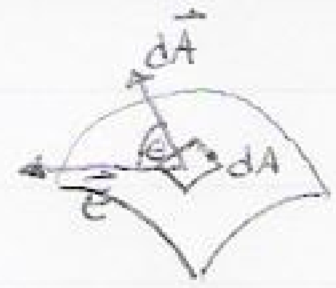
10/11/10

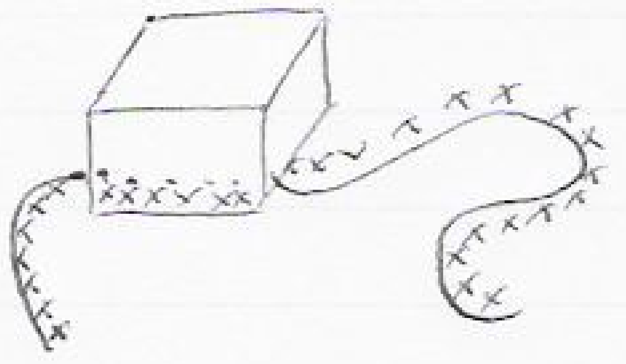
Notes

$\Phi_E = \int_{surface} \vec{E} \cdot d\vec{A} = \int E(dA) \cos\theta$



Gauss' Law $\frac{Q_{enclosed}}{\epsilon_0} = \Phi_E$ for closed surfaces

Given: $\Phi_E = 4.5 \cdot 10^4 \, V \cdot m$



$L_{total} = 3.0m$

$\frac{dQ}{dL} = \underbrace{2.7 \cdot 10^{-6} \frac{C}{m}}_{constant}$

Find $\frac{L_{enclosed}}{L_{total}}$, same as $\frac{Q_{enclosed}}{Q_{total}}$

$\frac{Q_{enclosed}}{Q_{total}} = \frac{(dQ/dL)L_{enclosed}}{(dQ/dL)L_{total}}$

$\frac{\lambda L_{enclosed}}{\lambda L_{total}}$

$\frac{\lambda L_{enclosed}}{8.1 \cdot 10^{-6} C}$

$\frac{Q_{enclosed}}{8.1 \cdot 10^{-6} C}$

$Q_{encl} = \epsilon_0 \Phi_E$

$\left[8.854 \cdot 10^{-12} \, C^2/(N \cdot m^2)\right] \cdot 4.5 \cdot 10^4 \, V \cdot m$ $\quad \frac{N \cdot m}{C} \cdot m$

$= 3.984 \ldots \cdot 10^{-7} \frac{\cancel{C^2}}{\cancel{N m^2}} \cdot \frac{\cancel{N m^2}}{\cancel{C}}$

$= 3.984 \ldots \times 10^{-7} C$

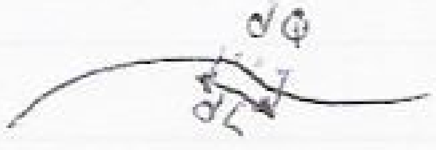
$\frac{L_{encl}}{L_{total}} = \frac{Q_{encl}}{Q_{total}} = 4.9 \times 10^{-2} = 4.9\%$

$V_{ab} = -\int_b^a \vec{E} \cdot d\vec{l}$ $\quad \vec{E} = \frac{\vec{F}}{q}$

$1 \text{ volt} = \frac{N}{C} \cdot m$

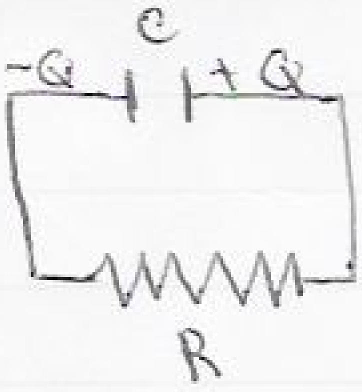
$Q_{total} = \int_{string} dQ = \int_{string} \underbrace{\frac{dQ}{dL}}_{constant} dL = \frac{dQ}{dL} \int_{string} dL = \underbrace{\frac{dQ}{dL}}_{2.7 \times 10^{-6} C/m} \cdot L_{total}$

