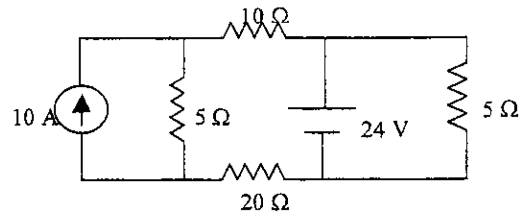
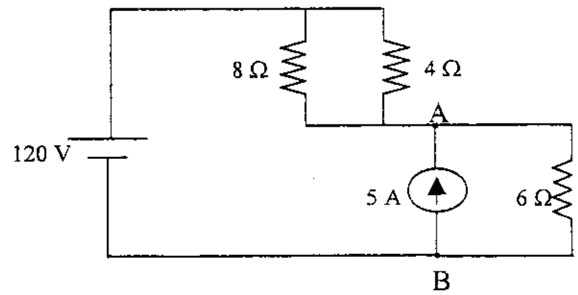
Physics 228
Home Work Chapter II

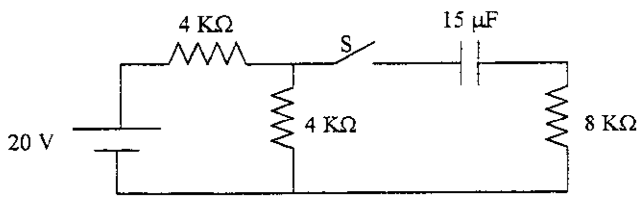
I. Use the superposition to find the current through the 10-Ω resistor.



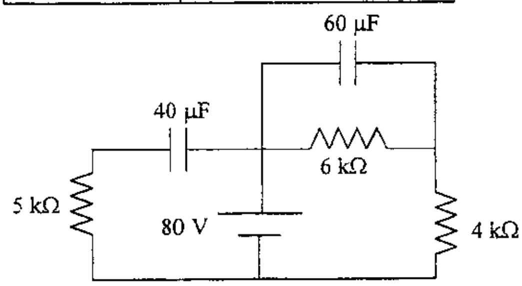
II. Find the thevenin's equivalent between A and B.



III. Find the expression for the current in the 8 kW resistor following the closure of the switch.



IV. Find the voltage across each resistor after the system has reached equilibrium.

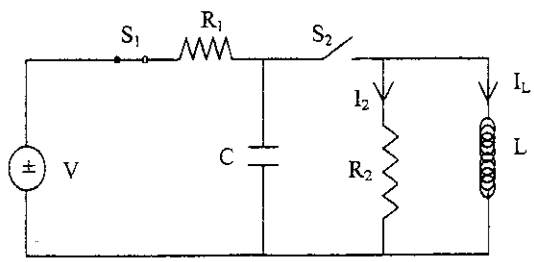


V. Capacitor C is charged by closing switch S_1. After equilibrium is reached, switch S_2 is closed.

a) Just before closing S_2, what is the voltage across C.

b) Just after closing S_2, what is the voltage across C? and the current in the inductor and R_2?

c) Long after S_2 is closed and equilibrium is reached what are the values of V_C, I_L, and I_2?



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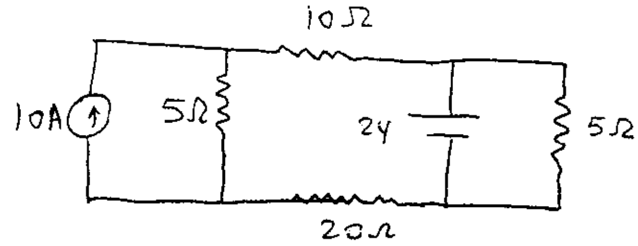
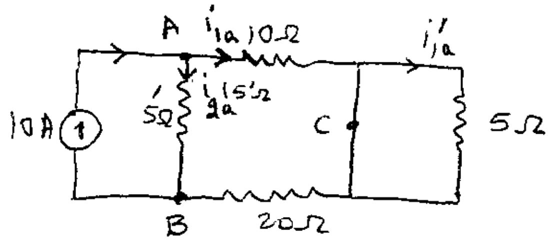
Solution SET II.

Ns 1) Superposition principle



Let us first short circuit the voltage source;



Note that No Current will pass through the 5Ω resistor.

