Assignment 3

Thomas Boyd
#: 300117763

P 7.5-22

$i(t) = 0.25\cos(2t)\ A$

$V_a = -10\sin(2t)$

$V_b = 10\sin(2t)$

$V_c = 10\cos(2t)$

$V(t) = R\ 0.25\cos(2t)\ A$

$V_c = R\,i(t)$

$10\cos(2t) = R\ 0.25\cos(2t)$

$$R = 40\,\Omega$$

$V(t) = \frac{1}{C}\int_0^t i(t)\,dt$

$V_b = \frac{1}{C}\int_0^t i(t)\,dt$

$10\sin(2t) = \frac{1}{C} \cdot 0.125\sin(2t)$

$$C = \frac{1}{80}\ F$$

$V(t) = L\frac{di}{dt} = -L\ 0.5\sin(2t)$

$V_a = L\frac{di}{dt}$

$-10\sin(2t) = -L\ 0.5\sin(2t)$

$$L = 20\ H$$

P 7.6-4

$L = \frac{1}{4}\ H$ $\quad i(t) = \begin{cases} 0 & t \le 0 \\ 4te^{-t} & t \ge 0 \end{cases}$

Partial Answer: $w = 2t^2e^{-2t}\ J$

$V(t) = L\frac{di}{dt}$

$$V(t) = \begin{cases} 0\ V & t \le 0 \\ e^{-t}(1-t)\ V & t > 0 \end{cases}$$

$P(t) = i(t)v(t)$

$$P(t) = \begin{cases} 0 & t \le 0 \\ 4te^{-2t}(1-t)\ W & t \ge 0 \end{cases}$$

$W(t) = \int_0^t P(t)\,dt$

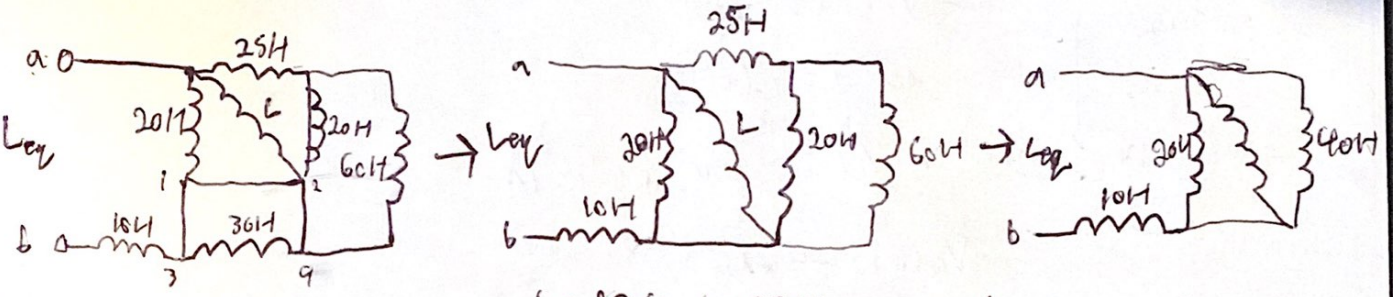
$W(t) = \int_0^t 4te^{-2t}(1-t)\,dt$

$= 4\left(\left(\frac{e^{-2t}}{-2}\left(t - \frac{1}{-2}\right)\right)_0^t - \left(\frac{e^{-2t}}{-2}\left(t^2 - \frac{2t}{-2} + \frac{2}{(-2)^2}\right)\right)_0^t\right)$

$= 2t^2e^{-2t}$

$$W(t) = \begin{cases} 0 & t \le 0 \\ 2t^2e^{-2t} & t > 0 \end{cases}$$

P. 7.7-5 $L_{eq} = 18H$



$L_{12} = 0$

$L_{34} = 30$ $\quad L_p = \frac{0 \times 30}{0+30} = 0$

$L_p = \frac{20 \times 60}{20+60} = 15H$ $\quad L_s = 25 + 15 = 40H$

$\frac{1}{L_p} = \frac{1}{20} + \frac{1}{L} + \frac{1}{40}$

$\frac{1}{L_p} = \frac{40L + 800 + 20L}{800L}$

$L_p = \frac{800L}{60L+800}$

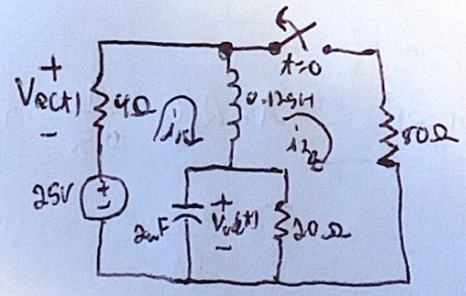
$\therefore L_{eq} = 10 + \frac{800L}{60L+800}$

