

For an ohmic conductor, we have

$$V_{\text{drift}} = a \tau, \quad a = \frac{q E}{m}, \quad \text{and} \quad J = n q v_{\text{drift}}.$$

So the drift speed or the current density is proportional to E . This relation holds only if τ is strictly constant.

Estimate how much will τ be changed, if v_{drift} is doubled, for a typical case where the average thermal speed is $v_{\text{th}} \approx 10^3$ km/s, and average drift speed, $v_{\text{drift}} \approx 10^{-4}$ m/s.

- 1) It increases by more than 0.01%.
- 2) It stays essentially the same; *i.e.*, the change is less than 0.01%.
- 3) It decreases by more than 0.01%.

Based on thermo energy considerations the reader should convince himself/herself that the percentage of the maximum change in v is less than

$$\frac{2 v_{\text{drift}}}{v_{\text{th}}} = \frac{2 \times 10^{-4}}{10^6} = 2 \times 10^{-8}\%. \quad \text{This is less than 0.01\%.$$

Answer 2.