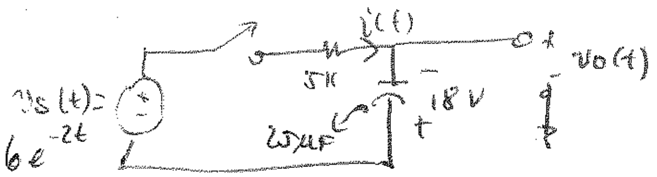


$$\frac{C\,dv_o(t)}{dt} = \frac{v_s - v_o}{5K} \;;\; \frac{dv_o(t)}{dt} + \frac{v_o(t)}{.125} = \frac{v_s(t)}{.125} \;;\; \frac{dv_o(t)}{dt} + 8v_o(t) = 8v_s(t)$$

$$\boxed{\frac{dv_o(t)}{dt} + 8v_o(t) = 48e^{-2t}}$$

Ecuación diferencial que describe el sistema (I)

; Natural (complem. sol) must satisfy

$$\frac{dv_{oc}(t)}{dt} + 8v_{oc}(t) = 0 \;\therefore$$

$$\frac{dv_{oc}(t)}{dt} = -8v_{oc}(t) \;;\; \int \frac{dv_{oc}(t)}{v_{oc}(t)} = \int -8\,dt$$

$$\Downarrow$$

$$\boxed{v_{oc}(t) = e^{-8t}K_2}$$

Forced response (particular sol.)

$$\frac{dv_{op}(t)}{dt} + 8v_{op}(t) = 48e^{-2t}$$

; $v_{op}(t)$ & its derivative must have the form "e^{-2t}"

Assume $\boxed{v_{op} = K_1e^{-2t}}$; TOTAL SOL: $v_o(t) = K_1e^{-2t} + K_2e^{-8t}$

Now, substitute v_{op} in (I);

$$\frac{d(K_1e^{-2t})}{dt} + 8(K_1e^{-2t}) = 48e^{-2t} \;;\; [K_1(-2) + 8K_1]\cancel{e^{-2t}} = 48\cancel{e^{-2t}}$$

$$\boxed{K_1 = 8}$$

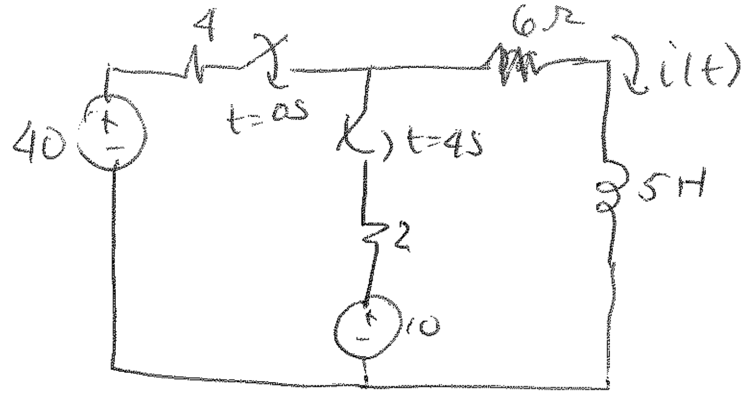
TOTAL SOLUTION: $v_o(t) = 8e^{-2t} + K_2e^{-8t}$

Use initial cond's to determine K_2: $v_o(0) = -18$

$v_o(0) = -18 = 8e^{0} + K_2e^{0}$; $\boxed{K_2 = -26}$ $\boxed{v_o(t) = 8e^{-2t} + -26e^{-8t}}$ $\forall t \geq 0$

for $i(t)$:

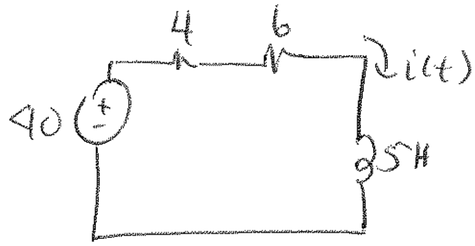
$$i(t) = C\frac{dv_o(t)}{dt} = 25\times10^{-6}\frac{d}{dt}\left[8e^{-2t} + -26e^{-8t}\right] = -.4e^{-2t} + 5.2e^{-8t} \text{ mA} \quad t>0$$



find $i(t)$

$$i(t) = \begin{cases} 0 & \forall\ t \le 0 \\ 4(1-e^{-2t}) & \forall\ 0 \le t \le 4 \\ 2.72 + 1.273e^{-1.464(t-4)} & \forall\ t \ge 4 \end{cases}$$

