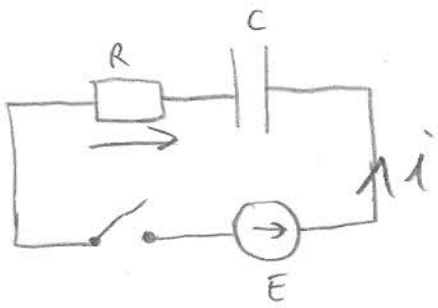

Dane:
$E = 30\,V$
$R = 10\,\Omega$
$C = 10\,\mu F$
Szukane:
$q = ?$ dla ~~$t = 10\,s$~~

$\tau = R \cdot C$

$t = 5\tau$

$i_C = \frac{E}{R} \cdot e^{-\frac{t}{\tau}}$

$\int e^{ax}\,dx = \frac{1}{a} \cdot e^{ax} + C$

$e \approx 2{,}718$

Rozwiązanie:

$$q = \int i \cdot dt$$

$$q = \int_0^{10} \frac{E}{R} \cdot e^{-\frac{t}{\tau}} \cdot dt = \frac{E}{R} \cdot \int_0^{10} e^{-\frac{t}{\tau}} \cdot dt = \frac{E}{R} \cdot \left(-\tau \cdot e^{-\frac{t}{\tau}} \right) \Big|_0^{10} =$$

$$= \frac{E}{R} \cdot \left(-\tau \cdot e^{-\frac{10}{\tau}} + \tau \cdot e^{0} \right) = \frac{E}{R} \cdot \tau \cdot \left(1 - e^{-\frac{10}{\tau}} \right) =$$

$$= \frac{E}{R} \cdot R \cdot C \cdot \left(1 - e^{-\frac{10}{0{,}0001}} \right) = E \cdot C \cdot \left(1 - e^{-\frac{10}{0{,}0001}} \right) =$$

$$= E \cdot C \cdot (-1) \cdot \left(-1 + e^{-\frac{10}{0{,}0001}} \right) =$$

$i_C = \frac{E}{R} \cdot e^{-\frac{t}{\tau}}$

$$q = \int i \cdot dt = \int \frac{E}{R} \cdot e^{-\frac{t}{\tau}} \cdot dt = \frac{E}{R} \int_0^{5\tau} e^{-\frac{t}{\tau}} \cdot dt =$$

$$= \frac{E}{R} \cdot \left(-\tau \cdot e^{-\frac{t}{\tau}} \right) \Big|_0^{5\tau} = -E \cdot C \cdot \left(e^{-\frac{5\tau}{\tau}} - e^{0} \right) =$$

$$= -E \cdot C \cdot (-1) \cdot \left(-e^{-5} + e^{0} \right) = E \cdot C \cdot \left(1 - \frac{1}{e^5} \right) =$$

$$= 290\,\mu C$$

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