Capacitors Inductors 001

Problem has been graded.

You are given a capacitor with a capacitance C_1. At time $t = 0$, the voltage across this capacitor is V_o.

If a constant current I_1 flows through the capacitor, how long will the capacitor take to charge up to a charge of 10 nC?

Given Variables:

C1 : 8 nF

Vo : 1 V

I1 : 2 mA

Calculate the following:

t (us) :

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C1 = 2 nF

Vo = 3 V

I1 = 2 mA

$V_0 = 3\,V$ $\qquad Q = C \cdot V$

$$V_{END} = \frac{Q_{END}}{C_1} = \frac{10 \cdot 10^{-9}}{2 \cdot 10^{-9}} = 5\,V$$

$$i = C \frac{dv}{dt}$$

$$\Downarrow$$

$$V_{END} = V_0 + \frac{1}{C} \int_{t_0}^{t} I_1 \, dt = V_0 + \frac{I_1}{C} \cdot t$$

$$t = (V_{END} - V_0) \cdot \frac{C}{I_1} = (5 - 3) \cdot \frac{2 \cdot 10^{-9}}{2 \cdot 10^{-3}}$$

$$t = 2 \cdot 10^{-6}\,s$$

$$\boxed{t = 2\,\mu s}$$