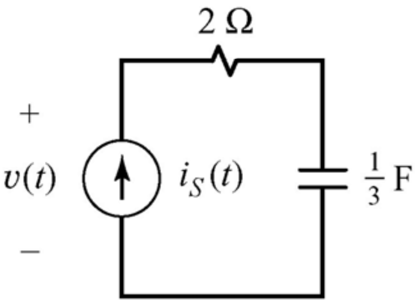
EE 202-Fall 2012(121)

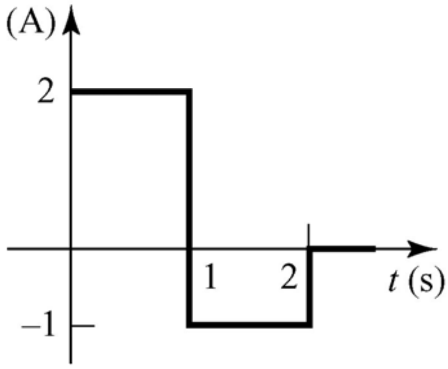
HW5 Solution

Dr. Alakhdhar

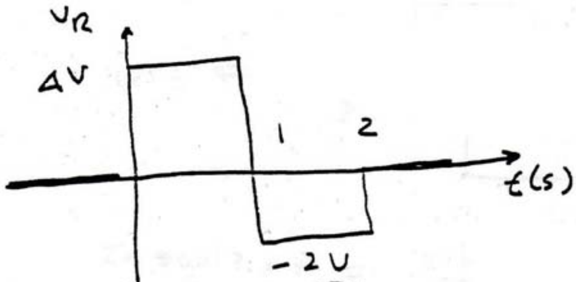
Due 1/12/2012

Q1Sketch the voltage v(t) in the circuit shown. Assume $i_s(t) = 0$ for $t \le 0$

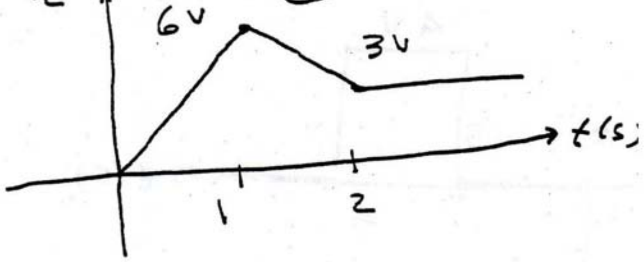


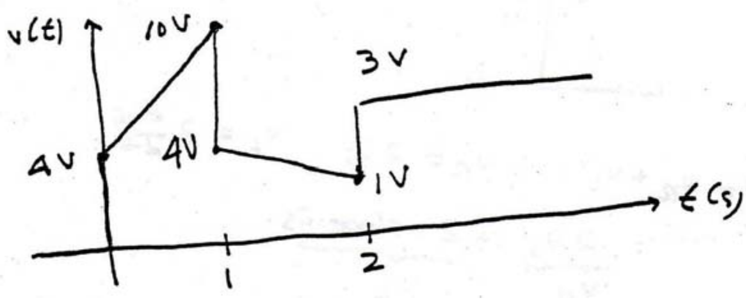


$$v(t) = v_R + v_C, \quad v_C + v_R = \underbrace{2 i_s}_{v_R} + \underbrace{3\int_{-\infty}^{t} i_s(\tau)\,d\tau}_{v_C}$$

