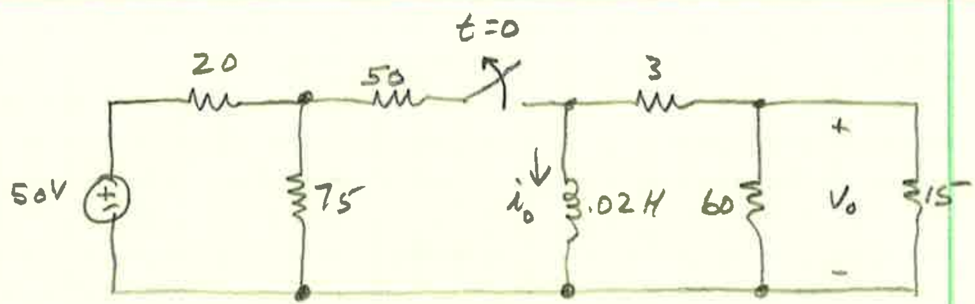
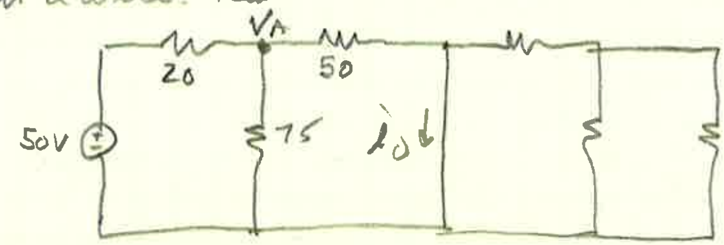
The switch has been closed for a long time. it is opened @ t = 0 sec.



a) find $i_o(t)$ for $t \geq 0$

First find $i_o(0)$, just before the switch opens. Replace the inductor with a wire. then:

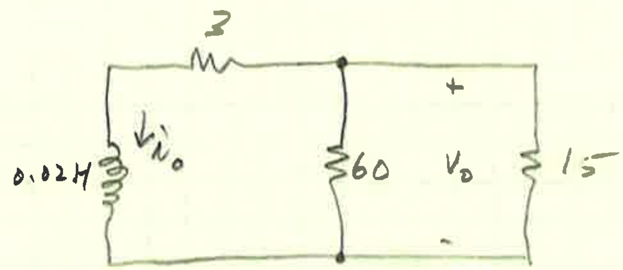


No current flow to the right half of the circuit

$$V_A = \frac{50(50 \| 75)}{50 \| 75 + 20} = 30V$$

$$i_o(0) = \frac{V_A}{50} = 0.6A$$

after the switch opens,



$$\tau = \frac{L}{R_{eq}} = \frac{0.02}{3 + 60 \| 15}$$

$$= 1.333\ mS$$

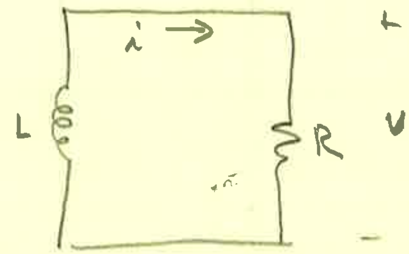
$$\boxed{i_L = I_o e^{-t/\tau} = 0.6 e^{-750t} \text{ A for } t \geq 0 \text{ sec}}$$

b) find $v_o(t)$ for $t \geq 0^+$

$$\boxed{V_o = -i_o(60 \| 15) = -7.20\, e^{-750t} \quad V}$$

7.8 Nilsson 11th

$v = 160e^{-10t}\,V \quad t \geq 0^+$
$i = 6.4e^{-10t}\,A \quad t \geq 0$



A) Find R

$R = \frac{V}{I} = \frac{160}{6.4} = \boxed{25\Omega}$

b) Find τ:

$\tau = \frac{1}{10} = \boxed{100\,ms}$

c) Find L:

$\tau = \frac{L}{R}$; $L = \tau R = \boxed{2.5\,H}$

d) Find initial energy stored in inductor:

