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

\[
\begin{align*}
v_c(0) &= \frac{6/12}{2 + 6 + 6/12} \times 15 \\
&= \frac{4}{12} \times 15 = 5V \\

\text{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 \text{ for } 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), \text{ by current div.} \\
&= 0.1667e^{-2.5t}A
\end{align*}
\]

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

\[
\begin{align*}
\text{For } t < 0, \\
v_{6A} &= 6 \times 4/12 = 18V \\
\text{By voltage division} \\
v_c(0^-) &= v_1(0^-) \\
&= \frac{8}{8+4} \times 18 = 12V
\end{align*}
\]

\[
\begin{align*}
\text{For } t > 0, \\
R_{th} &= 12 + 8 = 20\Omega \\
\frac{1}{R_{th}C} &= \frac{1}{20 \times 0.025} = 2 \\
v_c(t) &= 12e^{-2t}V \\
\text{By voltage division,} \\
v_1(t) &= \frac{8}{20} \times 12e^{-2t} = 4.8e^{-2t}V
\end{align*}
\]
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 $t$, 
$$I_x(t) = \frac{v_c(t)}{30}$$ (Eq1)

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

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

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

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), 
$$I_x(t) = \frac{16}{30} e^{-0.2t} A, \text{ for } t > 0$$
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:

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

For $t > 0$ ,

$R_{th}$ with respect to $L$:

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

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

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

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 $t > 0$:

$$R_{th} = \frac{30}{20} = 12\Omega$$
$$\frac{R_{th}}{L} = \frac{12}{2} = 6$$
$$i_L(t) = 2e^{-6t}A$$

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 $t > 0$.

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

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

\[
v(0) = 0; \\
\text{For } t > 0, \\
R_{th} = 2k/(1k + 1k) \\
= 1k\Omega \\
\frac{1}{R_{th}C} = 4 \\
v_{30mA}(\infty) = 0.03(1k/3k) = 22.5V \\
v(\infty) = \frac{2}{3}v_{30mA} = 15V \\
v(t) = 15(1 - e^{-4t})V; \\
i_c(t) = C \frac{dv}{dt} = 0.25m(15)(4)e^{-4t} = 15e^{-4t}mA \\
i_1(t) = \frac{v}{2k} = 7.5(1 - e^{-4t})mA \\
i_x(t) = 30 - i_c - i_1 = 22.5 - 7.5e^{-4t}mA
\]
Practice 8: Find \( i(t) \) for all \( t \).

\[
A: \quad i(0) = \frac{10}{2+3} = 2A
\]

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

\( i(\infty) \) 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 $t > 0$.

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,

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

$$\frac{1}{R_{th}C} = 0.5$$

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