HW #9 Solutions

25.1

$$I = \frac{V}{R} \qquad R_+ = R_{Cu} + R_{Ag}$$

$$R_{Cu} = \frac{\rho L}{A} = \frac{(1.72\times10^{-8})(0.8)}{\pi\left(\frac{6\times10^{-4}}{2}\right)^2} = 0.049\,\Omega$$

$$R_{Ag} = \frac{\rho L}{A} = \frac{(1.47\times10^{-8})(1.2)}{\pi\left(\frac{6\times10^{-4}}{2}\right)^2} = 0.062\,\Omega$$

$$I = \frac{V}{R_{Cu}+R_{Ag}} = \frac{5}{.049+.062} = 45\,A$$

a. & b.) Conservation of charge requires the charge is the same in both sections

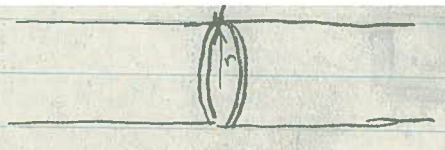
$$\Rightarrow 45\,A$$

c.) $E = \rho J = \frac{\rho I}{A} = \frac{IR}{L} \Rightarrow E_{Cu} = \frac{45(.049)}{.8} = \boxed{2.76\ V/m}$

d.) $E_{Ag} = \frac{45(.062)}{1.2} = \boxed{2.33\ V/m}$

e.) $V_{Ag} = IR_{Ag} = (45)(.062) = \boxed{2.79\ V}$

25.2



$dR = \rho \frac{dx}{A}$

a.)

$$R = \int \rho \frac{dx}{A} = \int_0^L (a + bx^2) \frac{dx}{\pi r^2} = \frac{aL + \frac{bL^3}{3}}{\pi r^2}$$

at $L = 0$ $\rho(0) = a + b(0)^2 = a = 2.25 \times 10^{-8}$

@ $L = 1.5$ $\rho(1.5) = (2.25 \times 10^{-8}) + b(1.5)^2 = 8.5 \times 10^{-8}$

$\Rightarrow b = 2.78 \times 10^{-8}$

$$\Rightarrow R = \frac{(2.25 \times 10^{-8})(1.5) + \frac{(2.78 \times 10^{-8})(1.5)^3}{3}}{\pi (.011)^2} = \boxed{1.71 \times 10^{-4}\ \Omega}$$

b.) $E = \frac{\rho I}{\pi r^2} = \frac{\left[2.25 \times 10^{-8} + 2.78 \times 10^{-8}(.75)^2\right](1.75)}{\pi (.011)^2}$

$$\boxed{1.76 \times 10^{-4}\ \frac{V}{m}}$$

c.) $R_1 = \int_0^{L/2} (a + bx^2) \frac{dx}{\pi r^2} = \left[a\left(\frac{L}{2}\right) + b\left(\frac{L}{2}\right)^3 / 3\right] \cdot \frac{1}{\pi r^2}$

$$= \boxed{5.47 \times 10^{-5}\ \Omega}$$

$R_2 = R_T - R_1 = (1.71 \times 10^{-4}) - (5.47 \times 10^{-5}) = \boxed{1.16 \times 10^{-4}\ \Omega}$

25.3

a.) $V_{C_1} = \frac{Q_1}{C_1} = \frac{18\mu C}{2\mu F} = 9V$

$V_{C_1} = V_{C_2} = \frac{Q_2}{C_2} = \frac{Q_2}{7\mu F} \Rightarrow Q_2 = (9V)(7\mu F)$

$= \boxed{63\mu C}$

b.) No current flows to the capacitors when they are fully charged so...

$\mathcal{E} = IR_1 + IR_2$

$V_{R_2} = V_{C_1} = 9V \qquad I = \frac{V_{R_2}}{R_2} = \frac{9}{3} = 3A$

$R_1 = \frac{\mathcal{E} - IR_2}{I} = \frac{62V - 9V}{3A} = \boxed{17.67\Omega}$