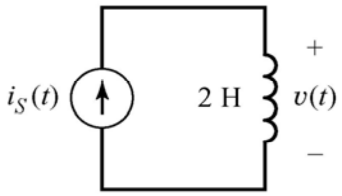


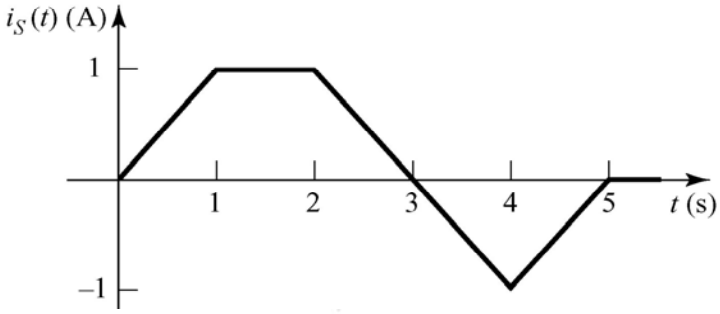
+



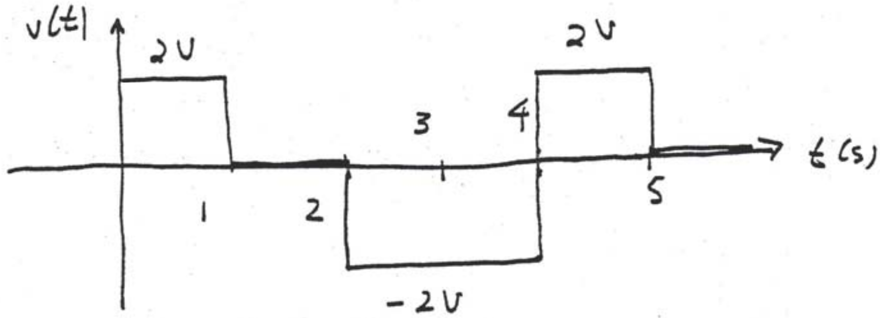


Q2Sketch the voltage v(t) in the circuit shown

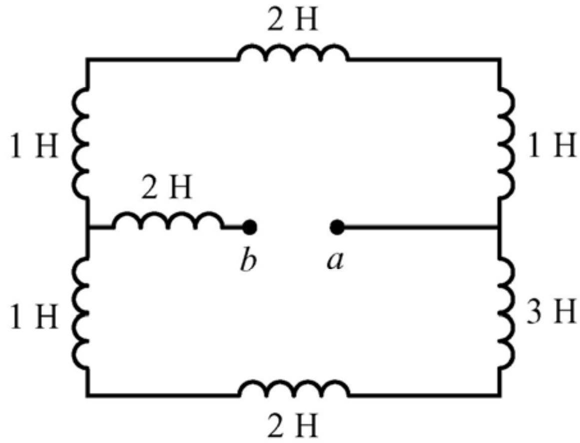




$$v(t) = L\frac{di(t)}{dt} = 2\frac{di_s}{dt}$$



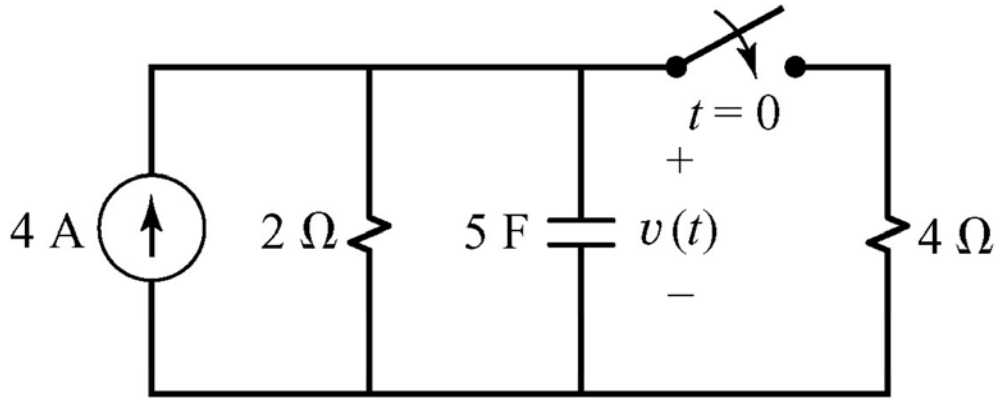
Q3Determine the equivalent inductance between the terminal

