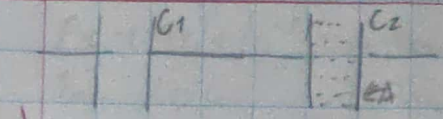
T5

P1



a) $C_2 \rightarrow A = 0.100\,m^2$ $\quad d = 1*10^{-3}\,m$ $\quad K = 5.40$ $\quad C_{eq} = 2.75\,nF$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} \Rightarrow C_2 = \frac{K\varepsilon_0 A}{d} = \frac{\varepsilon_0 (5.4)(0.100)}{1*10^{-3}} =$$

$$\frac{1}{C_1} = \frac{1}{C_{eq}} - \frac{1}{C_2} \qquad C_2 = 4.78*10^{-9}\,F$$

$$\frac{1}{C_1} = \frac{1}{2.75*10^{-9}} - \frac{1}{4.78*10^{-9}} = 154431342.7\,F$$

$$C_1 = \frac{1}{154431342.7} = 6.47*10^{-9}\,F$$

$C_1 = 6.5\,nF$

b) $C_1 \rightarrow V_1 = 8750\,V$ $\quad d = 2.50\,mm$ $\quad u = \frac{U_E}{Ad}$

$$U_E = \frac{C_1 V^2}{2} = \frac{(6.5*10^{-9})(8750)^2}{2} = 0.2488\,J$$

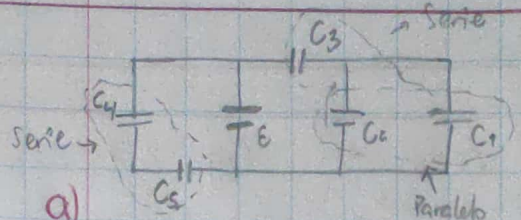
$$C_1 = \frac{\varepsilon_0 A}{d} \Rightarrow \frac{d C_1}{\varepsilon_0} = A \Rightarrow A = \frac{(2.5*10^{-3})(6.5*10^{-9})}{\varepsilon_0}$$

$A = 1.8352\,m^2$

$$u = \frac{0.2488}{(1.84)(2.5*10^{-3})} = 54.08\,J/m^3$$

$u = 54.1\,J/m^3$

P.2



$\varepsilon = 10.0\,V$ $\quad C_4 = 4.00\,\mu F$

$C_1 = 5.00\,\mu F$ $\quad C_5 = 1.00\,\mu F$

$C_2 = 2.00\,\mu F$

$C_3 = 3.00\,\mu F$

a)

$$C_{45} = \left(\frac{1}{C_4} + \frac{1}{C_5}\right)^{-1} = \left(\frac{1}{4\mu} + \frac{1}{1\mu}\right)^{-1} = 0.8\,\mu F$$

$$C_{12} = C_1 + C_2 = 5\mu + 2\mu = 7\,\mu F$$

$$C_{312} = \left(\frac{1}{C_3} + \frac{1}{C_{12}}\right)^{-1} = \left(\frac{1}{3\mu} + \frac{1}{7\mu}\right)^{-1} = 2.1\,\mu F$$

$$C_{eq} = 0.8\mu + 2.1\mu = 2.90\,\mu F$$

$C_{eq} = 2.90\,\mu F$

b) $C = \frac{Q}{V} \Rightarrow Q = C_{45} V$

$Q = (0.8\mu)(10) = 8\,\mu C$

$Q = 8\,\mu C$

c) $Q_{312} = \varepsilon C_{312} = (10)(2.1\mu) = 21\,\mu C.$

$$V_{12} = \frac{21\mu C}{7\mu F} = 3V$$

$U_1 = 22.5\,\mu J$

$$U_1 = \frac{1}{2} C_1 V_1^2 = \frac{1}{2}(5\mu)(3)^2 = 22.5\,\mu J$$

P.3

$\rho_{Cu} = 1.70 \times 10^{-8}\,\Omega \cdot m$

$V = 55.5\,V$

$R = \frac{V}{I} \Rightarrow I = \frac{Q}{t}$

a) $n_e = 12.5 \times 10^{21}$ en $t = 15\,min$

$$t = 15\,\text{min} \times \frac{60\,s}{1\,\text{min}} = 900\,s.$$

$$I = \frac{(12.5 \times 10^{21})(1.6022 \times 10^{-19})}{(900)} = 2.22\,A$$

$R = 25\,\Omega$

$$R = \frac{55.5}{2.22} = 25\,\Omega.$$

b) $A = 0.18\,m^2$

$v_d = 1 \times 10^{-4}\,m/s$

$J = \frac{I}{A}$

$n = \frac{I}{q v_d}$

$$n = \frac{(2.17)/(0.18)}{(1 \times 10^{-4})(1.6 \times 10^{-19})(0.18)} = 7.71 \times 10^{23}$$

$n = 7.71 \times 10^{23}\,e/m^3$

P.4

$V_0 = 120\ V$
$P = 3000\ W$
$\rho = 1.72 \times 10^{-8}\ \Omega \cdot m$
$T_0 = 20°C$
$\alpha = 0.003\ °C^{-1}$

a) $R = R_0 [1 + \alpha (T - T_0)]$

$R = (4.8)[1 + (0.003)(120-20)]$

$R = 6.24\ \Omega$

$P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P} = \frac{(120)^2}{3000} = 4.8\ \Omega$

