

Suggested problems: Chapter 26- HRW-Principles of Physics- ISV 10th Edition.

15. A heater contains a Nichrome wire (resistivity $5.00 \times 10^{-7} \Omega \cdot \text{m}$) of length 5.85 m, with end-to-end potential difference of 112 V, and with a dissipation power of 4000 W. (a) What is wire's cross-sectional area? (b) If 100 V is used to obtain the same dissipation rate, what should the length be?

Answer: (a) $9.33 \times 10^{-7} \text{ m}^2$; (b) 4.66 m

20. Figure 26-21 gives the electric potential $V(x)$ along a copper wire carrying uniform current, from a point of higher potential $V_s = 12.0 \mu\text{V}$ at $x = 0$ to a point of zero potential at $x_s = 3.00 \text{ m}$. The wire has a radius of 2.20 mm. What is the current in the wire?

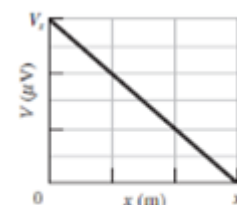


Fig. 26-21 Problem 20

Answer: 3.6 mA.

26. A small but measurable current of $1.2 \times 10^{-10} \text{ A}$ exists in a copper wire whose diameter is 3.0 mm. The number of charge carriers per unit volume is $8.49 \times 10^{28} \text{ m}^{-3}$. Assuming the current is uniform, calculate the (a) current density and (b) electron drift speed.

Answer: (a) $1.7 \times 10^{-5} \text{ A/m}^2$; (b) $1.3 \times 10^{-15} \text{ m/s}$.

30. A copper wire of cross-sectional area $2.40 \times 10^{-6} \text{ m}^2$ and length 4.00 m has a current of 2.00 A uniformly distributed across that area. (a) What is the magnitude of the electric field along the wire? (b) How much electrical energy is transferred to thermal energy in 30 min?

Answer: (a) $1.41 \times 10^{-2} \text{ V/m}$; (b) 203 J

35. A wire initially has length L_0 and resistance 5.0Ω . The resistance is to be increased to 45.0Ω by stretching the wire. Assuming that the resistivity and density of the material are unaffected by the stretching, find the ratio of new length to L_0 .

Answer: 3

42. Copper and aluminum are being considered for a high-voltage transmission line that must carry a current of 50.0 A. The resistance per unit length is to be $0.150 \Omega/\text{km}$. The densities of copper and aluminum are 8960 and 2600 kg/m^3 , respectively. Compute (a) the magnitude J of the current density and (b) the mass per unit length λ for a copper cable and (c) J and (d) λ for an aluminum cable.

Answer: (a) $4.44 \times 10^5 \text{ A/m}^2$; (b) 1.01 kg/m ; (c) $2.73 \times 10^5 \text{ A/m}^2$; (d) 0.495 kg/m .

51. A common flashlight bulb is rated at 0.20 A and 3.2 V (the values of the current and voltage under operating conditions). If the resistance of the tungsten bulb filament at room temperature (20°C) is 1.1Ω , what is the temperature of the filament when the bulb is on?

Answer: $3.0 \times 10^3 \text{ }^\circ\text{C}$.

52. An isolated conducting sphere has a 20 cm radius. One wire carries a current of $1.000\,002\,0 \text{ A}$ into it. Another wire carries a current of $1.000\,000\,0 \text{ A}$ out of it. How long would it take for the sphere to increase in potential by 1000 V?

Answer: $1.1 \times 10^{-2} \text{ s}$.