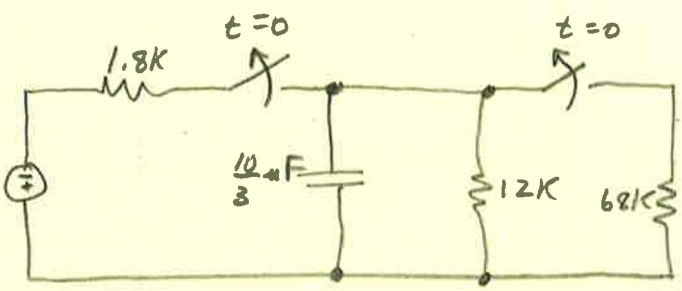
$w(0) = \frac{1}{2}LI^2 = \frac{1}{2}(2.5)(6.4)^2 = \boxed{51.2\,J}$

e) time to dissipate 60% of $w(0)$

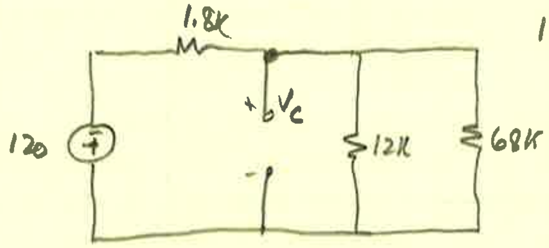
$w(t) = 51.2(.4) = 20.48\,J$

$20.48 = \frac{1}{2}LI^2 \Rightarrow I = 4.0477\,A$

$4.0477 = 6.4e^{-10t} \Rightarrow \boxed{t = 45.8\,ms}$



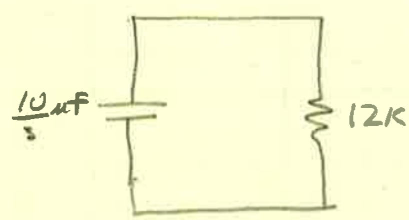
For $t < 0$:



$$V_c(0^-) = \frac{-120\,(12 /\!/ 68)}{(12/\!/68)+1.8} = -102V$$

for $t > 0$:

$$V_c(t) = -102e^{-25t}$$



$$\text{Power} = \frac{V^2}{R} = .867e^{-50t}$$

a) FIND How many μJoules have been dissipated in R 12 ms after the switch open.

$$W = \int_0^{.012} .867e^{-50t}\,dt$$

$$= \frac{.867}{-50}\left(e^{-50t}\Big|_0^{.012}\right) = \frac{.867}{-50}(.5488-1)$$

$$\boxed{W = 7.824\ mJ}$$

b) How long does it take to dissipate 75% of the initial stored energy?

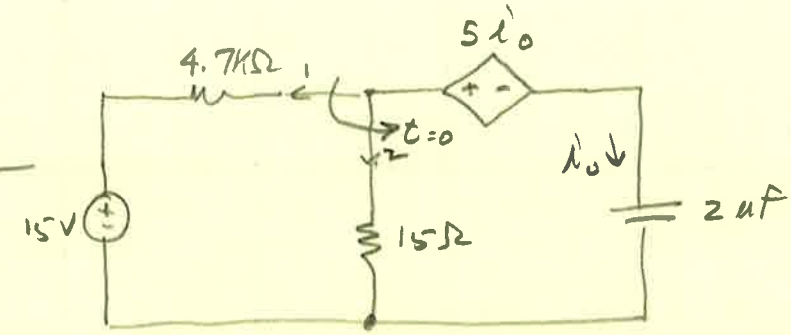
$$w(0) = \tfrac{1}{2}CV^2 = \tfrac{1}{2}\left(\tfrac{10}{3}\times10^{-6}\right)(-102)^2 = 17.34\ mJ$$

$$75\%\,(w(0)) = 13\ mJ$$

$$\int_0^{t_0} .867e^{-50t}\,dt = .013 \Rightarrow \boxed{t = 27.73\ ms}$$

7.29 Nilsson 11th

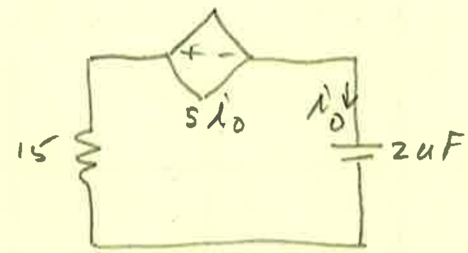
Switch moves @ $t=0$
Find $i_o(t)$ for $t \geq 0^+$



