

1. Are there more electrons on the bottom or in the middle of the valence band of a metal? Explain.
2. At what temperature can we expect a 10% probability that electrons in silver have an energy which is 1% above the Fermi energy? ($E_F = 5.5$ eV)
3. Calculate the density of states of 1 m^3 of copper at the Fermi level ($m^* = m_0$, $E_F = 7$ eV).
Note : Take 1eV as energy interval. (Why?)
4. The density of states at the Fermi level (7 eV) was calculated for 1 cm^3 of a certain metal to be about 10^{21} energy states per electron volt. Someone is asked to calculate the number of electrons for this metal using the Fermi energy as the maximum kinetic energy which the electrons have. He argues that because of the Pauli principle, each energy state is occupied by two electrons. Consequently, there are 2×10^{21} electrons in that band.
 - (a) What is wrong with that argument?
 - (b) Why is the answer, after all, not too far from the correct numerical value?
5.
 - (a) Calculate the number of free electrons per cubic centimeter in copper, assuming that the maximum energy of these electrons equals the Fermi energy ($m^* = m_0$).
 - (b) How does this result compare with that determined directly from the density and the atomic mass of copper? Hint : Consider equation (7.5)
 - (c) How can we correct for the discrepancy?
 - (d) Does using the effective mass decrease the discrepancy?
6. We stated in the text that the Fermi distribution function can be approximated by classical Boltzmann statistics, $\exp(\frac{E - E_F}{k_B T})$ if the exponential factor in the Fermi distribution function is significantly larger than one.
 - (a) Calculate $E - E_F = nk_B T$ for various values of n and state at which value for n can be considered to be “significantly larger” than 1 (assume $T = 300$ K).
 - (b) For what energy can we use Boltzmann statistics? (Assume $E_F = 5$ eV and $E - E_F = 4k_B T$)