 e^2} \right)^{-\frac{1}{2}}$

(ii) $D = \left(\frac{\epsilon_0 KT}{2N_0 e^2} \right)^{1/2}$

(iii) $D = \left(\frac{\epsilon_0 KT}{2N_0 e^2} \right)^{3/2}$

(iii) $D = \left(\frac{\epsilon_0 KT}{2N_0 e^2} \right)^{5/2}$

(g) If $\vec{a}$, $\vec{b}$, and $\vec{c}$ are the translation vectors of a lattice and $\vec{A}$, $\vec{B}$ and $\vec{C}$ are reciprocal lattice vectors then :

(i) $\vec{a} . \vec{A} = 0$

(ii) $\vec{a} . \vec{A} = 1$

(iii) $\vec{A} . \vec{a} = 2\pi$

(iv) None of these

(h) The ratio of Helium and Neon gases in the He-Ne gas LASER is :

(i) 1 : 1

(ii) 5 : 1

(iii) 8 : 1

(iv) 10 : 1

(i) Optical pumping is used to produce :

(i) UV-radiation

(ii) IR radiation

(iii) Normal population

(iv) Population Inversion

(j) The nature of lattice of diamond is :

(i) fcc lattice

(ii) bcc lattice

(iii) hep lattice

(iv) dual inter latice structure

(k) Bragg's law of diffraction is :

(i) $2d \sin\theta = n\lambda$

(ii) $2d \cos\theta = n\lambda$

(iii) $d \sin\theta = 2n\lambda$

(iv) $d \cos\theta = 2n\lambda$

(l) Power method was devised by :

(i) Laue

(ii) Bragg

(iii) Debye and Scherrer

(iv) None of these

(m) The size of nucleus is of order of :

(i) 10^{-8}m

(ii) 10^{-10}m

(iii) 10^{-14}m

(iv) 10^{-28}m

(n) If M is the atomic mass and A is mass number the $\frac{M-A}{M}$ is called :

(i) Binding energy

(ii) Fermi energy

(iii) Mass defect

(iv) Packing fraction

(o) Which atom model explains the fine structure of spectral lines ?

(i) Sommerfield model

(ii) Thomson model

(iii) Bohr's model

(iv) Rutherford model

(p) At high magnetic fields, the splitting of spectral lines is disturbed, this effect is called :

(i) Stark effect

(ii) Inverse Zeeman effect

(iii) Paschen-back effect

(iv) Anomalous Zeeman effect

(q) The Zeeman effect could not be proved by :

(i) Quantum mechanics

(ii) Bohr's model

(iii) L-S coupling

(iv) Hamiltonian operator

(r) Series that lie in the infrared region of electromagnetic spectrum :

(i) Lyman series

(ii) Ballmer series

(iii) Bracket series

(iv) Both (i) and (ii)

(s) The number of splitting levels in 2p orbit would be :

(i) 1 (ii) 2

(iii) 3 (iv) 4

(t) In laboratory plasma occurs in discharge of electricity through :

(i) Solid (ii) Liquid

(iii) Gas (iv) None of these

Group – A

2. Discuss Saha theory of Thermal Ionisation and mention its application.

3. What are conditions for existence of plasma ? Derive an expression for Debye length and potential.

4. Establish the convarience of Maxwell's electromagnetic field under Lorentz transformation.

Group – B

5. What is Kronig-Penney model ? Discuss how the propagation of electron wave in this model leads to the band structure of energy levels.

6. Explain reciprocal lattice. Obtain Bragg's law in term of reciprocal lattice.

7. Derive Boltzman Transport equation and obtain an expression for electrical conductivity of metals.

Group – C

8. Discuss the Bohr-Sommerfield theory of Hydrogen atom.

9. What is normal Zeeman effect ? Give the theory of normal Zeeman effect for single valence electron system. Draw its transition.

10. Give an account of nuclear shell models. Discuss the production of this model.