$\Rightarrow i'_{1a}(5\Omega) = 0$ "

$i_{2a}(5\Omega)' = ??$

Note that $10 = i_{1a}(10\Omega) + i_{2a}(5\Omega)$

$(V_A - V_B) + (V_B - V_C) + (V_C - V_A) = 0 \Rightarrow 5 i_{2a} - 20 i_{1a} - 10 i_{1a} = 0$

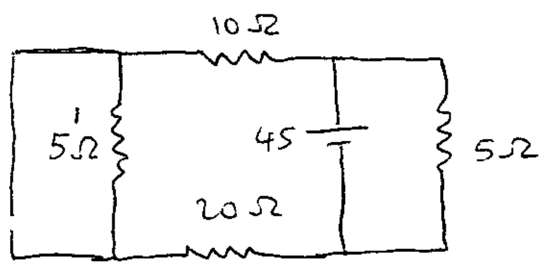
$\Rightarrow 5 i_{2a} - 30 I_{1a} = 0 \Rightarrow$

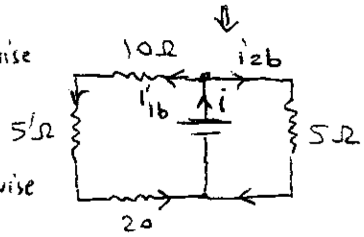
$5 i_{2a} - 30(10 - i_{2a}) = 0 \Rightarrow 35 i_{2a} = 300$

$\Rightarrow \boxed{i_{2a} = \frac{300}{35} = 8.57A}$.

$\Rightarrow \boxed{i_{1a} = 1.428 \text{ A}}$

then open circuit the current Source





$i_{2b} = \frac{\cancel{45}}{5} = 9A$ clockwise $24/5 = 4.8A$

$i_{1b} = \frac{45}{35} = 1.29$ A. Counterclockwise $24/35 = 0.68$

$i(5\Omega) = 9A$ Clockwise.

$i(10\Omega) = 1.428 - 1.29 = 0.138$ A Clockwise
$1.428 - 0.68 = 0.748A$

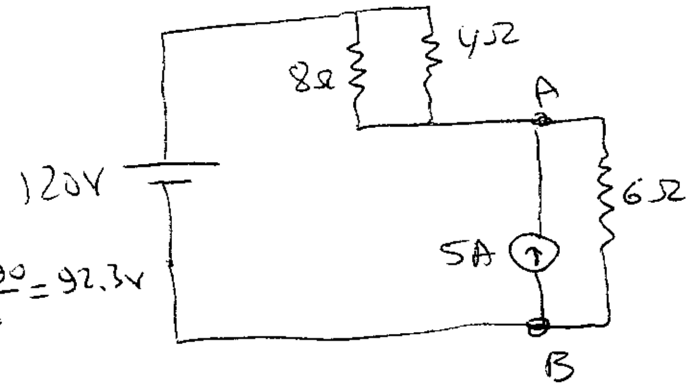
$i(5\Omega)' = -8.57 - 1.29 = -9.86$ A Counter clockwise
$-8.57 - 0.68 = 9.25A$

N; 2)

KC Law

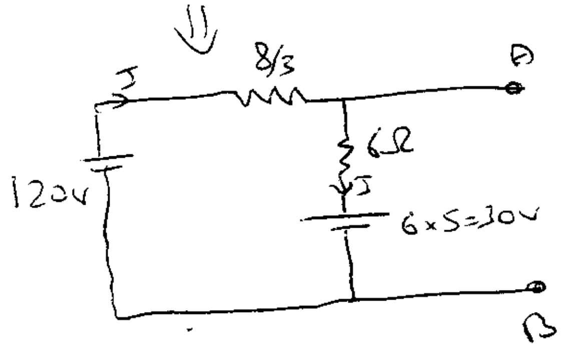
$$120 - \left(6 + \frac{8}{3}\right) I - 30 = 0$$

$$I = \frac{3 \times 90}{26}$$



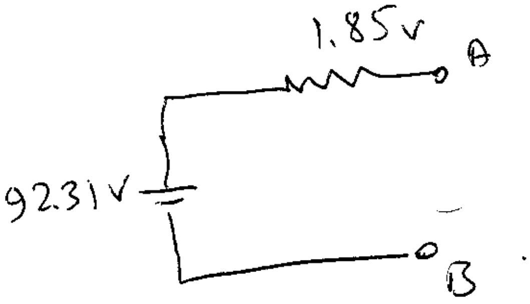
$$\Rightarrow V_{Th} = V_A - V_B = 30 + 6 \times \frac{3 \times 90}{26} = 92.3\text{V}$$

