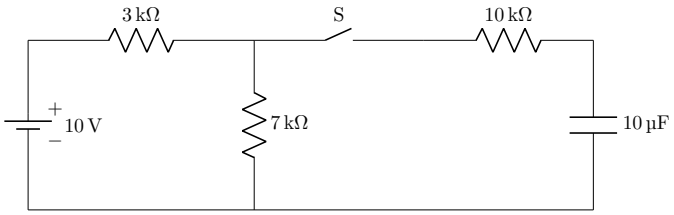
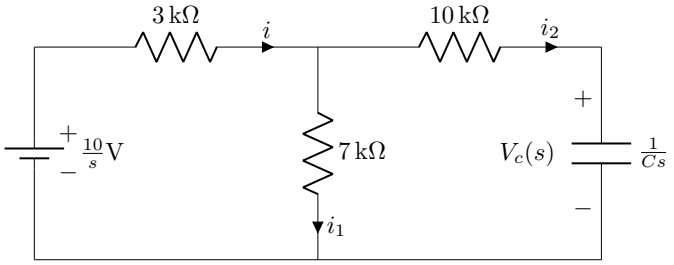
GATE 2023 BM 30

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?



Solution:
In s-domain:



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

$$i_2(s) = \frac{7\text{k}\Omega}{17\text{k}\Omega + \frac{1}{sC}} i(s) \tag{2}$$

$$= \frac{7 * 10^{-5}}{0.121s + 1} \tag{3}$$

$$V_c(s) = i_2(s)\frac{1}{sC} \tag{4}$$

$$= \frac{7}{s(0.121s + 1)} \tag{5}$$

$$= 7\left(\frac{\frac{1}{0.121}}{s(s + \frac{1}{0.121})}\right) \tag{6}$$

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

Taking inverse Laplace transform:

$$v_c(t) = 7u(t)\left(1 - e^{-\frac{t}{0.121}}\right) \tag{8}$$