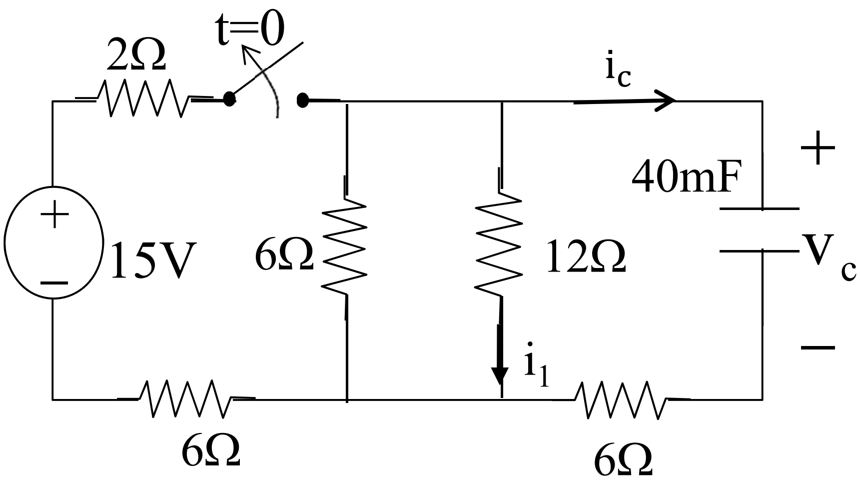
Practice 1: Find $v_c(t)$ and $i_1(t)$ for $t > 0$.



$$v_c(0) = \frac{6//12}{2+6+6//12} \times 15$$
$$= \frac{4}{12} \times 15 = 5V$$

For t>0,

$$R_{th} = 6//12 + 6 = 10\Omega$$
$$\frac{1}{R_{th}C} = \frac{1}{10 \times 0.04} = 2.5$$

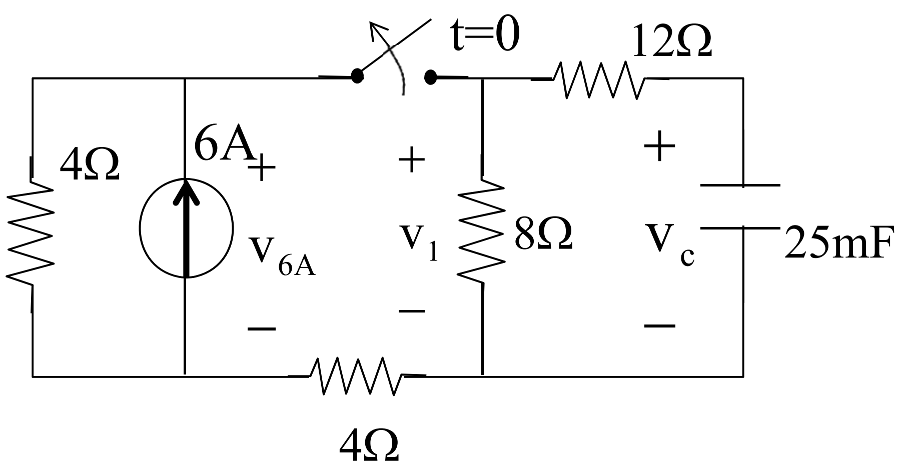
$$v_c(t) = 5e^{-2.5t}V \quad for \quad t \geq 0$$

$$i_c(t) = C\frac{dv}{dt}$$
$$= 0.04 \times 5 \times (-2.5)e^{-2.5t}$$
$$= -0.5e^{-2.5t}A$$

$i_1(t) = -\frac{6}{6+12} i_c(t)$, by current div.

$$= 0.1667e^{-2.5t}\,A$$

Practice 2: Find $v_c(t)$ and $v_1(t)$ for $t > 0$.