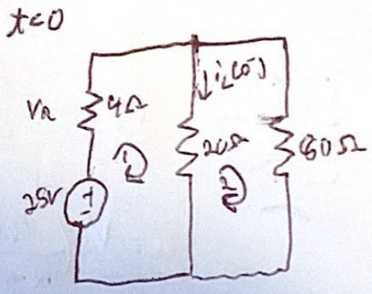
$L_{eq} = \frac{8000 + 1400L}{800 + 60L}$

$18 = \frac{8000 + 1400L}{800 + 60L}$

$L = 20H$

P. 7.8-11





KVL$_1$ $\quad -25 + 4i_1 + 20(i_1 - i_2) = 0$

$24i_1 - 20i_2 = 25$ ①

KVL$_2$ $\quad 20(i_2 - i_1) + 80i_2 = 0$

$-20i_1 + 100i_2 = 0$

$i_1 = 5i_2$ ②

$24(5i_2) - 20i_2 = 25$ ② into ①

$100 i_2 = 25$

$i_2 = 0.25A$ $\quad i_1 = 1.25A$

$i_L(0^-) = i_1 - i_2$

$= 1.25 - 0.25$

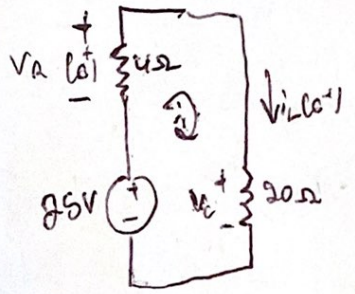
$= 1A$

$V_C(0) = 20 \times i_L(0^-)$ $\quad V_R(0^-) = -4 \times i_1(0^-)$

$= 20V$ $\quad = -5V$

7.8-11

$t > 0$



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

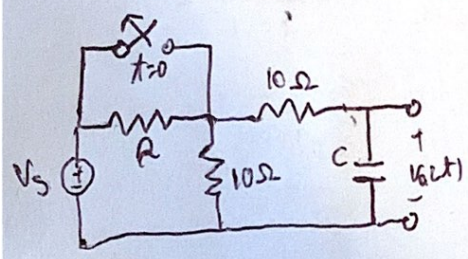
$i_L(0^-) = i_L(0^+)$

$\therefore v_C(0^+) = 20V,\ i_L(0^+) = 1A$

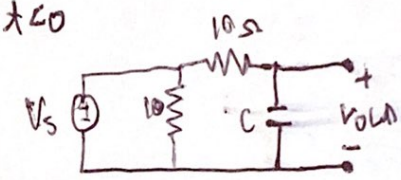
$v_R(0^+) = -4 \times i_L(0^+)$

$= -4V$

P 8.3-8 $v_o(t) = 2 + 8e^{-0.5t}\ V$ for $t > 0$



for $t < 0$



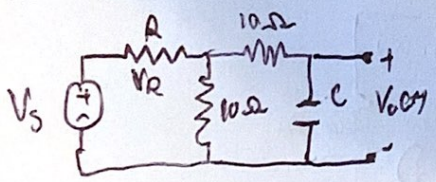
$\therefore v_s = v_o = 2 + 8e^{-0.5t}\ V$

at $t = 0$

$v_s = 2 + 8e^{-0.5(0)}\ V$

$= 10V$

for $t > 0$



$v_R = v_o = 2 + 8e^{-0.5t}\ V$

$v_R = 2 + 8e^{-0.5(\infty)}\ V$

$= 2V$

$v_R = v_s\left(\frac{10\Omega}{R+10\Omega}\right)$

$2V = 10V\left(\frac{10\Omega}{R+10\Omega}\right)$

$R = 40\Omega$

$\tau = R_t C = \frac{1}{0.5s^{-1}} = 2.0s$

$C = \frac{2.0s}{R_t}$

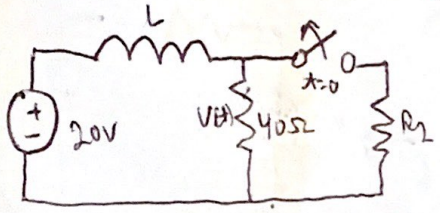
$R_t = \frac{(40\Omega)(10\Omega)}{40\Omega + 10\Omega} + 10\Omega$

