22-9. a) Mass of earth $M_e = 5.976 \times 10^{24}$ kg

\# of moles for Si. $M_e/S_i = 5.976\times10^{24}/28\times10^{-3} = 2.134\times10^{26}$ moles

total # of electrons: $N = 14\times10^{23}\times 6.023 \times 2.134\times10^{26} = 1.8\times10^{51}$

b) $\text{Charge} = \dfrac{1\times10^{-6}}{1.8\times10^{51}\times1.6\times10^{-19}} = 3.5\times10^{-39}$

22-11. a) Conserved ; b) not conserved ; c) Conserved ; d) not Conserved

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27-19.

On the left: $V_{d_1} = \dfrac{I}{n e A_1} = \dfrac{3}{7\times10^{22}\times1.6\times10^{-19}\times\pi\times(0.1)^2} = 8.53\times10^{-3}$ cm/s

by conservation of charge: $2V_{d_1}A_1 = 3V_{d_2}A_2$

$\Rightarrow V_{d_2} = \dfrac{2}{3}\dfrac{A_1}{A_2}V_{d_1} = \dfrac{2}{3}\dfrac{\pi(0.1)^2}{\pi(0.05)^2}V_{d_1} = \dfrac{2}{3}\times\dfrac{(0.1)^2}{(0.05)^2}\times8.53\times10^{-3}$

$= 2.27\times10^{-2}$ cm/s

27-40. Density of copper. $D = 8.92\times10^{3}\ \text{kg/m}^3$

Resistivity : $\rho = 1.72\times10^{-8}\ \Omega\cdot m$

$R = 2 = \rho\dfrac{L}{A}$ ①

$m = 1.5 = ALD$ ②

① × ② $\Rightarrow 3 = \rho L^2 D \Rightarrow L = \sqrt{\dfrac{3}{\rho D}} = \sqrt{\dfrac{3}{1.72\times10^{-8}\times8.92\times10^{3}}}$

$= 139.8$ m

From ① $\Rightarrow A = \dfrac{L\rho}{2} = 139.8\times1.72\times10^{-8}/2 = 1.20\times10^{-6}\ m^2$

$\pi r^2 = A \Rightarrow r = \sqrt{A/\pi} = \sqrt{1.20\times10^{-6}/3.14} = 6.2\times10^{-4}$ m

#61. a) $P = VI = 110 \times 15 = 1650$ W

b) # of light bulbs $= 1650/75 \approx 22$ bulbs

#66. $R_1 = \rho \frac{L_1}{A_1}$, $R_2 = \rho \frac{L_2}{A_2}$ $\Rightarrow \frac{R_2}{R_1} = \frac{L_2}{L_1} \frac{A_1}{A_2}$

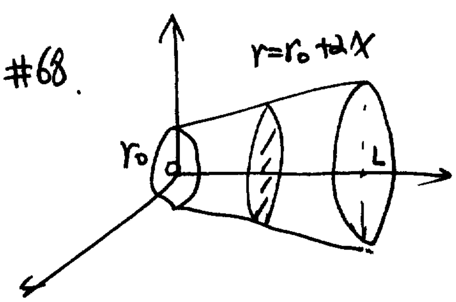
Since $V = L_1 A_1 = L_2 A_2 = \text{Const.}$ & $L_2 = 2L_1$ $\Rightarrow A_2 = \frac{1}{2} A_1$

$\Rightarrow \frac{R_2}{R_1} = \frac{2L_1}{L_1} \cdot \frac{A_1}{\frac{1}{2}A_1} = 4$

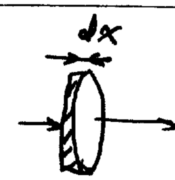
$\therefore R_2 = 4R_1 \Rightarrow P = \frac{U^2}{R}$ & U is constant

Thus, $P_2 = \frac{1}{4} P_1$

#68.



For an arbitary disc



$$dR = \rho \frac{dx}{A} = \rho \frac{dx}{\pi r^2} = \rho \frac{dx}{\pi (r_0 + \alpha x)^2}$$

$\Rightarrow$ the total resistance

$$R = \int dR = \int_0^L \rho \frac{dx}{\pi (r_0 + \alpha x)^2}$$

$$\xrightarrow[x = \frac{1}{\alpha}(t - r_0)]{r_0 + \alpha x = t} \int_{r_0}^{r_0 + L\alpha} \frac{\rho}{\pi} \frac{d(\frac{1}{\alpha} t)}{t^2} = \frac{\rho}{\pi \alpha} \left(-\frac{1}{t}\right)\Bigg|_{r_0}^{r_0 + \alpha L}$$

$$= \frac{\rho}{\pi \alpha} \frac{\alpha L}{r_0 (r_0 + \alpha L)} = \frac{\rho L}{\pi r_0 (r_0 + \alpha L)}$$