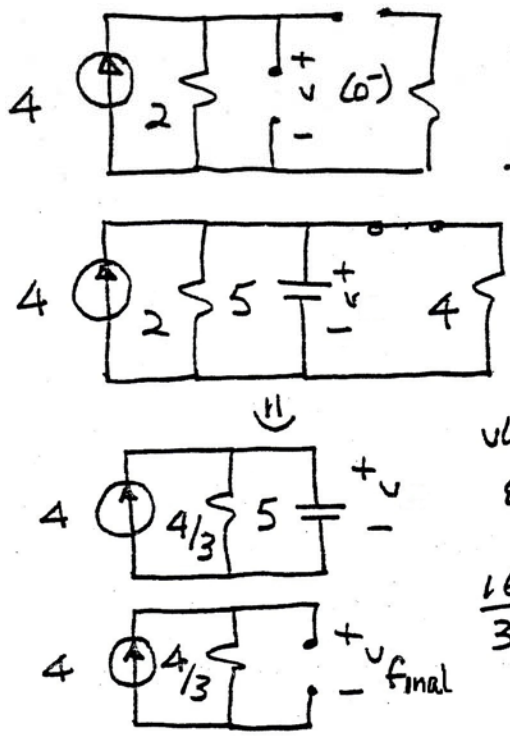


$L_{eq} = 2H + \left[(1H + 2H + 1H) \| (1H + 2H + 3H)\right]$

$= 2 + [4 \| 6] = 2 + \frac{12}{5} = \frac{22}{5} H$

Q4Determine and sketch the voltage v(t) for all t.



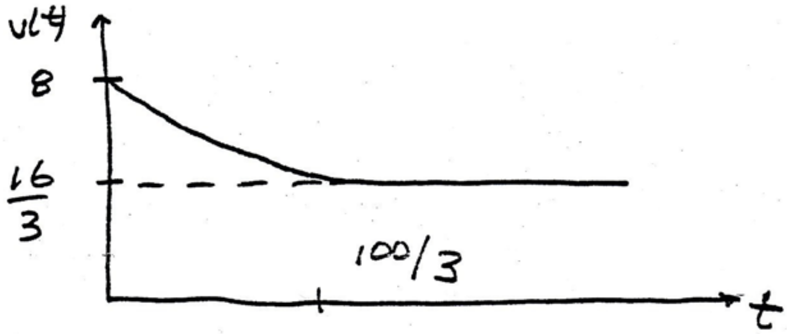


$$v\,(0^-) = 8\text{V} = v\,(0^+)$$

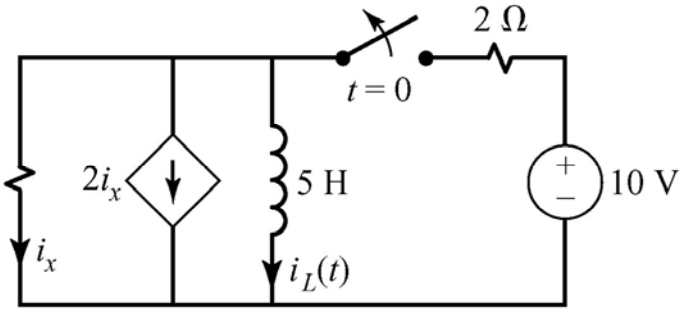
$$v_{final} = \frac{16}{3} \qquad \tau = RC = \frac{4}{3} \times 5 = \frac{20}{3}$$

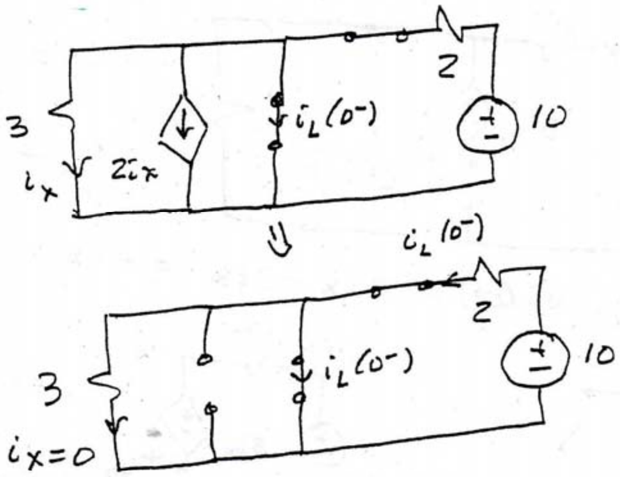
$$\therefore v\,(t) = \frac{16}{3} + \left[8 - \frac{16}{3}\right] e^{-3t/20}$$

$$\therefore v\,(t) = \left(\frac{16}{3} + \frac{8}{3} e^{-3t/20}\right) \text{V}_{\;t>0}$$



Q5 Determine and sketch the current $i_L(t)$ for all t.



