[1] Consider a homogeneous gallium arsenide semiconductor at T = 300 K with $N_d = 10^{16}$ cm^{-3} and Na = 0. (a) Calculate the thermal-equilibrium values of electron and hole concentrations. (b) For an applied E-field of 10 V/cm^{-3}, calculate the drift current density. (c) Repeat parts (a) and (b) if $N_d = 0$ and $N_a = 10^{16}$ cm^{-3}. (n_i is 1.8 x 10^6 cm^{-3}).

[2] In a particular semiconductor material, μ_n = 1000 cm^2/V-s, μ_p = 600 cm^2/V-s, and $N_c = N_v = 10^{19}$ cm^{-3}. The measured conductivity of the intrinsic material is $\sigma = 10^{-6}$ (Ω-cm)$^{-1}$ at T = 300 K. Find the conductivity at T = 500 K.

[3] Consider a semiconductor that is uniformly doped with $N_d = 10^{14}$ cm^{-3} and $N_a = 0$, with an applied electric field of E = 100 V/cm. Assume that μ_n = 1000 cm^2/V-s and $\mu_p = 0$. Also assume the following parameters: $N_c = 2 \times 10^{19} (T/300)^{3/2}$ cm-3, $N_v = 1 \times 10^{19} (T/300)^{3/2}$ cm-3, E_g = 1.10 eV. (a) Calculate the electric current density at T = 300 K. (b) At what temperature will this current increase by 5 %? You only need to write the equation as a function of T, don't calculate it. (Assume the mobilities are independent of temperature.)