Modern physics Exercises Chapter 9-10

9.1.1 What is the resistivity of copper at T = 373 K?

Answer: 2,4 x 10^{-8} Ωm

9.1.2 How much will the resistivity of silicon change if you increase the temperature from 20^{o}C to 25^{o}?

Answer: It is reduced by 35%

9.2.1 With X-ray radiation of the wavelength 1.2 Å on examines a crystal applying Bragg scattering and find the first maximum at an angle of incidence of 30^{o}.
Calculate the distance between the atomic layers /grating constant).

Answer: 1.2 Å

9.3.1 Applying a simple model of NaCl one can calculate the potential energy. Suppose that Na^{+} only is influenced by the 6 closest Cl^{-} ions. Determine the potential energy if all the distances between the ions are 0.281 nm.

Answer: 31 eV

9.3.2 When building a linear model of NaCl one gets using series expansion a simple expression which contains the Madelung constant α. The potential energy becomes 7,2 eV. Determine α.

Answer: α = 1,4

9.6.1 Calculate the lowest energy of a crystal of cubic form with the side 1,0 mm if you do a model looking like the particle in the box and puts $n_1=n_2=n_3=1$.

Answer: 1.3 x 10^{-13} eV

9.7.1 For Cs the Fermi energy is u_F = 1,5 eV. Calculate *N/V*, i.e. the density of free electrons.

Answer: 3.3 x 10^{26} electrons/m^3

9.7.2 Calculate the value of the Fermi function *f(u)* for $u = u_F - 0.1$ eV at T = 500 K.

Answer: 0.984

9.9.1 Calculate the relative probability for an electron to jump from the valence band to the conduction band at room temperature for cesium where the Fermi energy is 1.5 eV.

Answer: 1.7 x 10^{-26}

9.10.1 One studies the Hall-effect with a semi-conductor material and measures the so-called drift velocity v of electrons to be 0.43 m/s. One also determines an electric field of 10 mV/m perpendicular to the currents direction.
Calculate how large the magnetic field B must be in order to achieve Hall-equilibrium.

Answer: 24 mT

9.11.1 One puts a voltage of 1,00 V in the forward direction across a diode at room temperature.
Calculate the value of I/I_0.

Answer: 6×10^{16}

9.12.1 A LED-diode of galliumarsenide has a band gap of $E_g = 2.01$ eV.
Calculate the wavelength of the emitted light.

Answer: 620 nm

9.14.1 A junction laser the glass has been doped by the element erbium. Calculate the band gap of erbium if the laser emits light of the wavelength 1.51 μm.

Answer: 0.823 eV