

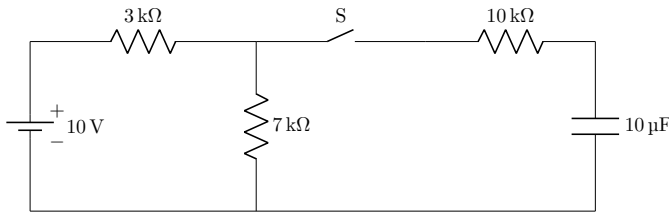
# GATE 2023 BM 30

EE23BTECH11007 - Aneesh Kadiyala\*

**Question:** In the following circuit, the switch S is open for  $t < 0$  and closed for  $t \geq 0$ . What is the steady state voltage (in Volts) across the capacitor when the switch is closed?

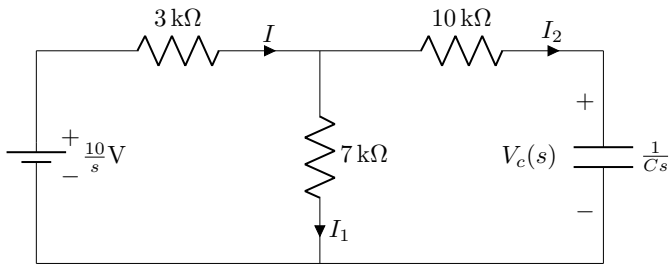
Taking inverse Laplace transform:

$$v_c(t) = 7u(t) \left(1 - e^{-\frac{t}{0.121}}\right) \quad (9)$$



**Solution:**

In s-domain:



$$I(s) = \frac{\frac{10}{s} \text{V}}{3\text{k}\Omega + \frac{(7\text{k}\Omega)(10\text{k}\Omega + \frac{1}{sC})}{17\text{k}\Omega + \frac{1}{sC}}} \quad (1)$$

$$I = I_1 + I_2 \quad (2)$$

$$\text{and } I_1(7\text{k}\Omega) = I_2 \left(10\text{k}\Omega + \frac{1}{sC}\right) \quad (3)$$

$$\Rightarrow I_2(s) = \frac{7\text{k}\Omega}{17\text{k}\Omega + \frac{1}{sC}} I(s) \quad (4)$$

$$\Rightarrow I_2(s) = \frac{7(10^{-5})}{0.121s + 1} \quad (5)$$

$$V_c(s) = I_2(s) \frac{1}{sC} \quad (6)$$

$$= \frac{7}{s(0.121s + 1)} \quad (7)$$

$$= 7 \left( \frac{1}{s} - \frac{1}{s + \frac{1}{0.121}} \right) \quad (8)$$