$= 2.7 \mu C/m$

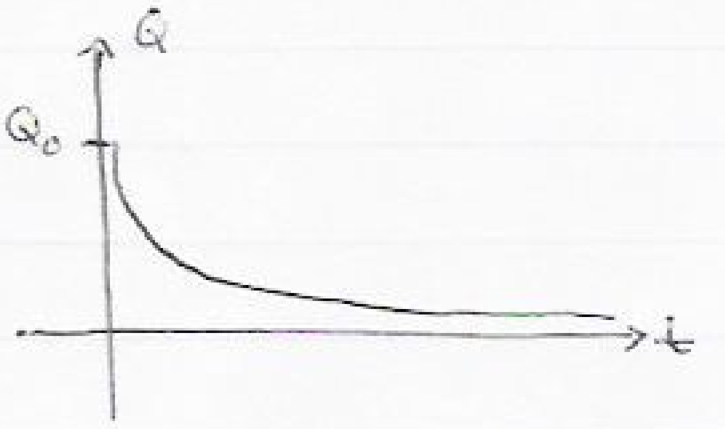


A

$Q = Q_0 e^{-t/\tau}$ ← Discharging RC circuit



$\tau = RC$



Solve $Q = \frac{1}{2} Q_0$ for t $\longrightarrow \frac{1}{2} Q_0 = Q_0 = e^{-t/\tau}$

Given $\tau = 1.32 \cdot 10^{-5} s$

$\ln \frac{1}{2} = -t/\tau$

$-\tau \underbrace{\ln \frac{1}{2}}_{} = t$

$-0.093147\ldots$

$\underline{9.1495\ldots \cdot 10^{-6} s = t}$

$\boxed{9.15 \cdot 10^{-6} s = t}$

MT #5b

$U = \frac{1}{2} U_0$ for t

$\frac{Q^2}{2C} = U$

$\frac{Q^2}{2C} = U = \frac{1}{2} U_0 = \frac{Q_0^2}{4C}$

$V_{ab} = -\int_b^a \vec{E} \cdot d\vec{l} = -\int_b^a \frac{\vec{F}}{q} \cdot d\vec{l} = \frac{1}{q} \underbrace{\left(-\int_b^a \vec{F} \cdot d\vec{l} \right)}_{U_{ab}}$

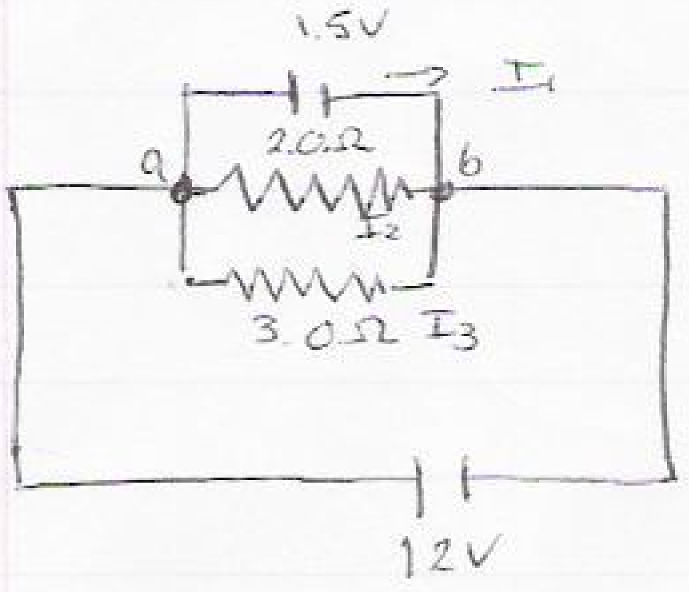
$U_{ab} = -W_{ab} = -\int_b^a \vec{F} \cdot d\vec{l}$

$V = \frac{U}{q}$

To charge a capacitor, you go from $a = 0$ to $a = Q$

$U = \int_{b=0}^{a=Q} \underbrace{V\,dq}_{dU} = \int_{a=0}^{a=Q} \frac{q}{C}\,dq = \frac{1}{C} \int_0^Q q\,dq = \frac{1}{C} \cdot \frac{1}{2} Q^2$

$\frac{Q_0^2}{2} = Q^2 \rightarrow \frac{Q_0}{\sqrt{2}} = Q = Q_0 e^{-t/\tau} \rightarrow \frac{1}{\sqrt{2}} = e^{-t/\tau} \rightarrow \ln \frac{1}{\sqrt{2}} = \frac{-t}{\tau} = -t \ln \frac{1}{\sqrt{2}} = \boxed{t = 4.57 \cdot 10^{-6}}$



Lie!!!