$$V_{th} = 92.3\text{ V}$$



$$R_{Th} = \left(8/3\right) \parallel (6\,\Omega)$$

$$\Rightarrow R_{Th} = \frac{24}{13} = 1.85\,\Omega$$



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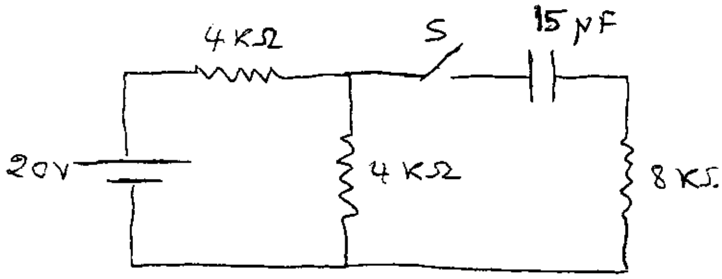
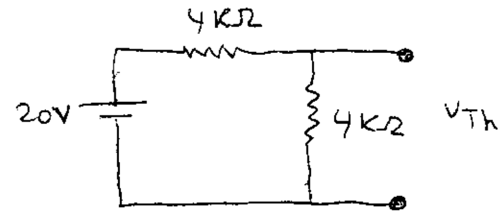
SET II Solution

N§3)



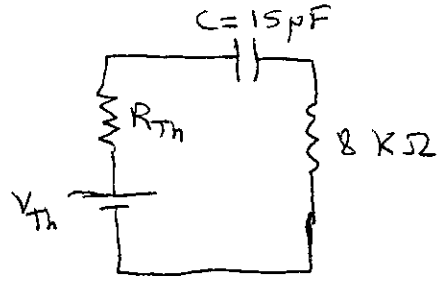
Let us use the Thevinin theorem

$$V_{Th} = 4 \times \frac{20}{8} = 10V$$

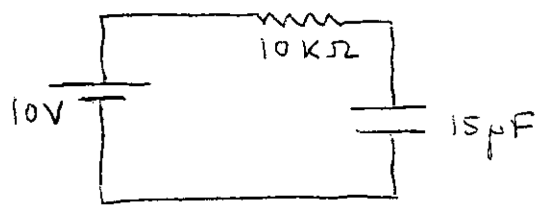


$$R_{Th} = \frac{4 \times 4}{4+4} = \frac{16}{8} = 2 K\Omega$$

The new circuit will be ⇒



R_{Th} and $8 K\Omega$ are in series. So,



The value of $RC = 10 \times 10^{3} \times 15 \times 10^{-6}$

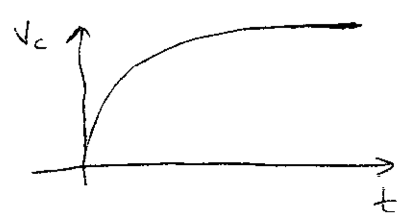
$RC = 0.15$ seconds.

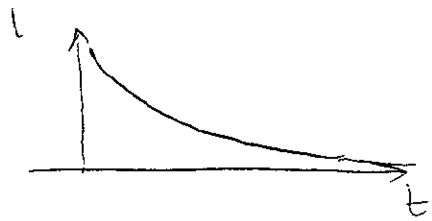
We know that current will flow to charge C.

$$i(t) = \frac{V_{Th}}{R} e^{-\frac{t}{RC}} = \frac{10}{10 \times 10^{3}} \cdot e^{-\frac{t}{0.15}} = (1 mA)\, e^{-t/0.15}$$

t is the time in seconds.

Remember that:





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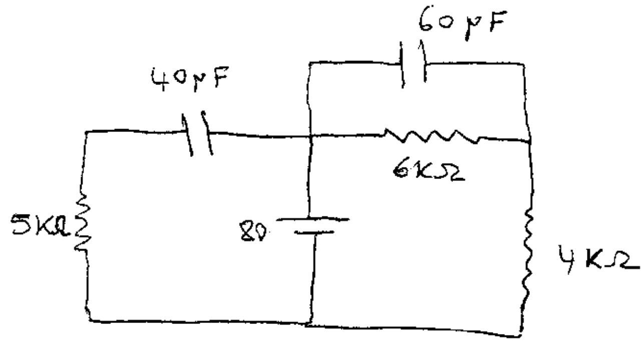
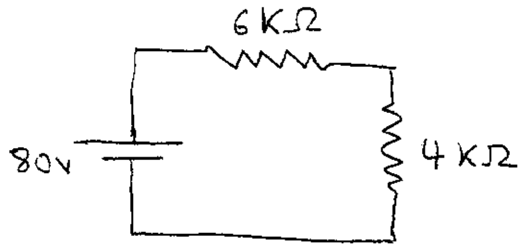
Solution Set II.