Before $t=0$,

$i_c = 0$ so $V_c(0) = 15V$

after,



writing KVL,

$$15 i_o + 5 i_o + \frac{1}{C}\int i_o \, dt = 0$$

$$20 \frac{di_o}{dt} + \frac{i_o}{C} = 0 \Rightarrow i_o = i_o(0) e^{-t/20C}$$
$$= i_o(0) e^{-25{,}000t}$$

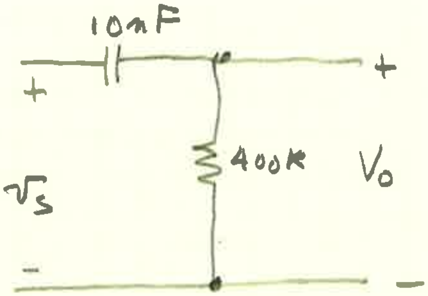
$$V_c = \frac{1}{C}\int i_c(t)\,dt = \frac{1}{C}\int i_o(0) e^{-25{,}000t} dt$$

$$V_c = \frac{i_o(0)}{-25{,}000C} e^{-25000t}$$

$$V_c(0) = 15 = \frac{i_o(0)}{-25{,}000C} e^{0} \Rightarrow i_o(0) = -0.75A$$

$$\boxed{i_o(t) = -.75 e^{-25000t} \text{ A}}$$

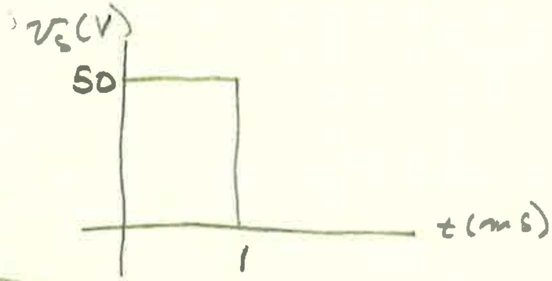
v_s is applied to the circuit shown.



$V_c(0) = 0.0V$

a) find v_o

$v_c(t) = V_f(1-e^{-t/RC}) + V(0)e^{-t/RC}$



$V_F = 50V$

$V(0) = 0$

$RC = (10 \times 10^{-9})(400 \times 10^{3}) = 0.004$

$v_c(t) = 50(1-e^{-250t})V$

$\boxed{v_o = v_s - v_c = 50e^{-250t} \qquad 0 \le t \le 1ms}$

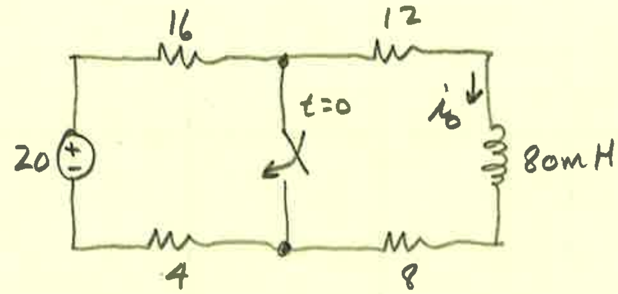
@ $t = 1ms$, $v_c(1ms) = 50(1-e^{-250(.001)}) = 11.06V$

$v_c(\infty) = 0$

$v_c(t) = 11.06e^{-250(t-.001)}$

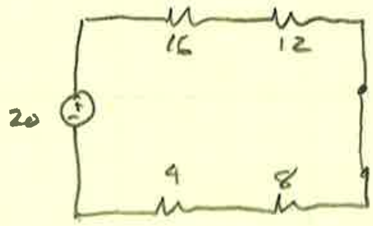
$\boxed{v_o(t) = v_s - v_c = -11.06e^{-250(t-.001)} V \qquad t \ge 1ms}$

