1. The switch in the circuit of fig.1 has been in position a for a long time. At $t = 0$ the switch moves instantaneously to position b. Find $v_o(t)$ for $t \geq 0$.

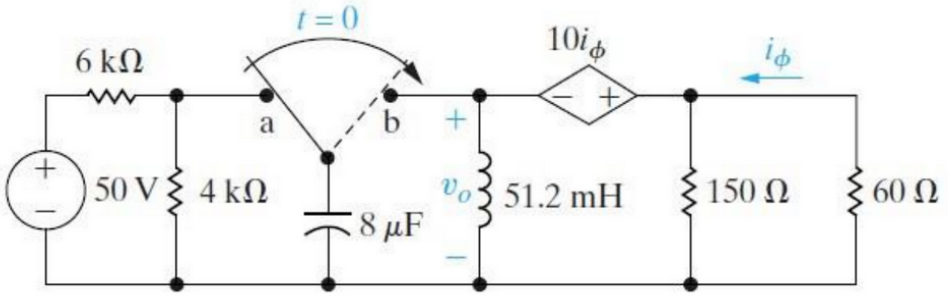
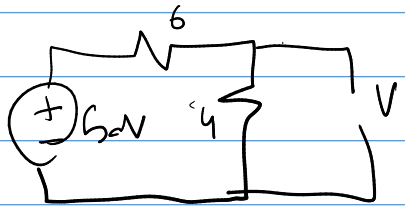


Figure 1

$t < 0$

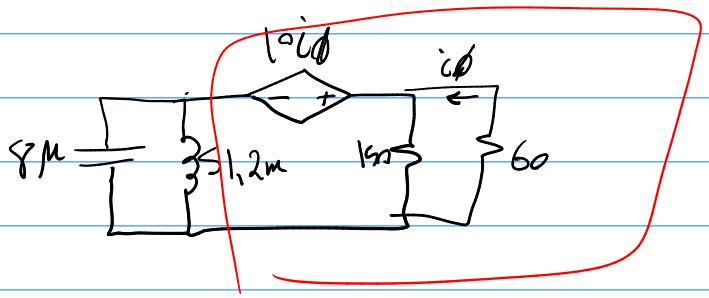


$\Rightarrow \quad V = 60 \dfrac{4}{4+6}$

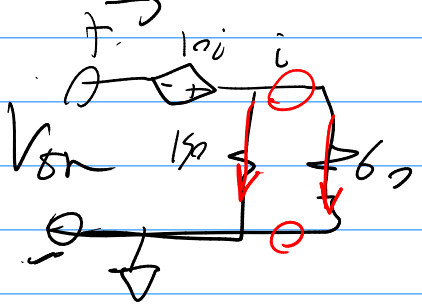
$= 20$

$\Downarrow$

$t > 0 \qquad V_o = 20 \,, i_o = 0$



I_{th}



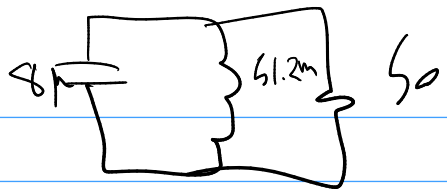
$R_{th} = 42.85$

$V_{th} = -10i + I_{th}\, 42.85$

$i = -I_{th} \dfrac{150}{150+60}$

$\dfrac{V_{th}}{I_{th}} = 10 \dfrac{150}{150+60} + 42.85$

$= 50$



$$\Rightarrow \alpha = \frac{1}{2RC} = 1250$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = 1526.5$$

$\alpha < \omega_0$

$$s_{1,2} = \alpha \pm \sqrt{\alpha^2 - \omega_0^2}$$

$$= 1250 \pm 937.5i$$

$$\Rightarrow v(t) = e^{\alpha t}(A_1 \sin \omega_d t + A_2 \cos \omega_d t)$$

$$= e^{-1250t}(A_1 \sin 937.5t + A_2 \cos 937.5t)$$

$$20 = A_2$$

$$\Rightarrow \frac{dv}{dt} = -50k$$

$$A_1 e^{-1250t} \sin 937.5t + e^{-1250t} 20 \cos 937.5t$$

$$D = 937.5 A_1 e^{-1250t} \cos 937.5t - 1250 A_1 e^{-1250t} \sin 937.5t$$

$$- 937.5 e^{-1250t} \sin 937.5t - 1250 e^{-1250t} \cos 937.5t 20$$

$$-50 = 937.5 A_1 - 1250 \times 20$$

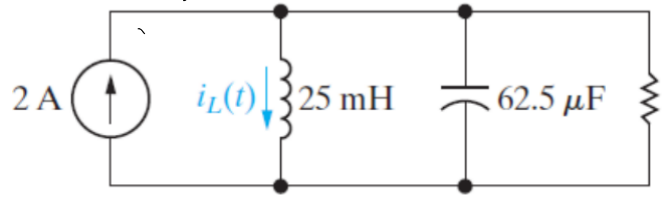
$$A_1 = -26.67$$

$$V(t) = \begin{cases} 20, & t < 0 \\ e^{-1250t}(20 \cos 937.5t - 26.67 \sin 937.5t), & t \geq 0 \end{cases}$$

2. Assume that the instant the 2A dc current source is applied to the circuit in fig. 2, the initial current in the 25 mH inductor is 1 A, and the initial voltage on the capacitor is 50 V (positive at the upper terminal). Find the expression for $i_L(t)$ for $t \geq 0$ if R equal 12.5 Ω.

$i_0 = 1$ $V_0 = 50$

$\frac{di}{dt} = \frac{50}{25m} = 2k$



$= 12.5$

$\alpha < \omega_0$ (under)

Figure 2

$i(t) = i_s + i_t = 2 + i_t$

$i_t = e^{-640t}(A_1 \cos 480t + A_2 \sin 480t)$

$1 = 2 + A_1 \Rightarrow A_1 = -1$

$\alpha = \frac{1}{2RC} = 640$

$\omega_0 = \frac{1}{\sqrt{LC}} = 800$

$\omega_d = \sqrt{\alpha^2 - \omega_0^2} = 480i$

$s_{1,2} = -\alpha \pm \omega_d$

$= -640 \pm 480i$

$\frac{di}{dt} = -640 e^{-640t} A_1 \cos 480t - 640 e^{-640t} A_2 \sin 480t$

$- 480 A_1 e^{-640t} \sin 480t + 480 A_2 e^{-640t} \cos 480t$

$2k = -640 A_1 + 480 A_2$

$= 640 + 480 A_2$

$\Rightarrow A_2 = 2.83$