8.2 In the circuit of Fig. 8.63, determine:
(a) $i_R(0^+)$, $i_L(0^+)$, and $i_C(0^+)$,
(b) $di_R(0^+)/dt$, $di_L(0^+)/dt$, and $di_C(0^+)/dt$,
(c) $i_R(\infty)$, $i_L(\infty)$, and $i_C(\infty)$.

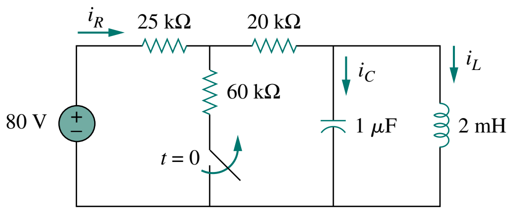

Figure 8.63 For Prob. 8.2.

8.3 Refer to the circuit shown in Fig. 8.64. Calculate:
(a) $i_L(0^+)$, $v_C(0^+)$, and $v_R(0^+)$,
(b) $di_L(0^+)/dt$, $dv_C(0^+)/dt$, and $dv_R(0^+)/dt$,
(c) $i_L(\infty)$, $v_C(\infty)$, and $v_R(\infty)$.

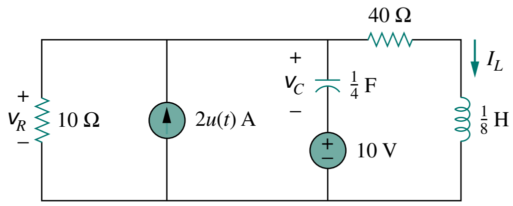

Figure 8.64 For Prob. 8.3.

8.4 In the circuit of Fig. 8.65, find:
(a) $v(0^+)$ and $i(0^+)$,
(b) $dv(0^+)/dt$ and $di(0^+)/dt$,
(c) $v(\infty)$ and $i(\infty)$.

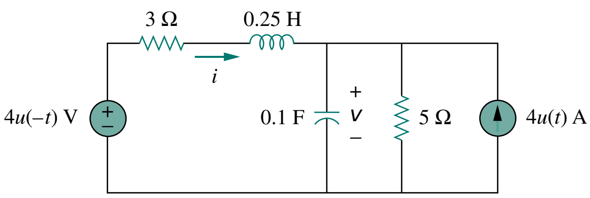

Figure 8.65 For Prob. 8.4.

8.5 Refer to the circuit in Fig. 8.66. Determine:
(a) $i(0^+)$ and $v(0^+)$,
(b) $di(0^+)/dt$ and $dv(0^+)/dt$,
(c) $i(\infty)$ and $v(\infty)$.

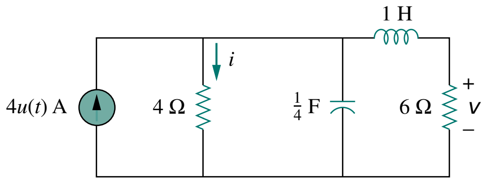

Figure 8.66 For Prob. 8.5.

8.6 In the circuit of Fig. 8.67, find:
(a) $v_R(0^+)$ and $v_L(0^+)$,
(b) $dv_R(0^+)/dt$ and $dv_L(0^+)/dt$,
(c) $v_R(\infty)$ and $v_L(\infty)$.

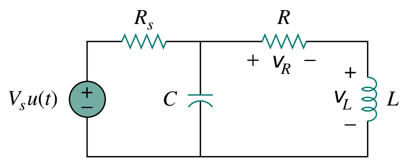

Figure 8.67 For Prob. 8.6.

Section 8.3 Source-Free Series *RLC* Circuit

8.7 The voltage in an RLC network is described by the differential equation

$$\frac{d^2v}{dt^2} + 4\frac{dv}{dt} + 4v = 0$$

subject to the initial conditions $v(0) = 1$ and $dv(0)/dt = -1$. Determine the characteristic equation. Find $v(t)$ for $t > 0$.

8.8 The branch current in an RLC circuit is described by the differential equation

$$\frac{d^2i}{dt^2} + 6\frac{di}{dt} + 9i = 0$$

and the initial conditions are $i(0) = 0$, $di(0)/dt = 4$. Obtain the characteristic equation and determine $i(t)$ for $t > 0$.

8.9 The current in an RLC circuit is described by

$$\frac{d^2i}{dt^2} + 10\frac{di}{dt} + 25i = 0$$

If $i(0) = 10$ and $di(0)/dt = 0$, find $i(t)$ for $t > 0$.

8.10 The differential equation that describes the voltage in an RLC network is

$$\frac{d^2v}{dt^2} + 5\frac{dv}{dt} + 4v = 0$$

Given that $v(0) = 0$, $dv(0)/dt = 10$, obtain $v(t)$.

