25-3. (a)

$$5 \text{ C/s} \div 1.6 \times 10^{-19} \text{ C/electron } = 3.12 \times 10^{19} \text{ electrons/s}$$

(b) The cross section of the wire has area $A = \frac{1}{4}\pi \text{dia}^2$ where dia $= 2.05$ mm.

$$J = \frac{I}{A} = \frac{5}{\frac{1}{4}\pi(2.05 \times 10^{-3})^2} = 1.51 \times 10^6 \text{ A/m}^2$$

(c)

$$v_d = \frac{J}{en} = \frac{1.51 \times 10^6}{1.6 \times 10^{-19} \cdot 8.5 \times 10^{28}} = 1.11 \times 10^{-4} \text{ m/s}$$

(d) dia increases $\Rightarrow A$ increases $\Rightarrow J$ decreases $\Rightarrow v_d$ decreases

25-22. Subscripts T refer to the situation after warm-up; subscripts 0 refer to the initial situation at 20°C. We assume the voltage is the same in both situations. Table 25.2 reports the temperature coefficient of resistivity for tungsten is: $\alpha = .0045\ (°\text{C})^{-1}$.

$$\begin{aligned}
R_T &= R_0(1 + \alpha(T - T_0)) \\
\frac{V}{I_T} &= \frac{V}{I_0}(1 + \alpha(T - T_0)) \\
\frac{I_0}{I_T} &= 1 + \alpha(T - T_0) \\
\frac{I_0/I_T - 1}{\alpha} &= T - T_0 \\
\frac{I_0/I_T - 1}{\alpha} + T_0 &= T
\end{aligned}$$

So:

$$T = \frac{I_0/I_T - 1}{\alpha} + T_0 = \frac{.860/.220 - 1}{.0045} + 20 = 666°\text{C}$$

25-57. (a)

$$\begin{aligned}
\frac{\rho L}{A} &= R \\
\rho &= \frac{RA}{L} = \frac{R\frac{1}{4}\pi \text{dia}^2}{L} \\
&= \frac{.104 \cdot \frac{1}{4}\pi(2.5 \times 10^{-3})^2}{14} = 3.65 \times 10^{-8}\ \Omega \cdot \text{m}
\end{aligned}$$

(b) $V = EL = 1.28 \cdot 14 = 17.92$ V; $I = V/R = 17.92/.104 = 172$ A. Alternatively: $J = E/\rho$ and $I = JA \Rightarrow I = EA/\rho = EL/R$

(c) $J = I/A = qnv_d \Rightarrow v_d = I/Aen$:

$$v_d = \frac{I}{Aen} = \frac{172}{\frac{1}{4}\pi(2.5 \times 10^{-3})^2 \cdot 1.6 \times 10^{-19} \cdot 8.5 \times 10^{28}} = 2.58 \times 10^{-3} \text{ m/s}$$