Solutions

26.25

$R = \rho l / A = 6\Omega$

Assume that the volume is fixed

$lA = (3l)(\frac{1}{3}A) \Rightarrow$

$R \rightarrow \rho(3l)(\frac{3}{A}) = 9 \times (\rho l/A) = 9 \times 6\Omega = 54\Omega$

26.33

$3.5 \times 10^{-4} m^2 = A$ $V = 35.8V$

$l = .158\ m$ $n = 5.33 \times 10^{22}\ e/m^3$ $R = 935$

$R = \rho l / A$ $\rho = \frac{RA}{l}$

(a) $I = \frac{V}{R} = \frac{35.8\ V}{935\ \Omega} = 3.83 \times 10^{-2} A$

(b) $J = \frac{I}{A} = \frac{3.83 \times 10^{-2}}{3.5 \times 10^{-4}} = 1.09 \times 10^{2}\ A/m^2$

(c) $\frac{I}{A} = J = nve$

$v = \frac{I}{neA} = \frac{(3.83 \times 10^{-2} A)}{(5.33 \times 10^{22} e/m^3)(1.60) \times 10^{-19} C/e)(3.5 \times 10^{-4} m)} = 1.2$

$= 1.28 \times 10^{-2}\ m/s$

(d) $E = V/l = \frac{35.8V}{.158m} = 2.27 \times 10^{2}\ V/m$

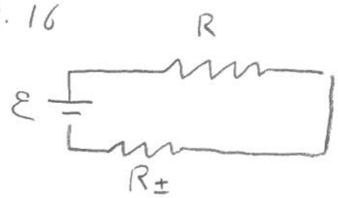
26.45

a) $I = \frac{P}{V} = \frac{1250W}{115V} = 10.9A$

b) $R = \frac{V}{I} = \frac{115\ V}{10.9\ A} = 10.6\ \Omega$

c) $E = PT = (1250)(60 \times 60)s = 4.5 \times 10^{6}\ J$

27.16



$$\mathcal{E} - I(R + R_I) = 0$$

$$IR = \mathcal{E} - IR_I = V$$

$$I = V/R$$

we have two unknows $\mathcal{E}$, R_I

$$\mathcal{E} - \frac{V_1}{R_1} R_I = V_1$$

$$\mathcal{E} - \frac{V_2}{R_2} R_I = V_2$$

$$(V_1 - V_2) = \left(\frac{V_2}{R_2} - \frac{V_1}{R_1}\right) R_I$$

a) $$R_I = \frac{V_1 - V_2}{(V_2/R_2 - V_1/R_1)} = \frac{.1 - .15}{.15/1000 - .1/500} = 1 \times 10^{-3}\,\Omega$$

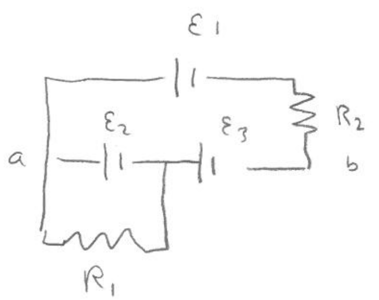
b) $$\mathcal{E} = V_1 \left(1 + \frac{1}{R_1} \frac{V_1 - V_2}{V_2/R_2 - V_1/R_1}\right) = (.1V)\left(1 + \frac{1 \times 10^{-3}\,\Omega}{500\,\Omega}\right) = .3V$$

c) $$\frac{\text{Power out}}{\text{Power in}} \times 100 = \left(\frac{V^2}{R}\right) \cdot \left(\frac{1}{2 \times 10^{-3}\ W/cm^2 \cdot .5\ cm^2}\right) \times 100$$

$$= \frac{(.15)^2}{1000} \cdot \frac{1}{10^{-3}\,W} \times 100$$

$$= 2.25\ \%$$

27.23



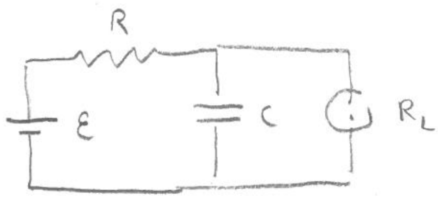
$R_1 = 100\,\Omega$
$R_2 = 50\,\Omega$
$\mathcal{E}_1 = 6V$
$\mathcal{E}_2 = 5V$
$\mathcal{E}_3 = 4V$

