Chapter 7, Problem 42.

(a) If the switch in Fig. 7.109 has been open for a long time and is closed at \( t = 0 \), find \( v_o(t) \).

\[
\tau = R_{eq} C_{eq}, \quad R_{eq} = 2 \parallel 4 = \frac{4}{3}
\]

\[
\tau = 4 \left( \frac{3}{3} \right) = 4
\]

\[
v_o(t) = 12 - 12 e^{-t/4}
\]

\[
v_o(t) = 12 \left( 1 - e^{-0.25t} \right) V, \quad t > 0
\]

(b) Suppose that the switch has been closed for a long time and is opened at \( t = 0 \). Find \( v_o(t) \).

\[
v_o(0) = \frac{4}{4 + 2} (18) = 12, \quad \tau = RC = (4)(3) = 12
\]
Chapter 7, Problem 44.

The switch in Fig. 7.111 has been in position $a$ for a long time. At $t = 0$, it moves to position $b$. Calculate $i(t)$ for all $t > 0$.

![Figure 7.111](image)

Chapter 7, Solution 44.

$$v_0(t) = 12e^{-t/12} \text{ V \ for \ } t > 0.$$

$$\Omega = \frac{23 || 6}{6} R_{eq}, \quad \tau = RC = 4$$

$$v(t) = v(\infty) + \left[ v(0) - v(\infty) \right] e^{-t/\tau}$$

Using voltage division,

$$v(0) = \frac{3}{3+6} (30) = 10 \text{ V}, \quad v(\infty) = \frac{3}{3+6} (12) = 4 \text{ V}$$

Thus,

$$v(t) = 4 + (10 - 4) e^{-t/4} = 4 + 6 e^{-t/4}$$

$$i(t) = C \frac{dv}{dt} = (2)(6) \left( -\frac{1}{4} \right) e^{-t/4} = -3e^{-0.25t} \text{ A}$$

Chapter 7, Problem 59.

Determine the step response $v_0(t)$ to $v_s = 9 u(t) \text{ V}$ in the circuit of Fig. 7.124.
Chapter 7, Solution 59.

Let $I$ be the current through the inductor.

For $t < 0$,

$$v_s = 0, \quad i(0) = 0$$

For $t > 0$,

$$R_{eq} = 4 + 6 \parallel 3 = 6, \quad \tau = \frac{L}{R_{eq}} = \frac{1.5}{6} = 0.25$$

$$V_{oc} = V_{Thev} = 9(3/(3+6)) = 3 \text{ V}$$

$$i(\infty) = 3/6 = 0.5 \text{ A}$$

$$i(t) = i(\infty) + \left[ i(0) - i(\infty) \right] e^{t/\tau}$$

$$i(t) = 0.5(1 - e^{-4t})$$

$$v_v(t) = L \frac{di}{dt} = (1.5)(0.5)(-4)(-e^{-4t})$$

$$v_v(t) = 3e^{-4t}u(t) \text{ V}$$

Chapter 7, Problem 60.

Find $v(t)$ for $t > 0$ in the circuit of Fig. 7.125 if the initial current in the inductor is zero.
Chapter 7, Solution 60.

Let I be the inductor current.

For $t < 0$, $u(t) = 0 \rightarrow i(0) = 0$

For $t > 0$, $R_{eq} = 5 \parallel 20 = 4 \Omega$,  $\tau = \frac{L}{R_{eq}} = \frac{8}{4} = 2$

1. $i(\infty) = 4$
2. $i(t) = i(\infty) + [i(0) - i(\infty)] e^{t/\tau}$
3. $i(t) = 4 \left(1 - e^{t/\tau}\right)$

$v(t) = L \frac{di}{dt} = (8)(-4)(\frac{-1}{2})e^{t/\tau}$

$v(t) = 16e^{-0.5t} V$

Chapter 8, Problem 12.

If $R = 20 \Omega, L = 0.6 \text{ H}$, what value of $C$ will make an $RLC$ series circuit:

(a) overdamped,
(b) critically damped,
(c) underdamped?

Chapter 8, Solution 12.

(a) Overdamped when $C > \frac{4L}{(R^2)} = \frac{4 \times 0.6}{400} = 6 \times 10^{-3}$, or $C > 6 \text{ mF}$

(b) Critically damped when $C = 6 \text{ mF}$

(c) Underdamped when $C < 6 \text{ mF}$