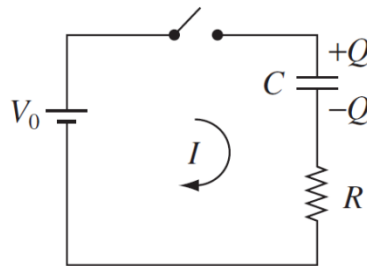


Answer on Question#78489 - Physics - Other

If the capacitor is initially uncharged what is charge after a long time? How long will it take the capacitor reaches 80% full charge?

Solution:



The figure above shows the process of charging capacitor of capacitance C by the source of constant voltage V_0 and internal resistance R .

Voltage drops at capacitor and resistor must be equal to source voltage:

$$V_0 = IR + \frac{Q}{C}$$

Since $I = \frac{dQ}{dt}$, we obtain

$$\frac{dQ}{dt} + \frac{Q}{RC} = \frac{V_0}{R}$$

Solution to this differential equation:

$$Q = CV_0 \left(1 - e^{-\frac{t}{RC}} \right)$$

Thus after a long time ($t \rightarrow \infty$) Q becomes CV_0 . In order to find time of charging the capacitor by 80%, we should solve the following equation:

$$\frac{Q}{CV_0} = 1 - e^{-\frac{t_{80\%}}{RC}} = 0.8$$

$$t_{80\%} = RC \ln 5$$

Answer: $Q = CV_0 \left(1 - e^{-\frac{t}{RC}} \right)$, $t_{80\%} = RC \ln 5$.