46. (a) Using Eq. 27-11 and Eq. 25-42, we obtain

$$\left|\vec{J}_A\right| = \frac{\left|\vec{E}_A\right|}{\rho} = \frac{|\Delta V_A|}{\rho L} = \frac{40 \times 10^{-6}\,\text{V}}{(100\,\Omega{\cdot}\text{m})(20\,\text{m})} = 2.0 \times 10^{-8}\ \text{A/m}^2\ .$$

(b) Similarly, in region B we find

$$\left|\vec{J}_B\right| = \frac{|\Delta V_B|}{\rho L} = \frac{60 \times 10^{-6}\,\text{V}}{(100\,\Omega{\cdot}\text{m})(20\,\text{m})} = 3.0 \times 10^{-8}\ \text{A/m}^2\ .$$

(c) With $w = 1.0$ m and $d_A = 3.8$ m (so that the cross-section area is $d_A w$) we have (using Eq. 27-5)

$$i_A = \left|\vec{J}_A\right| d_A w = \left(2.0 \times 10^{-8}\,\text{A/m}^2\right)(1.0\,\text{m})(3.8\,\text{m}) = 7.6 \times 10^{-8}\ \text{A}\ .$$

(d) Assuming $i_A = i_B$ we obtain

$$d_B = \frac{i_B}{\left|\vec{J}_B\right| w} = \frac{7.6 \times 10^{-8}\,\text{A}}{(3.0 \times 10^{-8}\,\text{A/m}^2)\,(1.0\,\text{m})} = 2.5\ \text{m}\ .$$

(e) We do not show the graph-and-figure here, but describe it briefly. To be meaningful (as a function of x) we would plot $V(x)$ measured relative to $V(0)$ (the voltage at, say, the left edge of the figure, which we are effectively setting equal to 0). From the problem statement, we note that $V(x)$ would grow linearly in region A, increasing by $40\,\mu$V for each 20 m distance. Once we reach the transition region (between A and B) we might assume a parabolic shape for $V(x)$ as it changes from the $40\,\mu$V-per-20 m slope to a $60\,\mu$V-per-20 m slope (which becomes its constant slope once we are into region B, where the function is again linear). The figure goes further than region B, so as we leave region B, we might assume again a parabolic shape for the function as it tends back down toward some lower slope value.