

Q- A capacitor in an RC circuit is charged to 60.0% of its maximum value in 0.900 s. What is the time constant of the circuit?

When a capacitor is charged through a resistance R and battery of EMF E , the charge on it as a function of time t is given by

$$q = CE \left(1 - e^{-\frac{t}{\tau}} \right)$$

Here CE is the maximum possible charge and τ is the time constant of the circuit.

Now the charge in 0.900 s is 60% of the maximum hence $q = 0.60 CE$ thus substituting in the equation we get

$$0.60 CE = CE \left(1 - e^{-\frac{t}{\tau}} \right)$$

Or $e^{-\frac{t}{\tau}} = 1 - 0.60 = 0.40$

Or $e^{\frac{t}{\tau}} = 1 / 0.40 = 2.5$

Or $0.900/\tau = \ln 2.5 = 0.9163$

Or $\tau = 0.900/0.9163 = 0.982 \text{ s}$