8.11 The natural response of an RLC circuit is described by the differential equation

$$\frac{d^2v}{dt^2} + 2\frac{dv}{dt} + v = 0$$

for which the initial conditions are $v(0) = 10$ and $dv(0)/dt = 0$. Solve for $v(t)$.

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

(a) overdamped, (b) critically damped,

(c) underdamped?

8.13 For the circuit in Fig. 8.68, calculate the value of R needed to have a critically damped response.

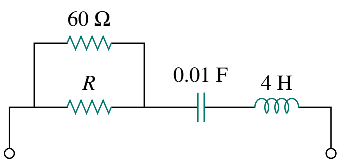

Figure 8.68 For Prob. 8.13.

8.14 Find $v(t)$ for $t > 0$ if $v(0) = 6$ V and $i(0) = 2$ A in the circuit shown in Fig. 8.69.

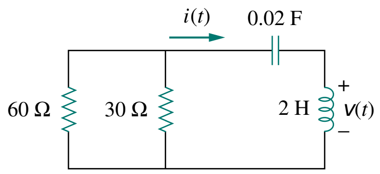

Figure 8.69 For Prob. 8.14.

8.15 The responses of a series RLC circuit are

$$v_C(t) = 30 - 10e^{-20t} + 30e^{-10t}\ \text{V}$$

$$i_L(t) = 40e^{-20t} - 60e^{-10t}\ \text{mA}$$

where v_C and i_L are the capacitor voltage and inductor current, respectively. Determine the values of R, L, and C.

8.16 Find $i(t)$ for $t > 0$ in the circuit of Fig. 8.70.

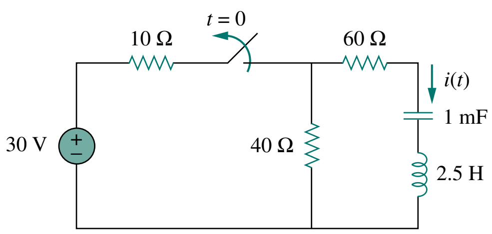

Figure 8.70 For Prob. 8.16.

8.17 Obtain $v(t)$ for $t > 0$ in the circuit of Fig. 8.71.

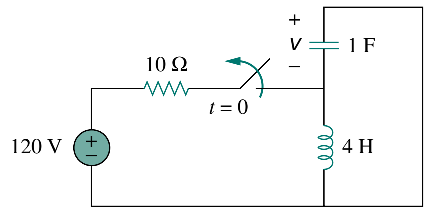

Figure 8.71 For Prob. 8.17.

8.18 The switch in the circuit of Fig. 8.72 has been closed for a long time but is opened at $t = 0$. Determine $i(t)$ for $t > 0$.

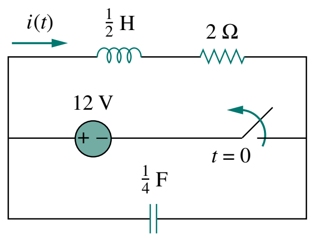

Figure 8.72 For Prob. 8.18.

*__8.19__ Calculate $v(t)$ for $t > 0$ in the circuit of Fig. 8.73.

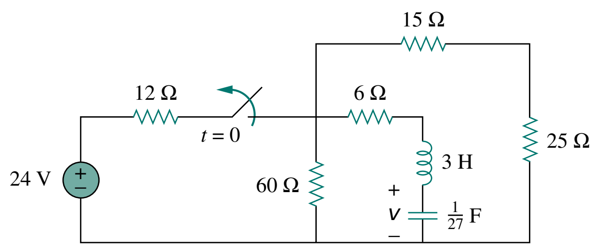

Figure 8.73 For Prob. 8.19.

Section 8.4 Source-Free Parallel *RLC* Circuit

8.20 For a parallel RLC circuit, the responses are

$$v_L(t) = 4e^{-20t} \cos 50t - 10e^{-20t} \sin 50t\ \text{V}$$

$$i_C(t) = -6.5e^{-20t} \cos 50t\ \text{mA}$$

where i_C and v_L are the capacitor current and inductor voltage, respectively. Determine the values of R, L, and C.

8.21 For the network in Fig. 8.74, what value of C is needed to make the response underdamped with unity damping factor ($\alpha = 1$)?

*An asterisk indicates a challenging problem.

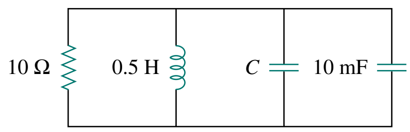

Figure 8.74 For Prob. 8.21.

