

Physics-II-2006

Mass of electron= 9.11×10^{-31} kg. Mass of proton= 1.67×10^{-27} kg, Boltzmann constant = 1.38×10^{-23} J/K.

Question 1

Answer the following questions: 2×10

- (a) What is the color of the light coming from ruby laser? Why its color is so?
- (b) Distinguish between spontaneous emission and stimulated emission.
- (c) Write in one sentence the necessity of nuclear accelerators.
- (d) A proton is revolving in a circular orbit of radius 100 cm under the action of magnetic field of induction 1 Tesla. What is the angle between the plane of the circular orbit and magnetic induction?
- (e) At certain temperature the resistance of wire becomes suddenly zero. Can we call the wire a superconductor? Justify your answer.
- (f) Calculate the critical magnetic field for tin at 4.2 K. The data given for tin are $T_c=3.72$ K and $H_c=30. \times 10^3$ Tesla at 0K.
- (g) How many ways are there to arrange geometrical points in three dimensional space satisfying definition of space lattice?
- (h) During study of certain crystal, the first order x-ray diffraction is observed at a diffraction angle of 45° with the characteristic x-ray wavelength 1.54 \AA . Calculate the interplanar spacing of the crystal.
- (i) Give few examples of compound semiconductors.
- (j) What is the role of donor atoms in an extrinsic semiconductor?

Question 2

(a) What is pumping in laser systems?

Mention different methods to achieve population inversion. (3)

(b) Derive an expression for the average energy of an electron as it comes out of betatron. (3)

(c) What are the characteristic features of Bragg's law? (4)

Question 3

(a) What are the conclusions you draw from Kronig-Penney model? (4)

(b) The London penetration depth for lead at 3 K is 396 \AA and at 7.1 K is 1730 \AA . Calculate its critical temperature and penetration depth at 0K. (3)

(c) How optical fibers are helpful to doctors in medical fields? (4)

Question 4

(a) What are the advantages and disadvantages of drift tube linear accelerators? Write an expression for the length of the n th tube in terms of the length of its first tube. (5)

(b) If 0.1, 0.2 and 0.3 are the coordinates of a point on a line passing through a origin, determine the direction indices of the line. (2)

(c) what are the advantages of compound semiconductor devices over elemental semiconductor devices? (3)

question 5

(a) Explain how, when material undergoes superconducting transition from normal state to superconducting state, entropy of the material changes. (5)

(b) Distinguish between single mode optical fiber cable. (3)

(c) A helium He_2^4 nucleus is to be used as a projectile in some atom smashing experiment for which negatively singly ionized helium ion is accelerated by using Tandem accelerator working under a potential difference of 5×10^6 volt. Assume that all the electrons were stripped off from the helium ion while passing through the stripper. Calculate the final energy of the helium nucleus. (2)

Question 6

(a) What do you mean by reciprocal lattice? What are the properties of reciprocal lattice? 1+4

(b) Explain the origin of energy bands quantum mechanically. (3)

(c) Show graphically the variation of electronic specific heat with respect to temperature of a superconducting material in superconducting state. (2)

Question 7

(a) What is the principle of semiconductor laser? Write few applications diode laser. 2+3

(b) The applied magnetic induction in a cyclotron is 1.5 T. calculate the frequency of the rf voltage source used to accelerate protons. (2)

(c) Calculate the geometrical structure factor of a FCC unit cell containing same types of atoms.(3)

Question 8

(a) How superconductivity concepts find wide applications in the field of defence and in controlling pollution hazards?

(b) A beam of x-rays of wavelength 1.54 \AA is incident on a cubic crystal at 15° when the first order Bragg's reflection occurs from $\{1\ 1\ 1\}$ planes. Calculate the interatomic spacing. (4)

(c) Give the band diagram of semiconductor and insulators. (2)

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