GATE 21 EE/29

EE23BTECH11040 - Manoj Kumar Ambatipudi*

QUESTION: In the circuit, switch 'S' is in the closed position for a very long time. If the switch is opened at time $t = 0$, then $i_L(t)$ in amperes, for $t \geq 0$ is

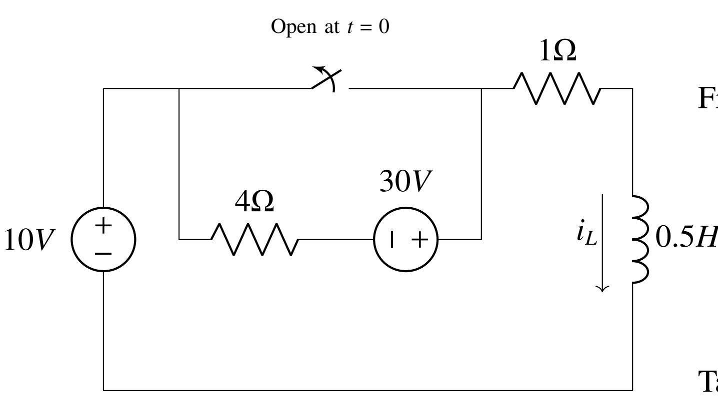

Fig. 1. Circuit in T domain

Solution: Circuit in S domain is

Variables	Description	value
$i_L(0)$	Initial current in Inductor	10A
L	Inductance of Inductor	0.5H

TABLE 1
CAPTION

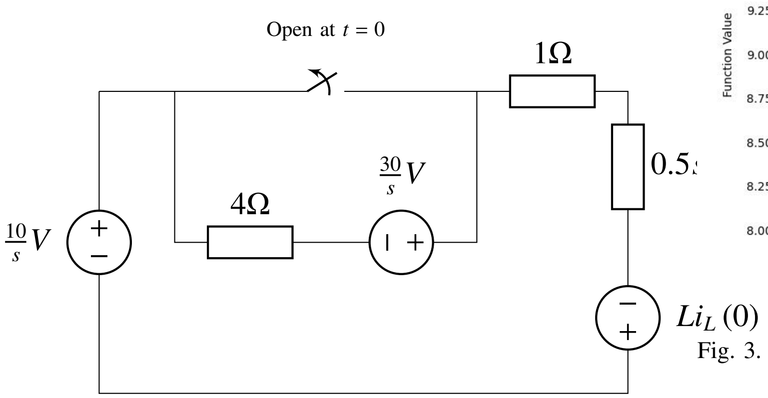

Fig. 1. Circuit in S domain

From Fig. 3, $i_L(0)$ can be found using steady state analysis. Writing KVL , we get

$$10 - i_L(0) = 0 \tag{1}$$

$$i_L(0) = 10 \tag{2}$$

Writing KVL for Fig. 1,

$$\frac{10}{s} - I_L(s)(4 + 1 + 0.5s) + \frac{30}{s} + Li_L(0) = 0 \tag{3}$$

$$\implies I_L(s) = \frac{sLi_L(0) + 40}{5s + 0.5s^2} \tag{4}$$

From Table 1,

$$I_L(s) = \frac{2.5s + 40}{5s + 0.5s^2} \tag{5}$$

$$I_L(s) = \frac{10s + 80}{10s + s^2} \tag{6}$$

$$= \frac{8}{s} + \frac{2}{s + 10} \tag{7}$$

Taking Inverse Laplace,

$$i_L(t) = \left(8 + 2e^{-10t}\right)u(t) \tag{8}$$

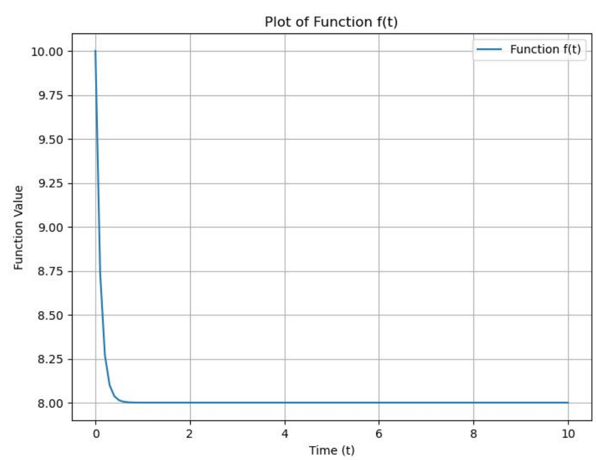

Fig. 3. Plot of $i_L(t)$ taken from Python3