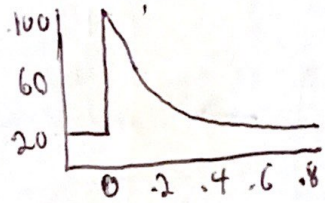
$= 18\Omega$

$C = \frac{2.0s}{18\Omega}$

$C = 0.111\ F$

9.3-25 $V(t) = \begin{cases} D \text{ for } t<0 \\ E + Fe^{-at} \text{ for } t>0 \end{cases}$





for $t<0$

$V(t) = 20V = D$

$V(0) = 100V = E + F$

$V(\infty) = 20V = E$

$F = 100V - 20V = 80V$

$V(0.14s) = 20V + 80Ve^{-a(0.14)} = 60V$

$e^{-a(0.14)} = \frac{60V - 20V}{80V} = 0.5$

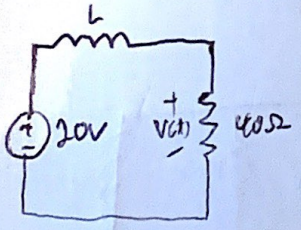
$-a(0.14) = \ln(0.5)$

$a = 4.95s^{-1}$

$V(t) = \begin{cases} 20V & t<0 \\ 20V + 80Ve^{-(4.95s^{-1})t} & t \geq 0 \end{cases}$