$R = 6.24\ \Omega$

b) $T = 120°C$
$t = 4h$ en 1 mes
$\$ = 0.50/kWh$

$P = \frac{(120)^2}{6.24} = 2307.69\ W$

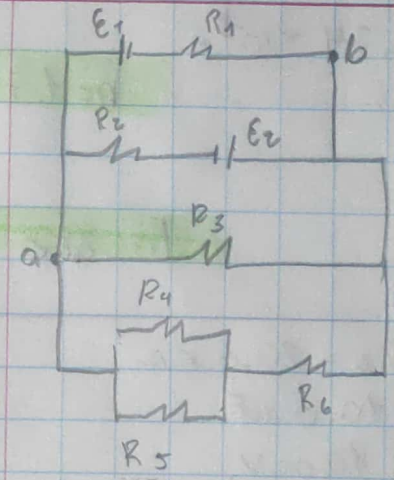
$E = (4)(30)(2307.69) = 276.92\ kWh$

$C = (276.92)(1.50) = 415.38$

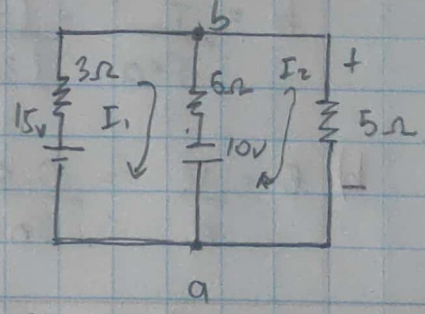
$C = 0415.38$

P.5

a)



$\varepsilon_1 = 10.0\ V$
$R_1 = 5.00\ \Omega$
$R_2 = 3.00\ \Omega$
$\varepsilon_2 = 15.0\ V$
$R_3 = 10.0\ \Omega$
$R_4 = 6.00\ \Omega$
$R_5 = 12.0\ \Omega$
$R_6 = 6.00\ \Omega$



$8I_1 - 5I_2 = 25$
$-5I_1 + 10I_2 = -10$

$I_1 = 40/11 A$ y $I_2 = 9/11 A$

$I_{3\Omega} = 3.64\ A$

$I_{3\Omega} = I_1 = 3.64\ A$

$P = 82.7\ W$

b) $P = (15)(40/11) + (10)(40/11 - 9/11) = 82.72\ W$

c) $V_a - V_b = -I_2(5) = -4.09\ V$

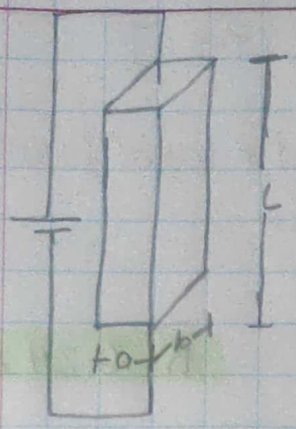
$V_a - V_b = -4.09\ V$

d) $I_{R6} = \frac{9}{22} A$

$P = 1.00\ W$

$P = \left(\frac{9}{22}\right)^2 (6) = 1.004\ W$

P.6



$\rho = 8.70 \times 10^{-4}\ \Omega \cdot m$

$V = 0.50\ V$

$P = 5.00\ mW$

$L = 0.2\ m$

$a = 2 \times 10^{-3}\ m$

$n = 1.23 \times 10^{23}\ e \cdot m^3$

a)

$$I = \frac{P}{V} = \frac{5 \times 10^{-3}}{0.5} = 10 \times 10^{-3}\ A \qquad \rho = \frac{E}{J} \Rightarrow J = \frac{E}{\rho}$$

$$\Delta V = Ed \Rightarrow E = \frac{V}{d} = \frac{0.50}{0.2} = 2.50\ V/m$$

$$J = \frac{2.50}{8.70 \times 10^{-4}} = 2873.563\ A/m^2 \Rightarrow A = \frac{I}{J} = a \times b = \frac{I}{J}$$

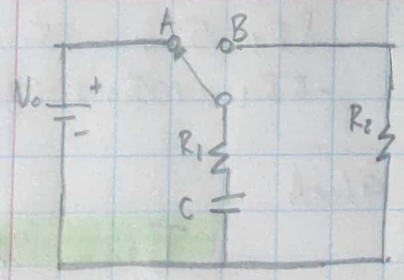
$$b = \frac{I}{J \cdot a} = \frac{(10 \times 10^{-3})}{(2873563)(2 \times 10^{-3})} = 1.74 \times 10^{-3}\ m$$

$b = 1.74 \times 10^{-3}\ m$

b) $E = \frac{V}{d} = \frac{0.50}{0.2} = 2.50\ V/m$

$E = 2.50\ V/m$

P.7



a)

$t = 0 \quad R_1 = R_2 = 20.0\ K\Omega$

$C = 10.0\ \mu F$

$V_0 = 10.00\ V$

$$q(t) = CV(1 - e^{-t/RC})$$

$$q(3t) = (10\mu)(10)(1 - e^{-3}) = 95.02 \times 10^{-6}\ C$$

$q(t) = 95.0\ \mu C$

b) $I = 125\ \mu A$

$$i = I_0 e^{-t/RC}$$

$$I_0 = \frac{10}{40 \times 10^3} = 0.25\ mA$$

$$t = -(400 \times 10^{-3}) \ln\left(\frac{0.125}{0.250}\right)$$

$$t = RC = (40 \times 10^3)(10\mu) = 400\ ms$$

$t = 277\ ms$