For t<0,

$v_{6A} = 6 \times 4//12$ =18V

By voltage division

$$v_c(0^-) = v_1(0^-)$$
$$= \frac{8}{8+4} 18 = 12V$$

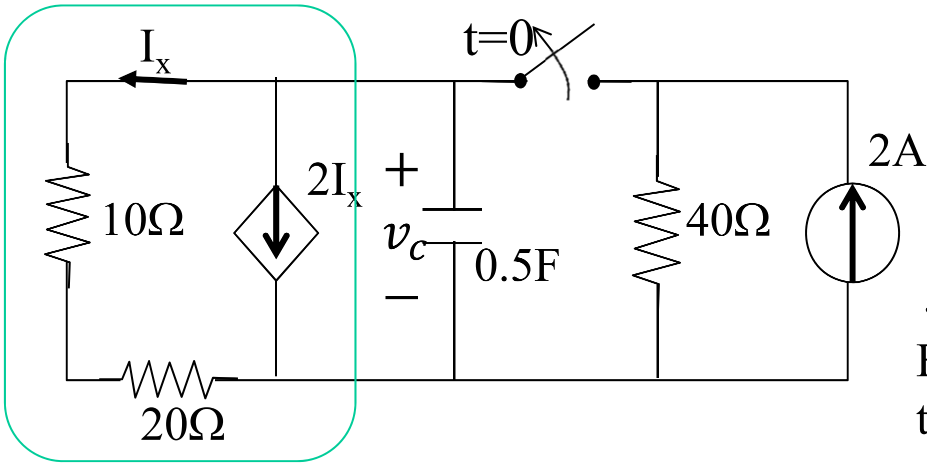
For t > 0,

$$R_{th} = 12 + 8 = 20\Omega$$
$$\frac{1}{R_{th}C} = \frac{1}{20 \times 0.025} = 2 \quad v_c(t) = 12e^{-2t}V$$

By voltage division,

$$v_1(t) = \frac{8}{20} \times 12e^{-2t} = 4.8e^{-2t}V$$

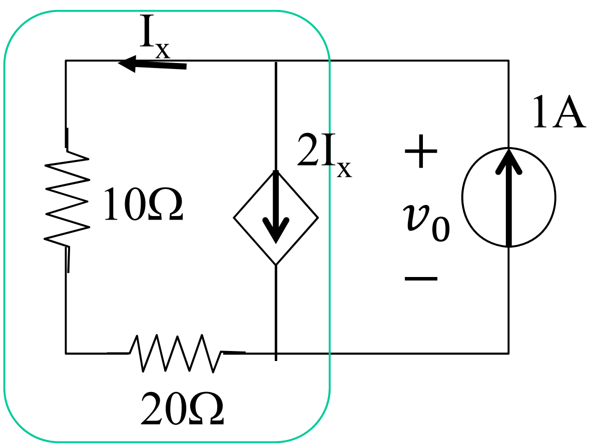
Practice 3: The switch has been closed for a long time before open at t =0. Find $I_x(t)$ for t >0.



Assign v_c.
Then by ohms law,
for all t,

$$I_x(t) = \frac{v_c(t)}{30} \qquad \text{(Eq1)}$$

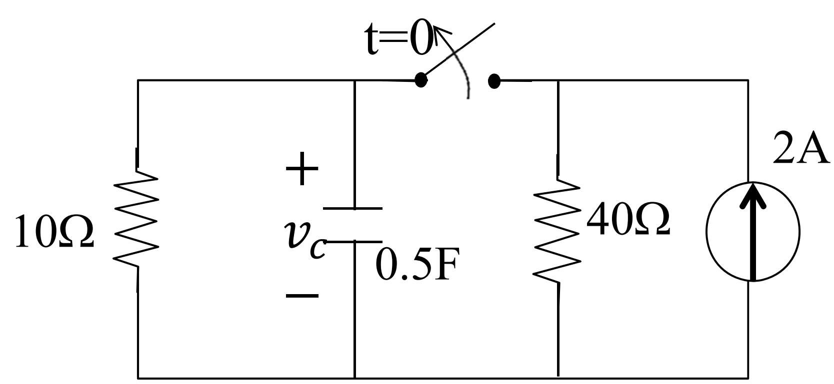
Just need to find $v_c(t)$.
For simplicity, replace the circuit inside the green box with an equivalent resistance



$$I_x + 2I_x = 1, \rightarrow \quad I_x = \frac{1}{3}A, v_0 = 10V$$

$$R_{eq} = \frac{v_0}{1} = 10\Omega$$

The equivalent circuit :
(Same $v_c(t)$ as original circuit)