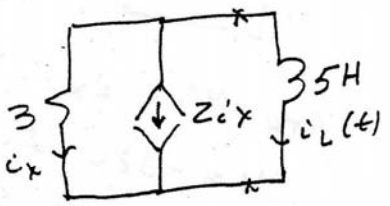


$i_x = 0$

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

$= \frac{10}{2} = 5A$

$t > 0$



$3\left(\frac{v_L}{3}\right) + i_L = 0$

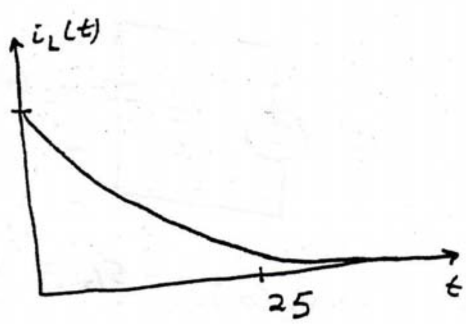
$5\frac{di_L}{dt} + i_L = 0$

$\frac{di_L}{dt} + \frac{1}{5}i = 0$

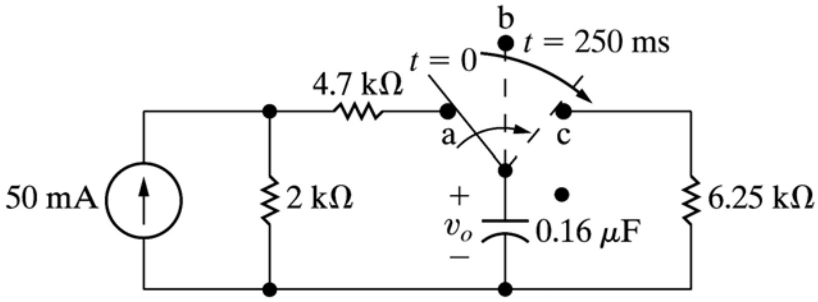
$\tau = 5s$

$\therefore i_L(t) = i_L(0^+)e^{-t/5}$

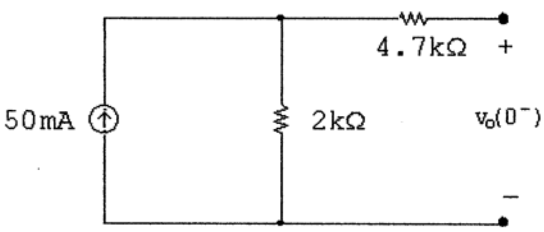
$= 5e^{-t/5} \quad t > 0$



Q6 The switch in the circuit shown has been in position a for a long time. At t = 0, it moves instantaneously to position b, where it remains for 350 ms before moving instantaneously to position c. Find $v_o(t)$ for $t \geq 0$.

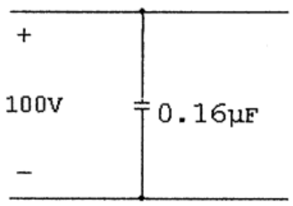


$t < 0$:



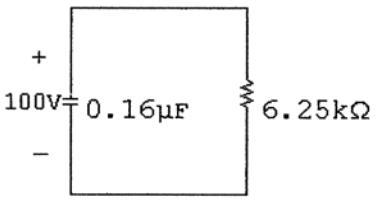
$$v_c(0^-) = (50)(2000) \times 10^{-3} = 100\,\text{V} = v_c(0^+)$$

$0 \leq t \leq 250\,\text{ms}$:



$\tau = \infty$; $\quad 1/\tau = 0$; $\quad v_o = 100e^{-0} = 100\,\text{V}$

$250\,\text{ms} \leq t < \infty$:



$\tau = (6.25)(0.16)10^{-3} = 1\,\text{ms}$; $\quad 1/\tau = 1000$; $\quad v_o = 100e^{-1000(t-0.25)}\,\text{V}$

Summary:

$v_o = 100\,\text{V}, \quad 0 \leq t \leq 250\,\text{ms}$

$v_o = 100e^{-1000(t-0.25)}\,\text{V}, \quad 250\,\text{ms} \leq t < \infty$