Homework 3

Michael Brodskiy
Professor: J. Adams

February 6, 2025

1. Per our formula, we know:

$$\mu_d = \frac{\sigma}{\eta e} = \frac{1}{\eta e \rho}$$

To find η, we use:

$$\eta = \frac{\rho N_A}{M_{at}}$$

Also, we need to find ρ, or the resistivity at $22\,[^\circ\text{C}]$. As such, we get:

$$\rho_{22} = \rho_o[1 + \alpha(T - T_o)]$$

Obtaining our values from a known value table, we get:

$$\rho_{22} = 2.44 \cdot 10^{-8}[1 + .003715(22 - 20)]$$
$$\rho_{22} = 2.458 \cdot 10^{-8}\,[\Omega\,\text{m}]$$

We return to the electron concentration to get:

$$\eta = \frac{2.458 \cdot 10^{-8} \cdot 6.022 \cdot 10^{23}}{196.67}$$
$$\eta = 590.96 \cdot 10^{26}\left[\frac{\text{electron}}{\text{m}^3}\right]$$

Finally, we calculate the drift mobility:

$$\mu_d = \frac{1}{590.96 \cdot 10^{26} \cdot 1.6 \cdot 10^{-19} \cdot 2.458 \cdot 10^{-8}}$$

$$\boxed{\mu_d = 4.3027 \cdot 10^{-3} \left[\frac{\mathrm{m}^2}{\mathrm{Vs}}\right]}$$

Furthermore, with the given velocity, we may find the mean free path as:

$$\lambda = \frac{\mu_d m_e \mu_V}{e}$$

This gives us:

$$\lambda = \frac{4.3027 \cdot 10^{-3} \cdot 9.1 \cdot 10^{-31} \cdot 1.4 \cdot 10^{6}}{1.6 \cdot 10^{-19}}$$

$$\boxed{\lambda = 3.426 \cdot 10^{-8} [\mathrm{m}]}$$

2.

3.

4.