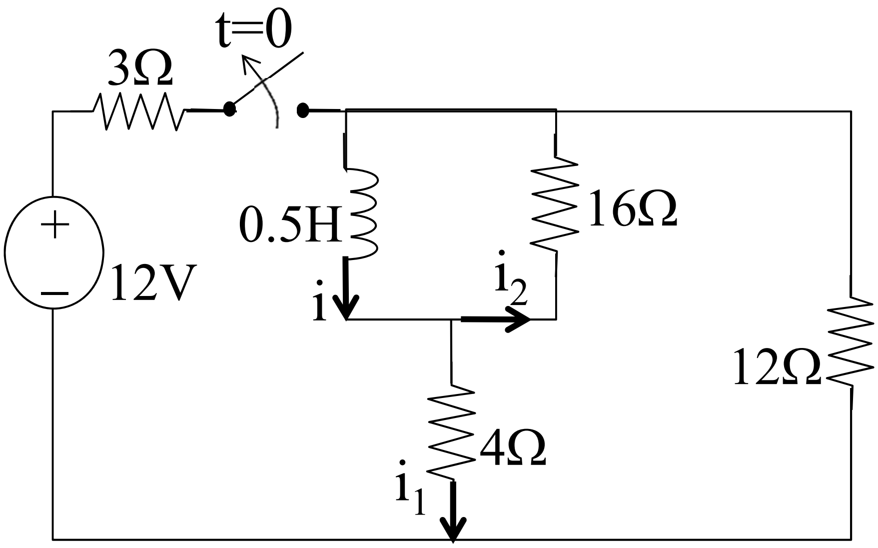
For t<0,
$v_c(0^-)$ =2(40//10)=16V
For t > 0,

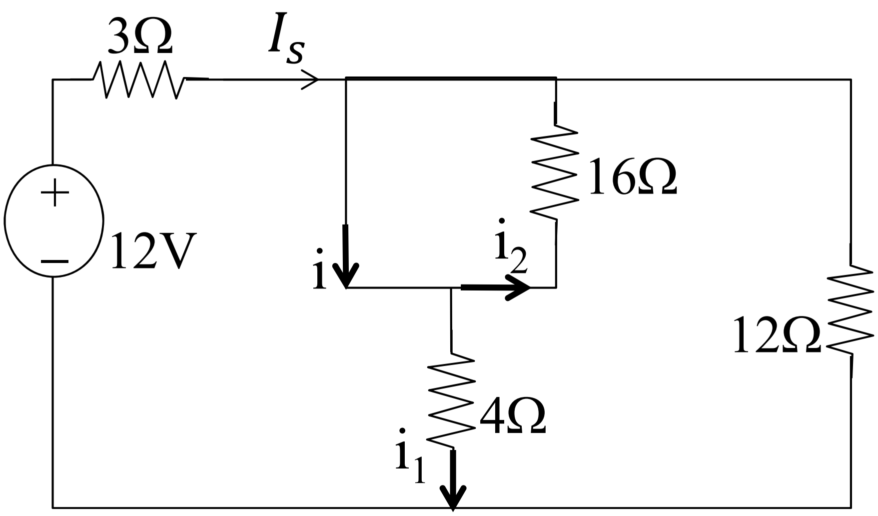
$$\frac{1}{R_{th}C} = \frac{1}{10\times 0.5} = 0.2$$

Thus, $v_c(t) = 16e^{-0.2t}V$

Finally, plug into (eq1), $I_x(t) = \frac{16}{30}\, e^{-0.2t}A, \quad for \;\; t > 0$.

Practice 4: Find $i(t)$, $i_1(t)$, $i_2(t)$ for $t > 0$.





For $t < 0$.

