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 $t > 0$,
\[ R_{th} = 6/12 + 6 = 10\Omega \]
\[ \frac{1}{R_{th}C} = \frac{1}{10 \times 0.04} = 2.5 \]
\[ v_c(t) = 5e^{-2.5t}V \text{ for } t \geq 0 \]
\[ i_c(t) = C \frac{dv}{dt} = 0.04 \times 5 \times (-2.5)e^{-2.5t} = -0.5e^{-2.5t}A \]
\[ i_1(t) = -\frac{6}{6+12} i_c(t), \text{ by current div.} = 0.1667e^{-2.5t}A \]

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 $t > 0$,
\[ R_{th} = 12 + 8 = 20\Omega \]
\[ \frac{1}{R_{th}C} = \frac{1}{20 \times 0.025} = 2 \]
\[ v_c(t) = 12e^{-2t}V \]
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 $t$, 

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

Just need to find $v_c(t)$.

For simplicity, replace the circuit inside the green box with an equivalent resistance

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), $I_x(t) = \frac{16}{30} e^{-0.2t}A$, for $t > 0$.
Practice 4: Find i(t), i_1(t), i_2(t) for t > 0.

For t < 0.

\[ R_{eq} \text{ with respect to } 12V: \]
\[ R_{eq} = 3 + \frac{4}{12} = 6\Omega \]
\[ I_s = \frac{12}{6} = 2A; \]

By current division:
\[ i(0^-) = \frac{12}{4+12} = 1.5A \]

For t > 0,

\[ R_{th} \text{ with respect to } L: \]
\[ R_{th} = \frac{16}{16} = 8\Omega \]
\[ \frac{8}{L} = \frac{0.5}{0.5} = 16 \]
\[ i(t) = 1.5e^{-16t}A \]

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:

$$I_1(t) = -\frac{30}{50} i_L(t) = -1.2e^{-6t} A$$

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

$$v_2(t) = 10I_2 = -8e^{-6t} V$$
Practise 6: Find \( v(t) \), \( i_x(t) \) for \( t > 0 \).

\[
\begin{align*}
\text{A:} & \quad v(t) = 4 + 8e^{-t/14} \quad i_x(t) = 2 + i_c(t) \\
& \quad = 2 + 2(8) \left( -\frac{1}{14} \right) e^{-t/14} \\
& \quad = 2 - \frac{8}{7} e^{-t/14} A
\end{align*}
\]

Practise 7: Find \( i_x(t) \) for \( t > 0 \).

\[
\text{A:} \quad v(t) = 15(1 - e^{-4t})V; \quad i_c(t) = C \frac{dv}{dt} = 0.25m(15)(4)e^{-4t} = 15e^{-4t} mA
\]

\[
\begin{align*}
& \quad v(\infty) = \frac{2}{3} v_{30mA} = 15V \\
& \quad v(t) = 15(1 - e^{-4t})V; \\
& \quad i_c(t) = C \frac{dv}{dt} = 0.25m(15)(4)e^{-4t} = 15e^{-4t} mA \\
& \quad i_1(t) = \frac{v}{2k} = 7.5(1 - e^{-4t})mA \\
& \quad i_x(t) = 30 - i_c - i_1 = 22.5 - 7.5e^{-4t} mA
\end{align*}
\]
Practice 8: Find $i(t)$ for all $t$.

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

$i(\infty)$ 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.

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,
\[ R_{th} = 1 + 4//4 + 3//6 = 5\Omega, \]
\[ \frac{1}{R_{th}C} = 0.5 \]
\[ v(t) = -2e^{-0.5t}V \]