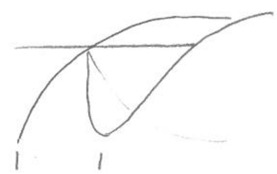
a) $$I_1 = \frac{\mathcal{E}_2}{R_1} = \frac{5V}{100\,\Omega} = 5 \times 10^{-2} A$$

b) $$I_2 = \frac{\mathcal{E}_1 - \mathcal{E}_2 - \mathcal{E}_3}{R_2} = \frac{6 - 5 - 4}{50\,\Omega} V = -\frac{3V}{50\,\Omega} = -6 \times 10^{-2} A$$

c) $$V_a - V_b = \mathcal{E}_2 + \mathcal{E}_3 = 5V + 4V = 9V$$

27.62





we assume that the lamp discharges quickly so the time between flashes is the time needed to charge the capacitor to 72V

$$V(t) = \frac{Q(t)}{C} = \mathcal{E}\left(1 - e^{-t/RC}\right)$$

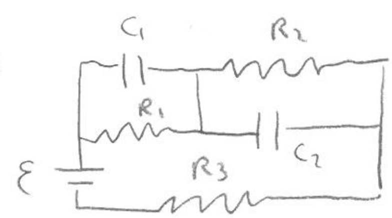
$$\frac{V}{\mathcal{E}} = 1 - e^{-t/RC} \qquad e^{-t/RC} = 1 - \frac{V}{\mathcal{E}}$$

$$-t/RC = \ln\left(1 - \frac{V}{\mathcal{E}}\right) =$$

$$RC = + \frac{t}{\ln\left(\frac{\mathcal{E}}{\mathcal{E}-V}\right)}$$

$$R = \frac{t}{C} \frac{1}{\ln\left(\frac{\mathcal{E}}{\mathcal{E}-V}\right)} = \left(\frac{.5s}{.15\times10^{-6}F}\right) \times \frac{1}{\ln\left(\frac{95}{23}\right)} = 2.35\times10^{6}\Omega$$

27.80



at steady state there is no current through the capacitors so

$$\mathcal{E} = I(R_1 + R_2 + R_3) \Rightarrow I = \frac{\mathcal{E}}{R_1+R_2+R_3}$$

$$V_{C_1} = IR_1 = \frac{\mathcal{E}R_1}{R_1+R_2+R_3}$$

$$V_{C_2} = IR_2 = \frac{\mathcal{E}R_2}{R_1+R_2+R_3}$$

$$\mathcal{U}_{C_1} = \frac{1}{2} C_1 V_{C_1}^2 = \frac{1}{2} C_1 \frac{\mathcal{E}^2 R_1^2}{(R_1 + R_2 + R_3)^2}$$

$$= \frac{1}{2}(5 \times 10^{-6} F) \frac{(20\,V)^2 (5)^2}{(5 + 10 + 15)^2}$$

$$= 2.78 \times 10^{-5}\ J$$

$$\mathcal{U}_{C_2} = \frac{1}{2} C_2 V_{C_2}^2 = \frac{1}{2} C_2 \frac{\mathcal{E}^2 R_2^2}{(R_1 + R_2 + R_3)^2}$$

$$= \frac{1}{2}(10 \times 10^{-6}) \frac{(20\,V)^2 (10)^2}{(5 + 10 + 15)^2}$$

$$= 8 \times \mathcal{U}_{C_1} = 5 \times 10^{-4} \text{ Joules}$$