Ns4)



When Equilibrium is reached ⇒
No current from 40 pF
and No Current 60 pF.



$V_{\text{Across } 4K\Omega} = 4 \times \frac{80 \times 10^3}{10 \times 10^3}$

$V_{\text{Across } 4K\Omega} = 32\,V$

$V_{\text{Across } 6K\Omega} = \frac{6 \times 10^3 \times 80}{10 \times 10^3} = 48\,V$

After Equilibrium is reached.

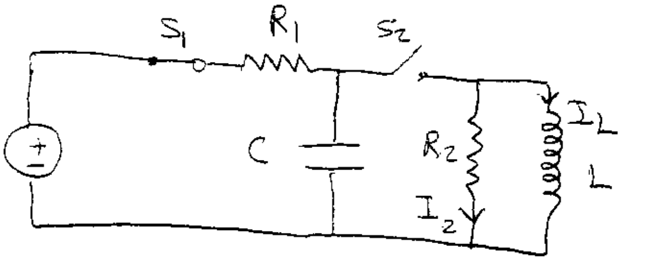
The voltage Across the 40 pF capacitor is 80 V.

The voltage Across the 60 pF capacitor is 48 V.

cuz ∥ with 60 pF

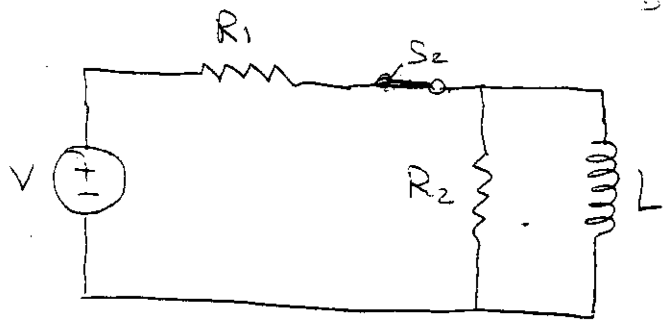
5)

a) After closing S_1 the capacitor C will start charging, until Equilibrium is reached where $V_C = V$



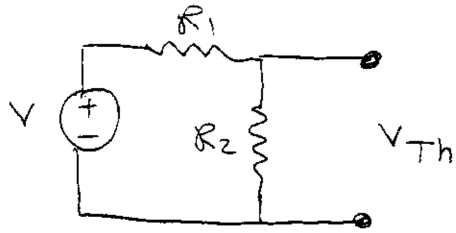
b) Just after closing S_2 ; $V_C = V$, $I_L = 0$, $I_{R_2} = \frac{V}{R_2}$

c) use of thevenin's.

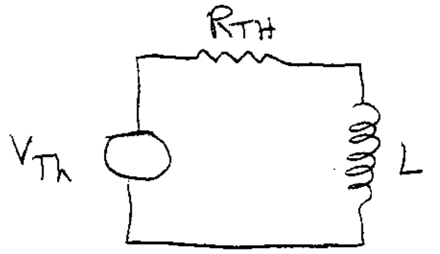


$$V_{Th} = \frac{R_2}{R_1+R_2} \cdot V$$

$$R_{Th} = \frac{R_1 R_2}{R_1+R_2}$$



$\Rightarrow$



We know that

$$i_L(t) = \frac{V_{Th}}{R_{Th}}\left(1 - e^{-t\frac{R_{Th}}{L}}\right)$$

$$\Rightarrow i_L(t) = \frac{R_2 V}{\cancel{R_1+R_2}} \times \frac{\cancel{R_1+R_2}}{R_1 R_2}\left(1 - e^{-t\frac{R_{Th}}{L}}\right)$$

$$i_L(t) = \frac{V}{R_1}\left(1 - e^{-\frac{t R_{Th}}{L}}\right)$$

$$\begin{cases} \text{at } t = 0 \Rightarrow i = 0 \\ t \to \infty \Rightarrow \frac{V}{R_1} = I_L \end{cases}$$

$i_2 = 0$