Switch closeD at $t=0$



a) FIND $i(0)$ + $i(\infty)$

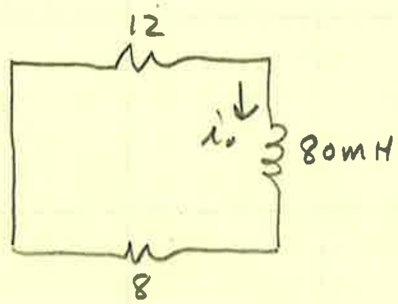
$i(0)$:



$\downarrow i_o(0) = \frac{20}{40} = \underline{\underline{0.5A}}$

$i(\infty) = \underline{\underline{0A}}$ (all energy is dissipated)

b) find $i(0)$ for $t \geq 0$



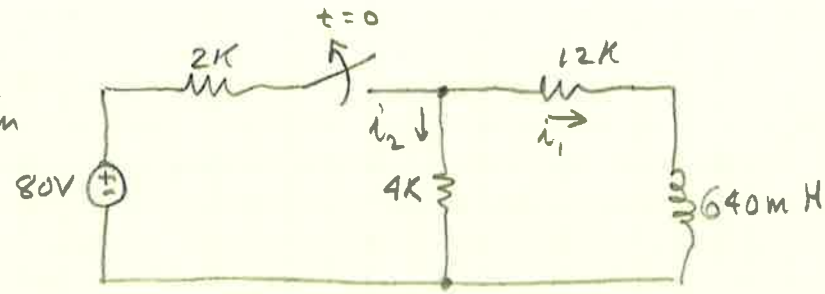
$i_o(t) = I_o e^{-\frac{t}{\tau}} = 0.5e^{-\frac{R}{L}t} = \underline{\underline{0.5e^{-250t} \quad A}}$

c) at what time is $i_o = 100mA$?

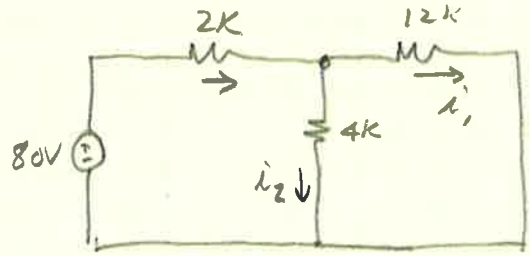
$100mA = .5e^{-250t}$

$\boxed{t = 6.44\,mS}$

The switch has been closed for a long time before opening @ $t=0$.



a) find $i_1(0^-)$ and $i_2(0^-)$



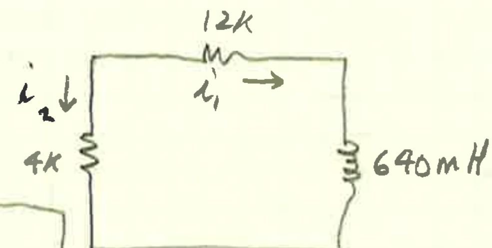
$$i = \frac{80}{2K + 4K \| 12K} = 16 \text{ mA}$$

using a current divider

$$i_2(0^-) = \frac{i(12K)}{4K+12K} = \frac{3}{4} i = \boxed{12\text{mA}}$$

$$i_1(0^-) = \frac{i(4K)}{4K+12K} = \frac{1}{4} i = \boxed{4\text{mA}}$$

b) find $i_1(0^+)$ and $i_2(0^+)$



current cannot change instantaneously in an inductor.

$\boxed{\text{So } i_1(0^-) = i_1(0^+) = 4\text{mA; since we have a series circuit, } i_2(0^+) = -i_1(0^+) = -4\text{mA}}$

c) find $i_1(t)$ for $t \geq 0$

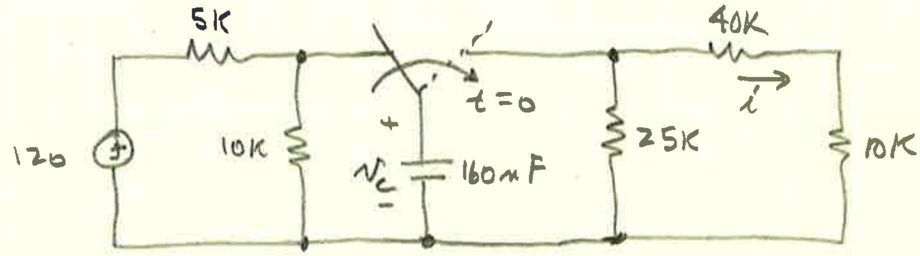
$$i_1(t) = I_0 e^{-\frac{R}{L}t} = 4e^{-\frac{16K}{.640}t} \text{ mA} = \boxed{4e^{-25{,}000t} \text{ mA}}$$