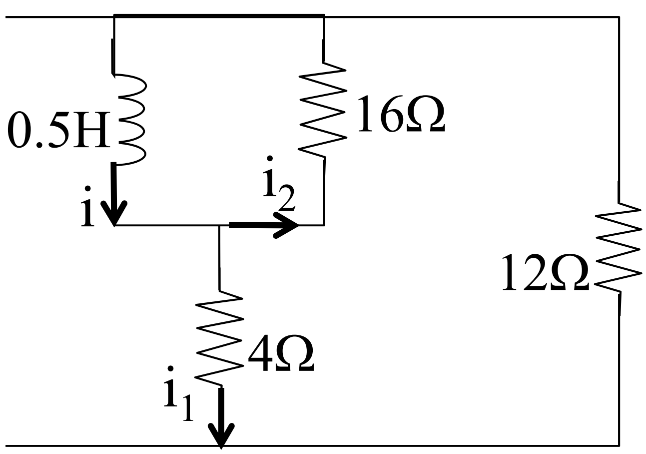
R_{eq} with respect to $12V$:

$R_{eq} = 3 + 4//12 = 6\Omega$

$$I_s = \frac{12}{6} = 2A;$$

By current division:

$i(0^-) = \frac{12}{4+12} 2 = 1.5A$



For $t > 0$,

R_{th} with respect to L:

$R_{th} = 16//16 = 8\Omega$

$$\frac{R_{th}}{L} = \frac{8}{0.5} = 16$$

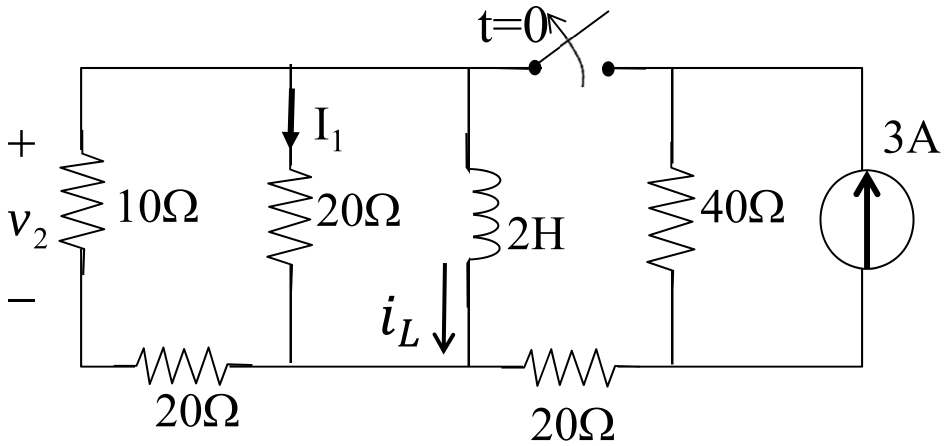
$i(t) = 1.5e^{-16t}A$

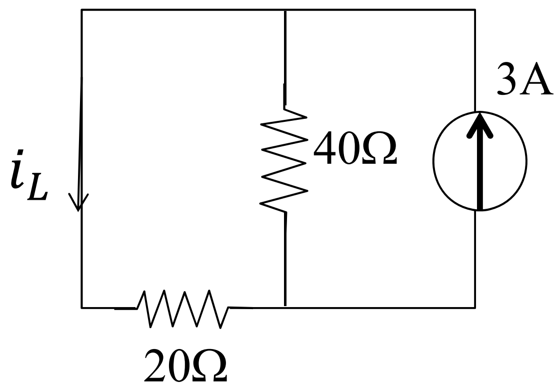
By current division:

$$i_1(t) = i_2(t) = \frac{16}{32} i(t)$$

$= 0.75e^{-16t}A$

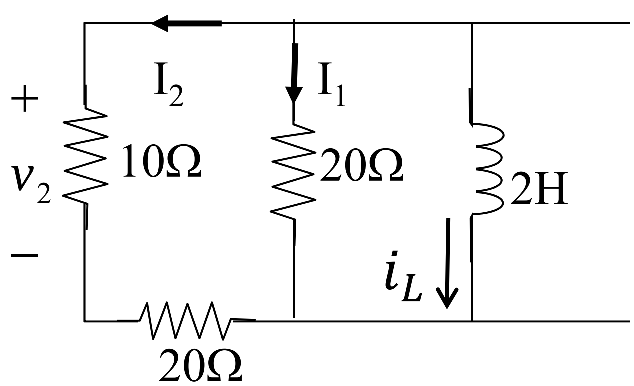
Practice 5: Find $I_1(t)$ and $v_2(t)$ for $t > 0$.