What is power being lost to heat through the 3.0 Ω resistor?

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

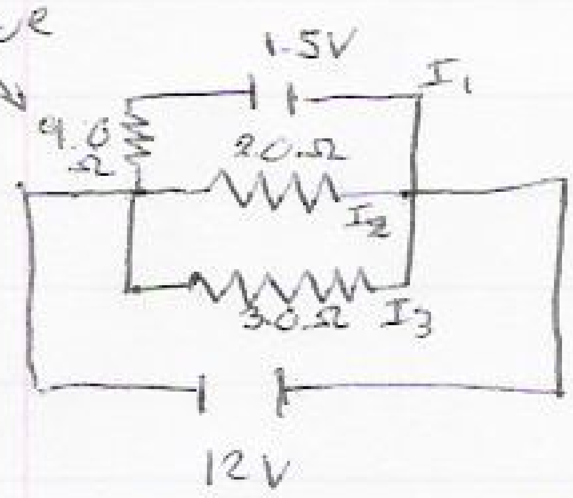
$P = I_3^2(3.0\Omega) = \frac{V_{ab}^2}{3.0\Omega} = \frac{(12V)^2}{3.0\Omega} = \frac{144}{3}w = 48w$

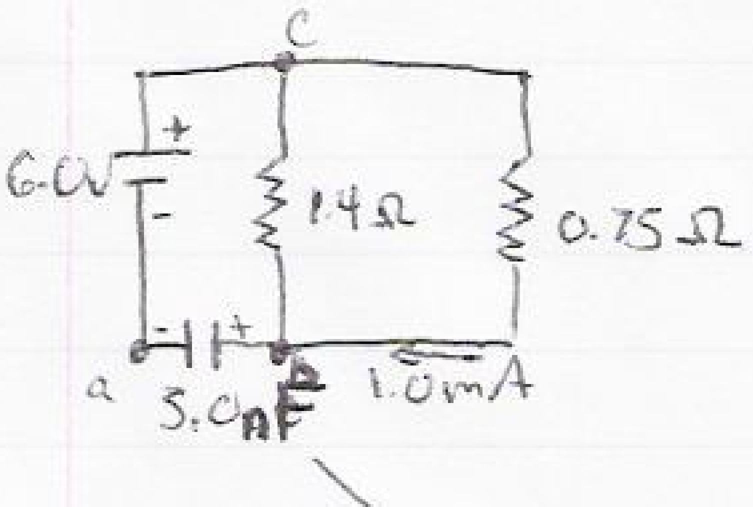
$I_3 = \frac{V_{ab}}{3.0\Omega} = \frac{12V}{3.0\Omega} = 4A \rightarrow P = 4^2 \cdot 3\ w = 48w$

In parrallel, Voltage equal; current & charges add

In series, current & charges equal; voltages add.

True





5.0nF

What is the charge on the capacitor?

$V_{cb} = I_1(1.4\Omega) = (1.0mA)\ 0.75\Omega = 0.75\ mV = 7.5 \cdot 10^{-4} V$

$V_{cA} + V_{ab} = 6.0V + V_{ab}$

$C = \frac{Q}{V_{ba}}$

$V_{ab} = 7.5 \cdot 10^{-4} V - 6.0V = -5.9925V$

$V_b - V_a = V_{ba} =$

$Q = CV_{ba} = 5.0 \times 10^{-9} \underset{(F)}{F} \cdot 5.9925 \underset{(V)}{V} = 3.0 \times 10^{-9} C$

coulomb / volt   volt