Answer on Question #84468, Physics / Molecular Physics | Thermodynamics

Question:

The electrical conductivity of monovalent Na metal is 2.17×10^7Ω^(-1)m^(-1). Calculate the relaxation time and the drift velocity in a field of 100 V m^(-1). Take density of Na to be 0.97 gm cm^(-3).

Solution:

In accordance with the theory of Lorentz-Drude the relaxation time equals to $\tau = \frac{2m\sigma\mu}{e^2\rho N_A} = \frac{2\cdot 9.1*10^{-31}\cdot 2.17\cdot 10^7\cdot 0.023}{1.6^2\cdot 10^{-38}\cdot 970\cdot 6\cdot 10^{23}} = 6.1\cdot 10^{-14}$ (s) and the drift velocity respectively is $v = \frac{\sigma\mu E}{e\rho N_A} = \frac{2.17\cdot 10^7\cdot 0.023\cdot 100}{1.6\ \cdot 10^{-19}\cdot 970\cdot 6\cdot 10^{23}} = 5.4\cdot 10^{-1}$ (m/s).

The answer:

1. The relaxation time equals to $6.1\cdot 10^{-14}$ s.

2. The drift velocity is $5.4\cdot 10^{-1}$ m/s.