CL23_Q1. Bring out the salient features of Drude-Lorentz theory and mention the drawbacks of the classical free-electron theory.

CL23_Q2. Define; (i) drift velocity (ii) relaxation time (iii) mean collision time (iv) mean free path and (v) mobility of electrons.

CL23_Q3. Distinguish between drift velocity and thermal velocity of an electron.

CL23_Q4. Give the microscopic form of Ohm's law and state whether the Ohm's law holds true at all temperatures.

CL23_Q5. Using the free electron model derive the expression for electrical conductivity in a metal.

CL23_Q6. The relaxation time of conduction electron in a metal is $3X10^{-14}$ s . If the density of electrons is $5.8x10^{28}$per m^3 , calculate the resistivity of the material and mobility of electrons.

CL26_Q1. Explain the concept of density of states and density of occupied states in metals.

CL26_Q2. Derive an expression for the density of electron states in a metal.

CL26_Q3. Calculate the density of states with energy between 4eV and 4.005eV in copper with Fermi energy of 7.02eV.(E = 4eV = $4*1.6x10^{-19}$ J and dE = $.005*1.6x10^{-19}$ J mass of electron = $9.1x\ 10^{-31}$ kg)

CL26_Q4. Calculate the density of occupied states, for copper, at an energy level which is 0.026 eV above the Fermi level, at a temperature 300K. Assume Fermi energy of copper as 7eV. (Answer: 3.02×10^{46} states/m^3/J)

CL26 _Q5. The energy states below E_F in the range kT are emptied and probability of occupancy lies between 1 and 0.5. Justify.

CL26_ Q6. With suitable plot, explain the dependence of density of states on energy

CL28_Q1. Define effective number of electrons.

CL28_Q2. The electrons near the Fermi level contribute to the conduction in metals. Explain.

CL28_Q3. How does the specific heat of metals depend on temperature?

CL28_Q4. Discuss the temperature dependence of conductivity of a metal based on the quantum free electron theory. How is the approach different from the classical method?

CL28_Q5. Explain the contribution of free electrons to the specific heat of metals on the basis of quantum free electron theory.

CL29_Q1. Mention the expressions for electrical and thermal conductivities of a metal and hence obtain the Wiedemann-Franz law.

CL29_Q2. State and explain Wiedemann–Franz law.

CL29_Q3. Deduce the Lorenz number.

CL29_Q4. What are the demerits of quantum free electron theory?

CL29_Q5. Obtain the relation between thermal and electrical conductivities of a metal.

CL30_Q1. Explain the terms (i) Periodic potential (ii) Bloch function and (iii) Effective mass.

CL30_Q2. Outline the Kronig Penny Model to describe the motion of electrons in a metal and discuss how the band structure evolves from this model.

CL30_Q3. What is Bloch function and how is it different from the free electron wave function?

CL30_Q4. How does the potential energy of an electron vary in an infinite one dimensional crystal and how this potential is represented in Kronig-Penny model?

CL30_Q5. What is crystal momentum? Is it a conserved quantity?

CL30_Q6. Describe the nature of potential experienced by valence electrons according to Kronig –Penny model. How does it affect the wave function of electron?

CL31_Q1. Discuss E-k diagram and give a qualitative picture of the origin of band gaps.

CL31_Q2. Explain the E-k relationship for a free electron and relate it to the electron mass.

CL31_Q3. Distinguish between conductors, insulators and semiconductors on the basis of band theory of solids.

CL31_Q4. Draw the E-K graph for electrons in metal as per the band theory of solids and discuss the concept of the effective mass of electrons in the conduction band of the metal.

CL31_Q5. With the help of E-K plot, show that materials can be classified into conductors, insulators and semiconductors.

CL32_Q1. What is meant by effective mass of electron?

CL32_Q2. The “effective mass” of electrons depends on the curvature of the E-k plot. Explain this statement.

CL32_Q3. “The mass of an electron in the periodic potential of a solid is different from the free electron mass” Is the statement true or false? Can the effective mass be positive and negative? If yes, what are the specific conditions for the same.

CL32_Q4. In which condition for an electron its effective mass is equal to its true mass.