d) find $i_2(t)$ for $t \geq 0$

$$\boxed{i_2(t) = -i_1(t) = -4e^{-25{,}000t} \text{ mA}}$$

e) explain why $i_2(0^-) \neq i_2(0^+)$

current in an inductor cannot change instantaneously, but current in a resistor can.

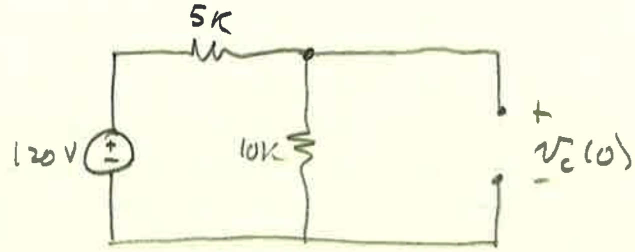


The switch has been in the left position for a long time. at $t=0$ it moves to the right position.

a) Find $V_c(t)$ for $t \geq 0$

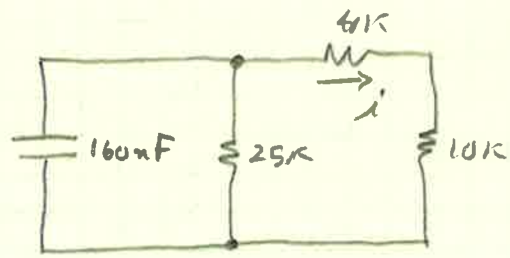
$$v_c(t) = v_c(0)\, e^{-t/RC}\ \text{V}$$

The capacitor is an open circuit.



$$V_c(0) = \frac{120(10K)}{10K + 5K} = 80V$$

For $t > 0$, the capacitor discharges through the circuit shown at the right.



$$R_{eq} = (40K + 10K) \| 25K = 16.667K\Omega$$

$$\tau = RC = (160 \times 10^{-9})(16.667K) = 2.667\ mS$$

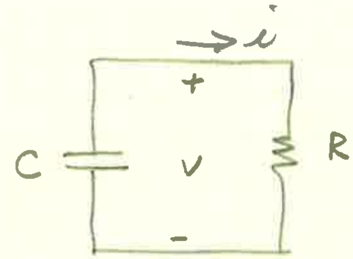
$$\boxed{V_c(t) = 80\, e^{-375t}\ \text{V}}$$

b) Find $i(t)$ for $t \geq 0$

Since $v_c(t) = 80e^{-375t}$,

$$i = \frac{V_c(t)}{40K + 10K} = \boxed{1.6\, e^{-375t}\ mA = i(t)}$$

$v = 72e^{-500t}$ V, $t \ge 0$
$i = 9e^{-500t}$ mA, $t \ge 0$



a) FIND R

$R = \frac{v}{i} = \boxed{8K\Omega}$

b) FIND C

$\frac{1}{RC} = 500 \Rightarrow C = \frac{1}{500(8K)} = \boxed{0.25\,\mu F}$

c) Find τ

$\tau = \frac{1}{500} = \boxed{2mS}$

d) initial energy in the capacitor

$w = \frac{1}{2}cV^2\Big|_{t=0} = \frac{1}{2}(.25\times10^{-6})(72)^2 = \boxed{648\,\mu J}$

e) how many microseconds to dissipate 68% of the initial energy in the capacitor.

energy left is 32% of $648\mu J = 207.36\mu J$

$w = \frac{1}{2}cV^2$ so $V = \sqrt{\frac{2w}{c}} = 40.7294V$

$40.7294 = 72e^{-500t} \Rightarrow \boxed{t = 1.139\,mS}$