for $t>0$

$i_L = i_{40} + i_{R_2} = 20V\left(\frac{1}{40\Omega} + \frac{1}{R_2}\right)$



$i_L = i_{40} = \frac{V(t)}{40\Omega} = \frac{100V}{40\Omega} = 2.50A$

$\alpha = \frac{R}{L} = 4.95s^{-1}$

$2.50A = 20V\left(\frac{1}{40\Omega} + \frac{1}{R_2}\right)$

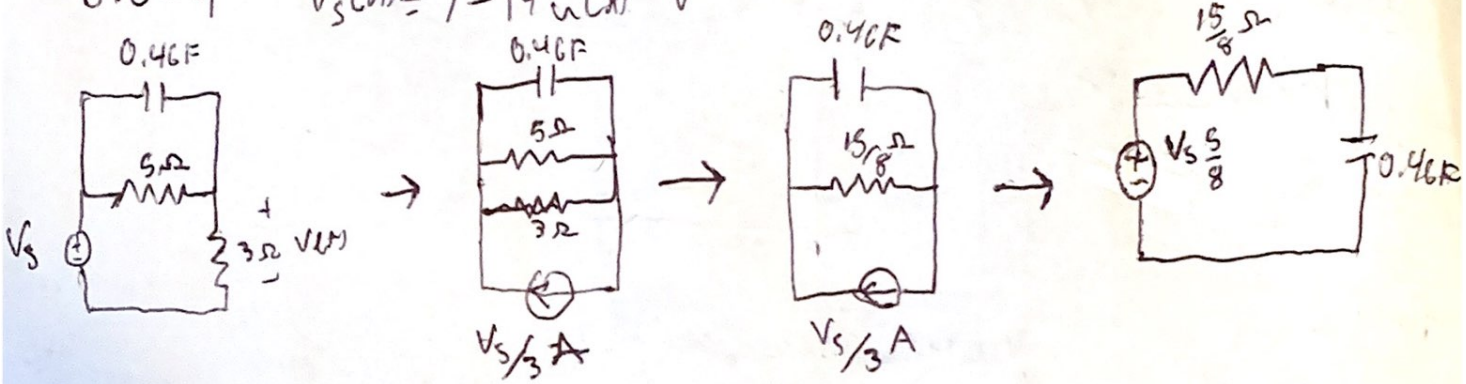
$L = \frac{40\Omega}{4.95s^{-1}}$

$R_2 = \frac{1}{0.100\Omega^{-1}}$

$\boxed{L = 8.08H}$

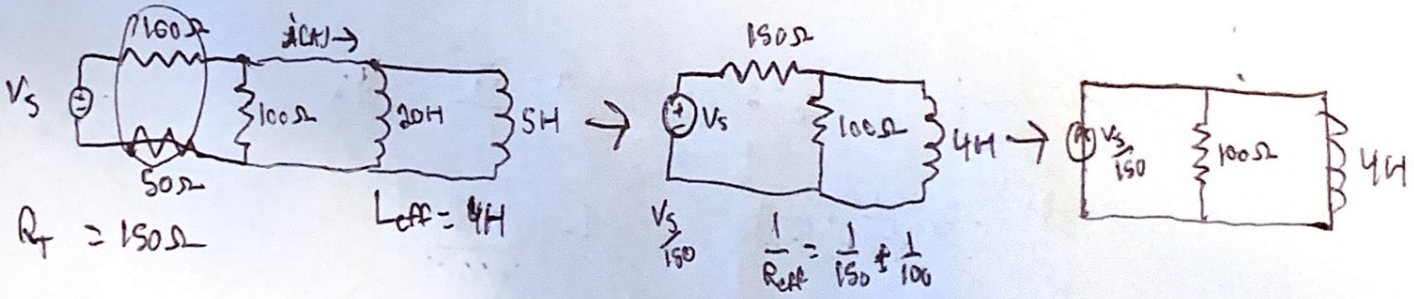
$\boxed{R_2 = 10\Omega}$

8.6-9 $v_s(t) = 7 - 14u(t)$ V



$$\frac{1}{R_{eff}} = \frac{1}{3} + \frac{1}{5} = \frac{8}{15}$$

8.6-21 $v_s(t) = 30 - 24u(t)$ V



$R_T = 150\Omega$

$$\frac{1}{R_{eff}} = \frac{1}{150} + \frac{1}{100}$$

$R_{eff} = 60\Omega$

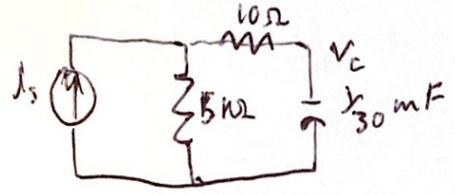
$$i(0) = \frac{[30 - 24u(0)]}{150} = 0.2A$$

$$i(\infty) = \frac{[30 - 24u(\infty)]}{150} = 0.04A$$

$$i(t) = i_\infty + (i(0) - i_\infty)e^{-t(R_T/L)}$$

$$i(t) = 0.04A + 0.16e^{-(25s^{-1})t} A$$

8.7-3 $i_S = (2\cos(2t))u(t)$



$i_S = i_5 + i_{10} = \frac{v_S}{5k\Omega} + C\frac{dv_c}{dt}$

$V_S - V_{10} - V_c =$

$V_S = i_{10}(10k\Omega) + V_c$

$i_{10} = C\frac{dv}{dt}$

$i_S = \frac{C\frac{dv}{dt}(10k\Omega)}{5k\Omega} + C\frac{dv}{dt} + \frac{V_c}{5k\Omega}$

$5k\Omega\, i_S = (5k\Omega)C\frac{dv}{dt}(3) + V_c$

$5k\Omega(2\cos(2t)) = (15k\Omega)\left(\frac{1}{30}mF\right)\frac{dv}{dt} + V_c$

$20\cos 2t = \frac{dv}{dt} + 2V_c$

$V_c = A\sin(2t) + B\cos(2t)$

$\frac{dv}{dt} = 2A\cos 2t - 2B\sin 2t$

$20\cos 2t = 2A\cos 2t - 2B\sin 2t + 2(A\sin(2t) + B\cos(2t))$

$20 = 2A + 2B$ cos

$0 = 2A - 2B$ sin

$A = B$

$10 = A + B = 2B$

$A = B = 5$

$V_c = 5\sin(2t) + 5\cos(2t)$

$V_c = 5\sin(2t) + 5\cos(2t) + Ke^{-t/\tau}$

$\tau = R_T C$

$R_T = 5k\Omega + 10k\Omega = 15k\Omega$

$\tau = (15k\Omega)\left(\frac{1}{30}mF\right) = \frac{1}{2}s$

$i_S(t=0) = 2\cos(2t)\,u(0) = 0$

$V_c(0) = 0 = 5\sin(2(0)) + 5\cos(2(0)) + Ke^{-0} = 0 + 5 + K$

$K = -5$

$\therefore V_c(t) = 5\sin(2t) + 5\cos(2t) - 5e^{-2t}$