For t < 0,

$$i_L(0^-) = \frac{40}{40+20} \times 3 = 2A$$



For t >0:

$$R_{th} = 30//20 = 12\Omega$$

$$\frac{R_{th}}{L} = \frac{12}{2} = 6$$

$$i_L(t) = 2e^{-6t}A$$

By current division:

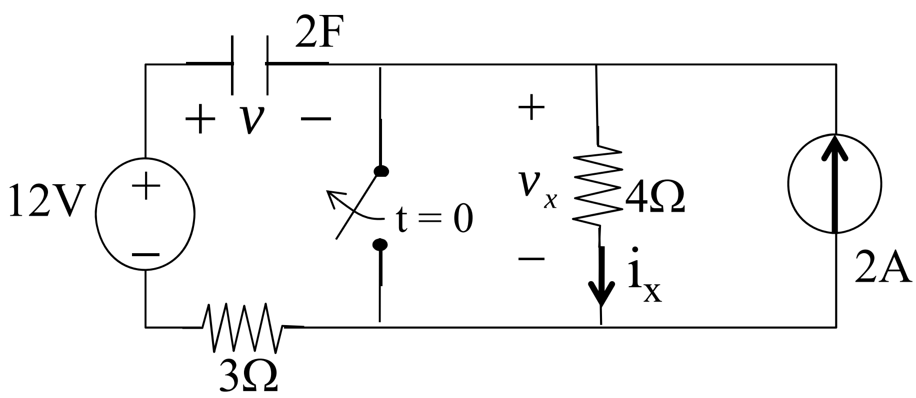
$$I_1(t) = -\frac{30}{50} i_L(t)$$

$$= -1.2e^{-6t}A$$

$$I_2(t) = -0.8e^{-6t}A$$

$$v_2(t) = 10I_2 = -8e^{-6t}V$$

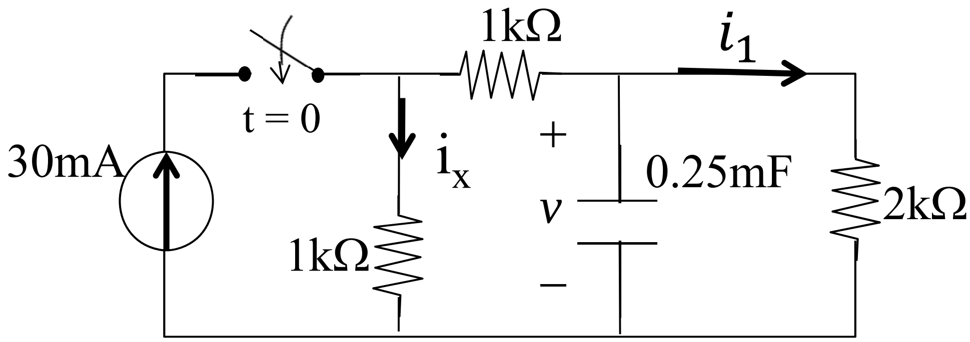
Practice 6: Find v(t), $i_x(t)$ for t > 0.



$$v(0) = 12V$$
$$v(\infty) = 12 - 2 \times 4 = 4V$$
$$R_{th}\ w.r.t\ C:$$
$$R_{th} = 7\Omega$$
$$\frac{1}{R_{th}C} = \frac{1}{14}$$
$$v(t) = 4 + 8\,e^{-t/14}V$$
$$i_x(t) = 2 + i_c(t)$$
$$= 2 + 2(8)\left(-\frac{1}{14}\right)e^{-t/14}$$
$$= 2 - \frac{8}{7}e^{-t/14}A$$

A: $v(t) = 4 + 8e^{-t/14}V$
$i_x(t) = 2 - (8/7)e^{-t/14}A$

Practice 7: Find $i_x(t)$ for t > 0.



v(0)=0;

