Chapter 27 Solutions

27.1  \[ I = \frac{\Delta Q}{\Delta t} \]
\[ \Delta Q = \Delta Q \times (30.0 \times 10^{-6} \text{ A})(40.0 \text{ s}) = 1.20 \times 10^{-3} \text{ C} \]
\[ N = \frac{Q}{e} = \frac{1.20 \times 10^{-3} \text{ C}}{1.60 \times 10^{-19} \text{ C/electron}} = 7.50 \times 10^{15} \text{ electrons} \]

27.8  \[ I = \frac{dq}{dt} \]
\[ q = \int dq = \int I \, dt = \int_{0}^{\frac{1}{240} \text{ s}} (100 \text{ A}) \sin(120\pi t / \text{ s}) \, dt \]
\[ q = -\frac{100 \text{ C}}{120\pi} \left( \cos \left( \frac{\pi}{2} \right) - \cos 0 \right) = \frac{100 \text{ C}}{120\pi} = 0.265 \text{ C} \]

27.17 (a) Given \( M = \rho_a V = \rho_d A \) where \( \rho_d \) is mass density, we obtain:
\[ A = \frac{M}{\rho_d} \]

Taking \( \rho_r \) + resistivity,
\[ R = \frac{\rho_r \frac{1}{A}}{A} = \frac{\rho_r \frac{1}{A}}{\frac{M}{\rho_d}} = \frac{\rho_r}{\rho_d} \frac{M}{M} \]

27.20 Originally,
\[ R = \frac{\rho_1}{A} \]

Finally,
\[ R_f = \frac{\rho_1 (1 / 3)}{3A} = \frac{\rho_1}{9A} = \frac{R}{9} \]

27.26 (a) \( n \) is unaffected

(b) \( J = \frac{I}{A} \) so it doubles

(c) \( J = n e v_d \) so \( v_d \) doubles

(d) \( \tau = \frac{m \sigma}{n q^2} \) is unchanged as long as \( \sigma \) does not change due to heating.