For $0 \le t \le 4$



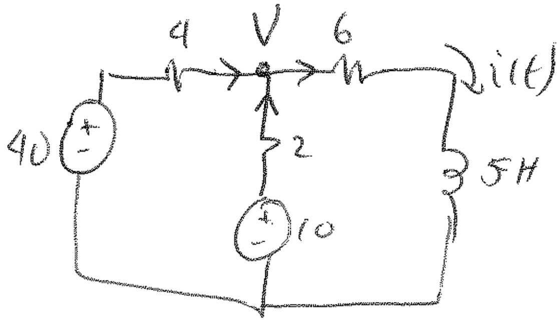
$i(0) = 0$

$i(\infty) = \frac{40}{10} = 4A$

$\tau = \frac{L}{R_{eq}} = \frac{5}{10} = \frac{1}{2}$; $i(t) = i(\infty) + [i(0) - i(\infty)]e^{-t/\tau}$

$$\boxed{i(t) = 4\left(1 - e^{-2t}\right) \ \forall\ 0 \le t \le 4}$$

For $t \ge 4$



$i(0) = i(4) = 4A$

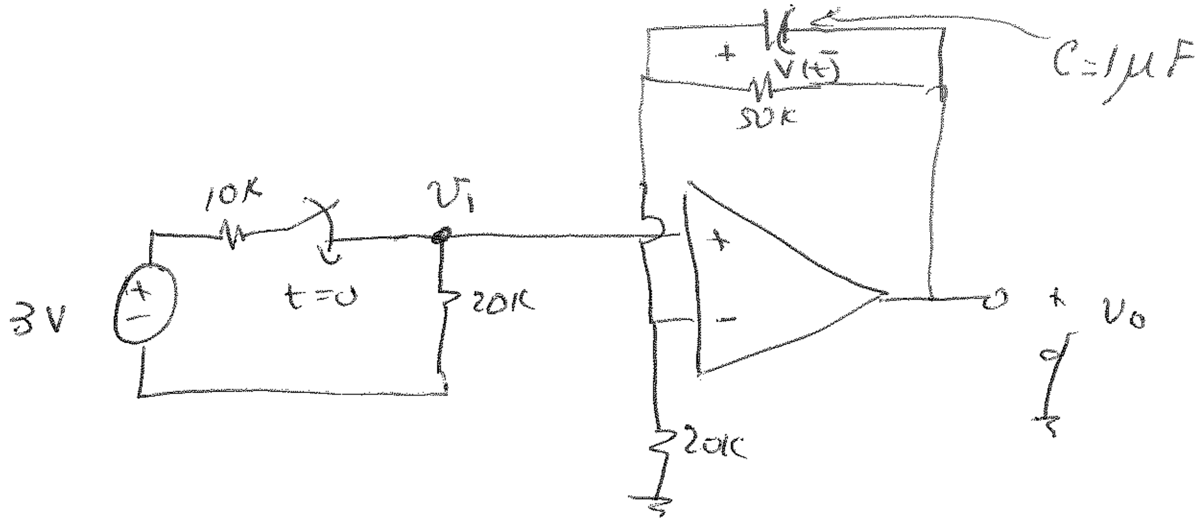
$i(\infty) = ?$; $i(\infty) = i(4)$

$i(\infty) = ?$; $\frac{40 - V}{4} + \frac{10 - V}{2} = \underbrace{\frac{V}{6}}_{i(\infty)}$; $V = \frac{180}{11} V$

$i(\infty) = \frac{V}{6} = \frac{180}{66} = 2.727A$

$\tau = (4 // 2) + 6 = \frac{22}{3} \Omega$

$$\boxed{i(t) = 2.72 + 1.273e^{-1.4667(t-4)}}$$



find $v(t)$: $\boxed{v(0^-) = 0}$

$v(0^+) = v(0^-) = 0$

$v(\infty) = ?$

$v_0(\infty) = \left(1 + \frac{50}{20}\right) v_1 =$

$\underbrace{v_1 = 3\left(\frac{20}{30}\right)}_{\text{divisor de voltaje}} = 2\,V$; $v_0(\infty) = \left(1 + \frac{50}{20}\right)2 = 7\,V$

But, $v = v_1 - v_0 \therefore$

$\boxed{v(\infty) = 2 - 7 = -5}$

$\tau = RC = (1\times10^{-6})(50\,k\Omega) = 0.05 \therefore$

$v(t) = -5 + [0 - (-5)]e^{-t/.05} = -5\left(1 - e^{-20t}\right) V \quad \forall\ \underline{\underline{t > 0}}$