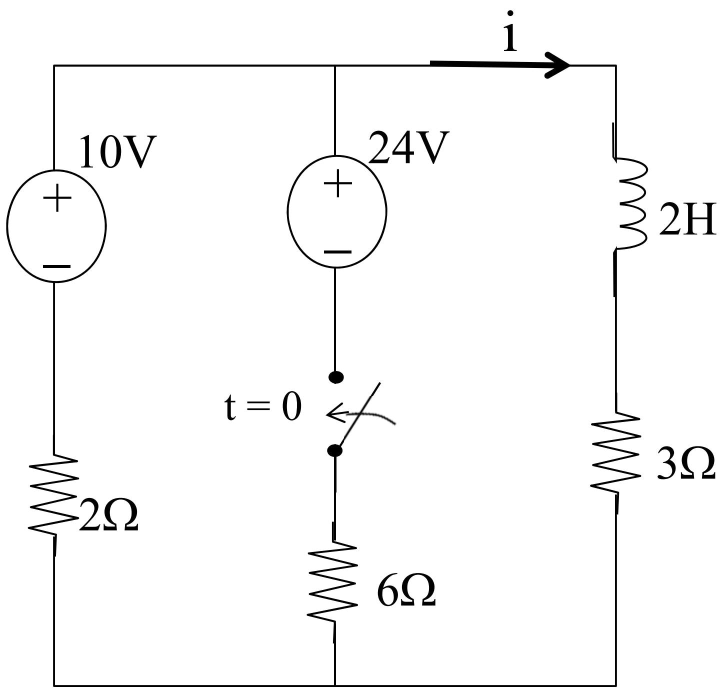
For t > 0,

$$R_{th} = 2k//(1k + 1k)$$
$$= 1k\Omega$$
$$\frac{1}{R_{th}C} = 4$$

A: $v(t) = 15(1 - e^{-4t})V$
$i_x(t) = 22.5 \times 10^{-3} - 7.5 \times 10^{-3} e^{-4t} A$

$$v_{30mA}(\infty) = 0.03(1k//3k) = 22.5V$$
$$v(\infty) = \frac{2}{3}v_{30mA} = 15V$$
$$v(t) = 15(1 - e^{-4t})V;$$
$$i_c(t) = C\frac{dv}{dt} = 0.25\text{m}(15)(4)e^{-4t} = 15e^{-4t}mA$$
$$i_1(t) = \frac{v}{2k} = 7.5(1 - e^{-4t})mA$$
$$i_x(t) = 30 - i_c - i_1 = 22.5 - 7.5e^{-4t}mA$$

Practice 8: Find i(t) for all t .

