

53. (a)

$$V = iR = i\rho \frac{L}{A} = \frac{(12 \text{ A})(1.69 \times 10^{-8} \Omega \cdot \text{m})(4.0 \times 10^{-2} \text{ m})}{\pi(5.2 \times 10^{-3} \text{ m}/2)^2} = 3.8 \times 10^{-4} \text{ V} .$$

(b) Since it moves in the direction of the electron drift which is against the direction of the current, its tail is negative compared to its head.

(c) The time of travel relates to the drift speed:

$$\begin{aligned} t &= \frac{L}{v_d} = \frac{lAne}{i} = \frac{\pi L d^2 n e}{4i} \\ &= \frac{\pi(1.0 \times 10^{-2} \text{ m})(5.2 \times 10^{-3} \text{ m})^2(8.47 \times 10^{28} / \text{m}^3)(1.60 \times 10^{-19} \text{ C})}{4(12 \text{ A})} \\ &= 238 \text{ s} = 3 \text{ min } 58 \text{ s} . \end{aligned}$$