Quiz 20.1A

A circuit contains a 120-Volt battery, a 5.6-Ohm resistor and a 22 μF capacitor. At t=0, the capacitor is uncharged, and a switch is closed allowing current to begin to flow in the circuit to charge the capacitor.

a) After 2.5 time constants have elapsed, what is the voltage drop across the capacitor?

b) At this time, what is the voltage drop across the resistor?

c) At what time is the voltage drop across the resistor equal to the voltage drop across the capacitor?

a) $Q(t) = Q_{max}(1 - e^{-t/\tau})$

$Q(t = 2.5\tau) = C\mathcal{E}(1 - e^{-2.5})$

$\Delta V = \frac{Q}{C} = \mathcal{E}(1 - e^{-2.5})$

$= 120(0.918) =$ **110 Volts**

b) Loop rules $\Delta V_C + \Delta V_R = \mathcal{E}$

$110 + \Delta V_R = \mathcal{E}$ **$\Delta V_R = 10$ Volts**

c) When $\Delta V_C = \Delta V_R$, both are 60 Volts

$60 + 60 = 120.$

$60 = 120(1 - e^{-t/\tau})$

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

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

$t = 0.693\tau$

$= 0.693RC$

$=$ **8.5×10^{-5} s**