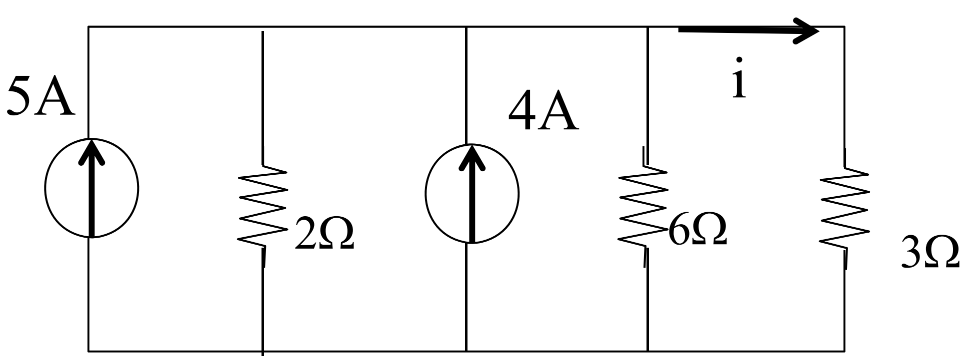


A: $i(0) = 2A, i(\infty) = 3A, R_N = 4.5\Omega$
$i(t) = 3 - e^{-2.25t} A$

$$i(0) = \frac{10}{2+3} = 2A$$

For t > 0, $R_{th} = 3 + 6//2 = 4.5\Omega$, $\frac{R_{th}}{L} = 2.25$

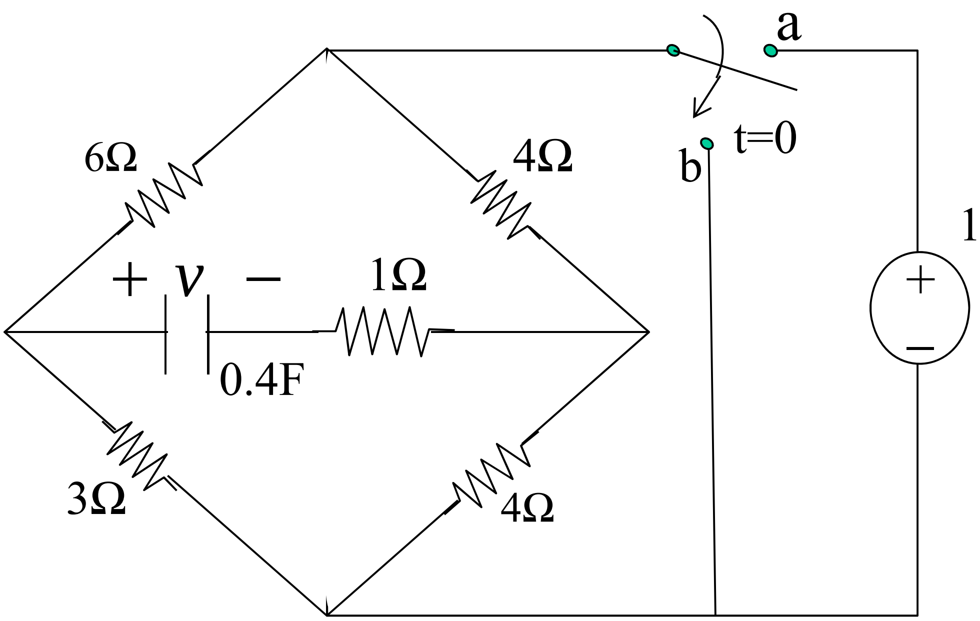
$i(\infty)$ can be found using source transformation:



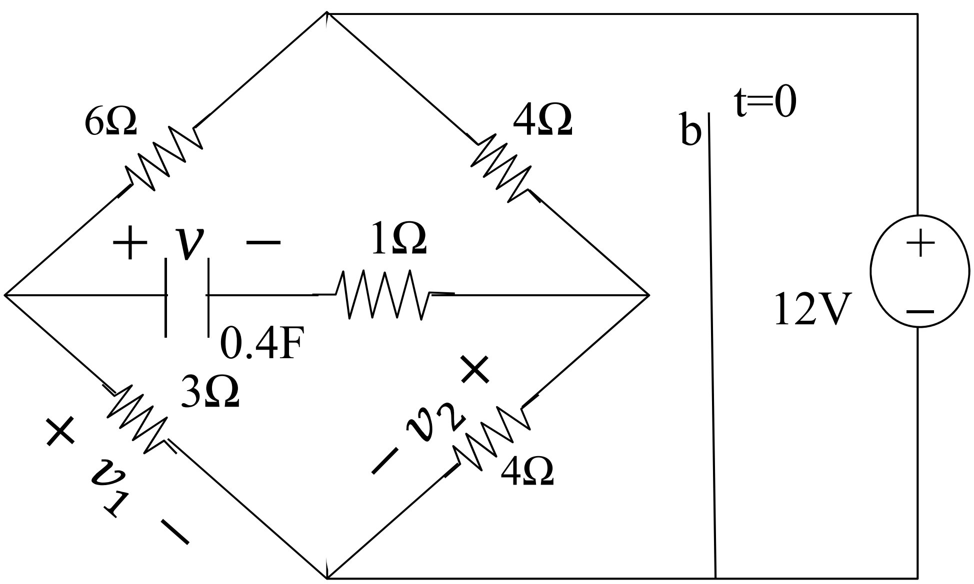
$$i(\infty) = \frac{2//6}{2//6+3}(4+5) = 3A$$

$$i(t) = 3 + (2-3)e^{-2.25t} A$$

Practice 9: Switch connected to "a" for a long time before connected to "b" at t=0. Find v(t) for t > 0.



A: $v(t) = -2e^{-t/2}V$



For t < 0:
C open.
4Ω and 4Ω *in series*
6Ω *and* 3Ω *in series*
By voltage division:

$v_2 = 6V;$

$v_1 = 4V$

By KVL,

$v(0) = 4 - 6 = -2V$

For t > 0, $v(\infty) = 0$.
Since 12V replaced by a short circuit, 4Ω*and* 4Ω *in parallel*, 3Ω *and* 6Ω *in parallel*. Thus,

$$R_{th} = 1 + 4//4 + 3//6 = 5\Omega, \qquad \frac{1}{R_{th}\,C} = 0.5$$

$$v(t) = -2e^{-0.5t}V$$