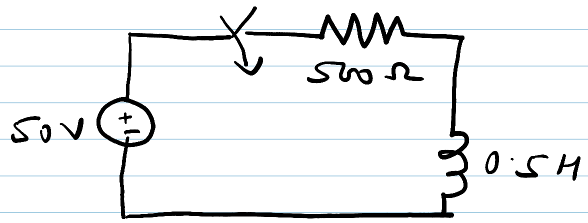
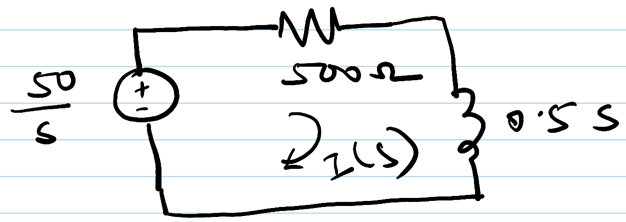
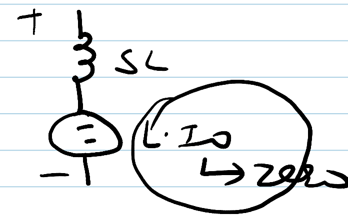


In the given circuit, switch is closed at $t=0$. There is no initial current through inductor.

Obtain $i(t)$ for $t \geq 0$ using $\mathcal{L}\cdot T$





KVL equation for mesh

$$\frac{50}{s} - 500\, I(s) - 0.5s\, I(s) = 0$$

$$\therefore \frac{50}{s} = I(s)\left[500 + 0.5s\right]$$

$$I(s) = \frac{50}{s(500+0.5s)}$$

$$\frac{50}{s(500+0.5s)} = \frac{A}{s} + \frac{B}{(0.5s+500)} \Rightarrow \text{P.f.E}$$

$$A = \frac{50}{\cancel{s}(500+0.5s)} \times \cancel{s}\Bigg|_{s=0} = \frac{50}{500} = 0.1$$

zero

$$B = \frac{50}{s(500+0.5s)} \times (0.5s+500)\Bigg|_{s=\frac{-500}{0.5}}$$

$$= \frac{500}{-500/0.5} = -0.05$$

$$I(s) = \frac{0.1}{s} + \frac{-0.05}{(0.5s+500)}$$

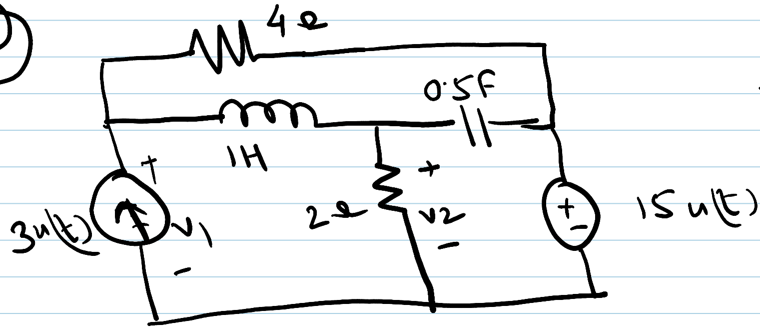
$$I(s) = \frac{0.1}{S} - \frac{0.1}{s+1000}$$

$\dots e^{-1000t}$ amp

$$s \qquad\qquad s+1000$$

$$i(t) \rightarrow ILT = \boxed{0.1\,u(t) - 0.1\,e^{-1000t}} \text{ amp}$$

(2)



