ch. 26 #1, 2, 21, 43, 49

#1

(a) $i = 5.0\ A$, $t = 4\ min$

$$i = \frac{dq}{dt} \Rightarrow \int dq = \int i\,dt = i \cdot t$$

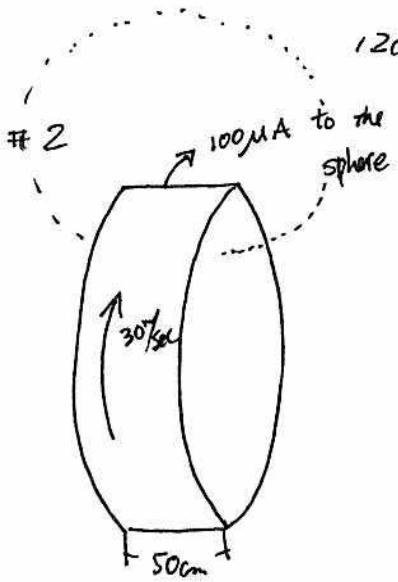
$$= (5\ A)(4\ min) = 5A \cdot 240\ sec$$

$$= \underline{\underline{1200\ C}}$$

(b) $e = 1.6 \times 10^{-19} C$

$$1200\ C \times \frac{1e}{1.6 \times 10^{-19} C} = \underline{\underline{7.5 \times 10^{21}\ electrons}}$$

#2



$$i = 100\ \mu A = 100 \times 10^{-6}\ C/sec$$

$$dq = \sigma \cdot dA$$

$$\frac{dq}{dt} = \frac{\sigma \cdot dA}{dt}$$

$$= \sigma \frac{d(W \cdot L)}{dt}$$

W: Width
L: length

$$= \sigma W \left(\frac{dL}{dt}\right) \quad (\text{width is const.} = 50cm)$$

$$= \sigma W \cdot Vel$$

$$\therefore i = \frac{dq}{dt} = \sigma W\, Vel$$

$$\therefore \sigma = \frac{i}{W \cdot Vel} = \frac{100 \times 10^{-6} C/sec}{(0.5m)(30\ m/sec)} = 6.6\ C/m^2 \quad (\text{units match!})$$

#21

$$R = \rho \frac{L}{A} = 6\Omega$$

$$\rho = 6\Omega \cdot \frac{A}{L}$$

New specifications: Length $\rightarrow 3L$, Area $\rightarrow \frac{1}{3}A$

(Vol $= l_1 A_1 = l_2 A_2$ if $l_2 = 3l_1$, $A_2 = \frac{1}{3}A_1$)

$$\therefore R_{New} = \rho \cdot \frac{3L}{\frac{1}{3}A} = \left(6\Omega \frac{A}{L}\right) \frac{3L}{\frac{1}{3}A}$$

$$= \underline{\underline{54\ \Omega}}$$

#43 $P = 100\ W$, $V = 120\ V$, cost $= 6¢/kwh$

(a) Total energy consumption (in Kwh) in one month

$$100W \times 30\ days \cdot \frac{24\ hrs}{day} = 7.2 \times 10^{4}\ W\ hr$$

$$= 7.2 \times 10^{1}\ kw\ hr$$

Since the cost is $6¢/kwh$

$$7.2 \times 10^{1}\ kwh \times 6¢/kwh = 432¢ = \$4.32$$

(b) $V = I \cdot R \Rightarrow I = \frac{V}{R}$

$$P = I \cdot V = \frac{V}{R} \cdot V = \frac{V^2}{R}$$

$$\therefore R = \frac{V^2}{P} = \frac{(120_V)^2}{100\ W} = 144\ \Omega$$

(c) $V = I \cdot R$

$$I = \frac{V}{R} = \frac{120\ V}{144\ \Omega} = 0.83\ amp$$

#79 Eqn 26-17 : $\rho - \rho_0 = \rho_0 \alpha (T - T_0)$

$\rho_0 = 1.69 \times 10^{-8}\ \Omega m$

$T_0 = 20°C = 293\ K$

$\alpha = 4.3 \times 10^{-3}/K$

$\rho = 2\rho_0$

$\therefore 2\rho_0 - \rho_0 = \rho_0 \alpha (T - T_0)$

$1 = \alpha (T - T_0)$

$T - T_0 = \frac{1}{\alpha}$

$$T = \frac{1}{\alpha} + T_0 = \frac{1}{4 \times 10^{-3}/K} + 293\ K = 525.96\ K$$

$$= 252.56°C$$