

1. An electron in the ground state is confined in a cube of length 10^{-10} m in each edge. Find the energy of this electron. (15%)
2. Find the primitive translation vectors of the lattice reciprocal to the face-centered cubic lattice. (10%)
3. Given the electron concentration of a metal is 10^{22} cm^{-3} . Find the Fermi energy of this metal. (15%)
4. The p-type Si shown in Fig. 1 is doped with 10^{17} cm^{-3} . Find the Hall voltage in this sample with $W = 100$ μm , $A = 10^{-3}$ cm^2 , $I = 10$ mA, and $B_z = 10^{-4}$ Wb/cm^2 . (10%)
5. A one-sided abrupt junction is doped with $N_A = 10^{15}$ cm^{-3} and $N_D = 10^{18}$ cm^{-3} . Calculate the depletion layer width at zero bias under $T = 300$ K. (15%)
6. Qualitatively draw the energy band diagram of a n-p-n bipolar transistor under the active mode of operation. Explain your answer. (10%)
7. Qualitatively draw the drain current versus drain voltage characteristics of: (a) p-channel enhancement, (b) p-channel depletion type of MOSFET. Explain your answer. (10%)
8. A 0.1 - μm -thick Si sample is illuminated with a monochromatic light of 10 mW in power and 400nm in wavelength. Given the absorption coefficient is 4×10^4 cm^{-1} , calculate the amount of energy dissipated per second to the lattice. (15%)

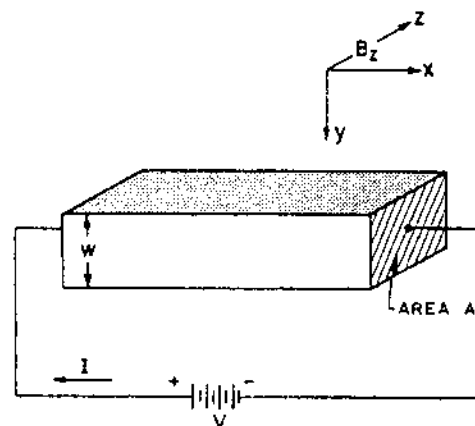


Fig. 1