CL32_Q5. Explain the concept of electrons and holes using the idea of effective mass.

CL32_Q6. With the help of a neat labelled diagram, explain the curvature of E-k in conduction band and valence band.

CL46_Q1. The magnetic induction inside a medium is given by $B = \mu_o H + \mu_o M$. Discuss this equation with basic principle.

CL46_Q2. Define the following terms (i) Intensity of magnetization and (ii) relative permeability.

CL46_Q3. Classify the magnetic materials based on susceptibility of the material .

CL46_Q4. Explain magnetic flux density B, magnetic flux intensity H and magnetization M . How are they related to each other?

CL46_Q5. A magnetic field of 2500 A/m is applied to a material which has a susceptibility of 800. Estimate (i) relative permeability (ii) intensity of magnetization and (iii) flux density.

CL48_Q1. How are magnetic materials classified?

CL48_Q2. Write the range of susceptibility values for each class of magnetic material.

CL48_Q3. What happens, if diamagnetic, paramagnetic and ferromagnetic sample is suspended by thread and a bar magnet is slowly brought near each of the sample?

CL48_Q4. Classify magnetic materials based on succeptibility dependence on temperature (versus T) and magnetization dependence on field (M versus H) plots.

CL48_Q5. Elaborate on two tests which can differentiate a paramagnetic material from a diamagnetic material.

CL47_Q1. Obtain the expression for orbital magnetic moment of the electron and Explain Bohr magneton.

CL47_Q2. Estimate the magnetic moment of an electron that revolves around a nucleus in an orbit of $0.53A^0$ radius. If the frequency of revolution 6.6×10^{15} Hz.

CL47_Q3. Why does a magnetic dipole due to orbital motion of the electron precess in a magnetic field?

CL47_Q4. Evaluate the magnetic moment corresponding to one Bohr magneton.

CL47_Q5. What is Larmor precsssion? A magnetic field of 2T is applied to an electron undergoing orbital motion. Calculate the precsssional frequency.

CL49_Q1. Obtain the expression saturation magnetization, if the magnetic interaction energy is much greater than the thermal energy.

CL49_Q2. What does Brillouin function represent?

CL49_Q3. Discuss the Brillouin function for magnetic materials for large values of j and when j=1/2. How does this lead to the expression for the paramagnetic susceptibility?

CL49_Q4. How does magnetic susceptibility vary with temperature in case of paramagnetic materials?

CL50_Q1. Describe Quantum theory of Para magnetism.

CL50_Q2. Discuss Weiss theory of spontaneous magnetization and express susceptibility in terms of the modified Curie-Weiss law

CL50_Q3. Explain how Curie law is modified by internal molecular field and mention the significance of Curie temperature?

CL50_Q4. Starting from the relation $M/H = C/T$ explain how Weiss was able to arrive at the paramagnetic behaviour $\square = \frac{T}{C-\theta}$.

CL51_Q1. Elaborate on spin ordered magnetic materials and their classification.

CL51_Q2. Discuss the temperature dependence of susceptibility for each type of magnetic material.

Answer

CL51_Q3. Distinguish between soft and hard magnets with the help of hysteresis graphs.

CL51_Q4. What are ferrites? In what respect it is superior to ferromagnetic materials?

CL51_Q5. Explain the significance of Neel temperature.

CL51_Q6. Discuss the parameters that distinguish Ferro, antiferro and Ferri-magnetic materials

CL52_Q1. What is Giant Magneto Resistance and mention its important applications.

CL52_Q2. Briefly describe the structure of a GMR nano-device.

CL52_Q3. Elaborate the significance of magnetization states of the magnetic layers towards giant magneto resistance.

CL52_Q4. List various applications of ferromagnetic and anti-ferromagnetic materials.

CL33_Q1. Compare the dependence of resistance on temperature of a superconductor with that of a normal conductor.

CL33_Q2. The DC resistance of a superconductor is practically zero. What about its AC resistance?

CL33_Q3. What is meant by persistent current in a superconductor?

CL33_Q4. Describe how cooper pairs are formed and explain the salient features of superconductivity.

CL33_Q5. What are type I and type II superconductors?

CL33_Q6. What is Meissner effect? Explain.