Quiz 5

Magnitude of electron charge: $e = 1.6 \times 10^{-19}$ C

Electron current: $i = nA\overline{v}$

Electron drift velocity: $\overline{v} = uE$

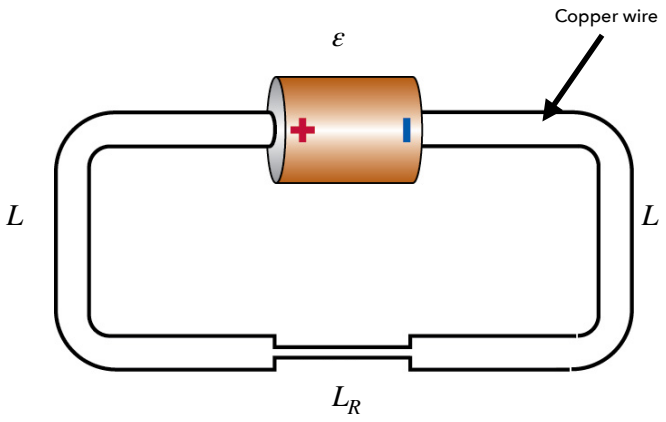
In the figure below, the thin resistor is made out of the same material as the connecting wires (Nichrome). You know the following information:

- The emf ε of the battery is 1.5 V
- The length L of each conducting wire is 0.5 cm
- The length L_R of the resistor is 0.1 cm
- The cross-sectional area of each conducting wire is 0.3 mm^2 $= 3 \times 10^{-7}$ m^2
- The cross-sectional area of the resistor is 0.005 mm^2 $= 5 \times 10^{-9}$ m^2

You also know the conductive properties of Nichrome:

Property	**Value**
Electron density (n)	9×10^{28} m^{-3}
Electron mobility (u)	7×10^{-5} $\frac{\text{m/s}}{\text{N/C}}$
Charge carrier	electron

Table 1:



What is the (a) Electric field and (b) electron drift velocity inside of the thin resistor?

$$\mathcal{E} - E_1 L - E_R L_R - E_2 L = 0$$

$$i_1 = i_R = i_2$$

$$E_1 = E_2$$

$$\mathcal{E} - 2 E_1 L - E_R L_R = 0$$

$$i = n A u E$$

$$n A_1 u E_1 = n A_R u E_R$$

$$E_R = \frac{A_1}{A_R} E_1$$

$$\mathcal{E} - 2 E_1 L - \frac{A_1}{A_R} E_1 L_R = 0$$

$$\mathcal{E} - E_1 \left(2L + \frac{A_1}{A_R} L_R \right) = 0$$

$$E_1 = \frac{\mathcal{E}}{2L + \frac{A_1}{A_R} L_R} = 21.4 \frac{V}{m} = E_2$$

$$E_R = \frac{A_1}{A_R} E_1 = 1285.7 \frac{V}{m}$$

$$\bar{v}_R = u E_R$$

$$= 7 \times 10^{-5} \frac{m/s}{N/C} \cdot 1285.7 \frac{N}{C} = 0.09 \frac{m}{s}$$