Answer on Question #66331 - Physics - Electric Circuits

Question

A 100-volt electromotive force is applied to an R-C series circuit in which the resistance R is 200 ohms and the capacitance C is 10-4 farad. find the charge q(t) on the capacitor if q(0) = 0.

Solution

The charge on the plates of the capacitor:

$Q = C{\times}V_c$

For RC charging circuit voltage across the capacitor is:

$V_C(t) = V_S{\times}\left(1 - e^{-t/R{\times}C}\right) = 100{\times}\left(1 - e^{-t/200{\times}10^{-4}}\right) = 100{\times}\left(1 - e^{-\frac{t}{0.02}}\right) = 100{\times}(1 - e^{-t{\times}50})$

Vc - is the voltage across the capacitor

Vs =100 - is the supply voltage

t - elapsed time since the application of the supply voltage

RC - time constant of the RC charging circuit

Charge

$q(t) = C{\times}V_C(t) = 10^{-4}{\times}100{\times}\left(1 - e^{-\frac{t}{0.02}}\right)$

Answer

$q(t) = C{\times}V_C(t) = 10^{-4}{\times}100{\times}(1 - e^{-50t})$