- No energy is stored initially

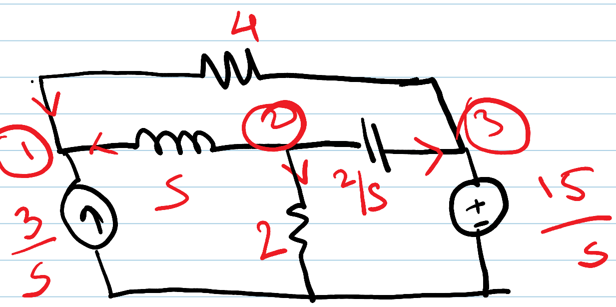
(1) $v_1(s)$ & $v_2(s)$

(2) $v_1(t)$ & $v_2(t)$ $t \geq 0$

(3) $v_1(0)$, $v_1(\infty)$, $v_2(0)$, $v_2(\infty)$

(4) check the result in (3) using initial value & final value theorem

⇒



$$C \Rightarrow \frac{1}{Cs} = \frac{1}{0.5s} = \frac{2}{s}$$

$$V_3 = \frac{15}{s}$$

$v_1(s) = v_1$ & $v_2(s) = v_2$

(4)

KCL at node (1)

$$\frac{3}{s} + \frac{v_2(s) - v_1(s)}{s} + \frac{\frac{15}{s} - v_1(s)}{4} = 0$$

$$12 + 4v_2(s) - 4v_1(s) + 15 - s v_1(s) = 0$$

$$(-4 - s)v_1(s) + 4v_2(s) + 27 = 0$$

$$(4+s)\,v_1(s) - 4v_2(s) = 27 \qquad (1)$$

KCL at node (2)

$$\frac{v_2(s)}{2} + \frac{v_2(s) - v_1(s)}{s} + \frac{v_2(s) - 15/s}{2/s} = 0$$

$$\frac{v_2(s)}{2} + \frac{v_2(s) - v_1(s)}{s} + \frac{s v_2(s) - 15}{2} = 0$$

$$s v_2(s) + 2v_2(s) - 2v_1(s) + s^2 v_2(s) - 15s = 0$$

$$v_2(s)\left[s + 2 + s^2\right] - 2v_1(s) - 15s = 0$$

$$2V_1(s) - V_2(s)\left[s^2+s+2\right] = -15s \quad (2)$$

$$\begin{bmatrix} 4+s & -4 \\ 2 & s^2+s+2 \end{bmatrix}\begin{bmatrix} V_1(s) \\ V_2(s) \end{bmatrix} = \begin{bmatrix} 27 \\ -15s \end{bmatrix}$$

$$\Delta =$$

$$V_1(s) = \frac{\Delta_1}{\Delta} \qquad V_2(s) = \frac{\Delta_2}{\Delta}$$

$$V_1(s) = \frac{27s^2+87s+54}{s(s+2)(s+3)} \qquad V_2(s) = \frac{15s^2+60s+54}{s(s+2)(s+3)}$$

(b) $v_1(t)$ & $v_2(t) = ?$

ILT $\rightarrow$ P.F.E

$$V_1(s) = \frac{A}{s} + \frac{B}{s+2} + \frac{C}{s+3}$$

$A = 9$

$B = 6$

$C = 12$

$$\boxed{v_1(t) = 9u(t) + 6e^{-2t} + 12e^{-3t}}$$

$$V_2(s) = \frac{A}{s} + \frac{B}{s+2} + \frac{C}{s+3}$$

$A = 9$

$B = 3$

$C = 3$

$$\boxed{v_2(t) = 9u(t) + 3e^{-2t} + 3e^{-3t}}$$

(3) $t = 0$, $v_1(0) = 9+6+12 = \underline{\underline{27V}}$ $\qquad v_2(0) = 9+3+3 = \underline{\underline{15 \text{ volts}}}$

$t = \infty$, $v_1(\infty) = 9+0+0 = \underline{\underline{9 \text{ volts}}}$ $\qquad v_2(\infty) = 9+0+0 = \underline{\underline{9 \text{ volts}}}$

(4) verify result of 3

Initial value theorem $f(0^+) = \lim_{s\to\infty}\left[s\,F(s)\right] = 27$

final value theorem $f(\infty) = \lim_{s\to 0}\left[s\,F(s)\right] = 9$