8.22 Find $v(t)$ for $t > 0$ in the circuit in Fig. 8.75.

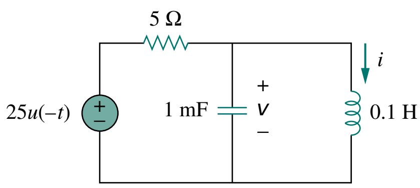

Figure 8.75 For Prob. 8.22.

8.23 In the circuit in Fig. 8.76, calculate $i_o(t)$ and $v_o(t)$ for $t > 0$.

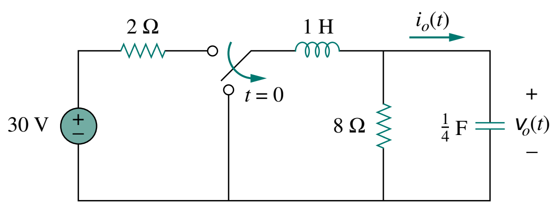

Figure 8.76 For Prob. 8.23.

Section 8.5 Step Response of a Series *RLC* Circuit

8.24 The step response of an RLC circuit is given by

$$\frac{d^2i}{dt^2} + 2\frac{di}{dt} + 5i = 10$$

Given that $i(0) = 2$ and $di(0)/dt = 4$, solve for $i(t)$.

8.25 A branch voltage in an RLC circuit is described by

$$\frac{d^2v}{dt^2} + 4\frac{dv}{dt} + 8v = 24$$

If the initial conditions are $v(0) = 0 = dv(0)/dt$, find $v(t)$.

8.26 The current in an RLC network is governed by the differential equation

$$\frac{d^2i}{dt^2} + 3\frac{di}{dt} + 2i = 4$$

subject to $i(0) = 1$, $di(0)/dt = -1$. Solve for $i(t)$.

8.27 Solve the following differential equations subject to the specified initial conditions

(a) $d^2v/dt^2 + 4v = 12$, $v(0) = 0$, $dv(0)/dt = 2$

(b) $d^2i/dt^2 + 5\,di/dt + 4i = 8$, $i(0) = -1$, $di(0)/dt = 0$

(c) $d^2v/dt^2 + 2\,dv/dt + v = 3$, $v(0) = 5$, $dv(0)/dt = 1$

(d) $d^2i/dt^2 + 2\,di/dt + 5i = 10$, $i(0) = 4$, $di(0)/dt = -2$

8.28 Consider the circuit in Fig. 8.77. Find $v_L(0)$ and $v_C(0)$.

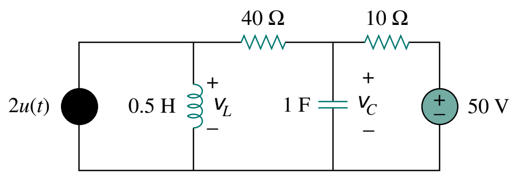

Figure 8.77 For Prob. 8.28.

8.29 For the circuit in Fig. 8.78, find $v(t)$ for $t > 0$.

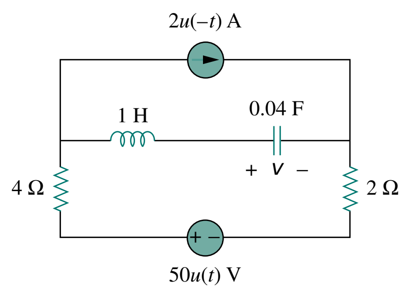

Figure 8.78 For Prob. 8.29.

8.30 Find $v(t)$ for $t > 0$ in the circuit in Fig. 8.79.

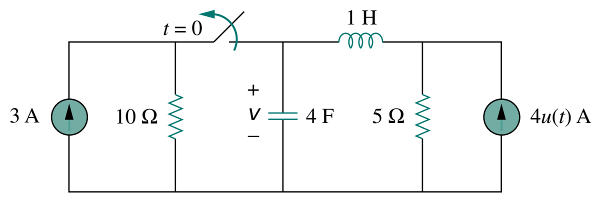

Figure 8.79 For Prob. 8.30.

8.31 Calculate $i(t)$ for $t > 0$ in the circuit in Fig. 8.80.

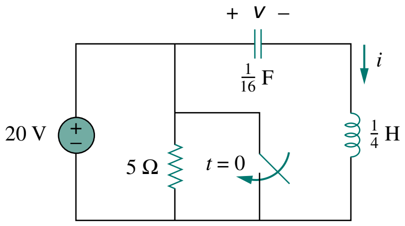

Figure 8.80 For Prob. 8.31.

8.32 Determine $v(t)$ for $t > 0$ in the circuit in Fig. 8.81.

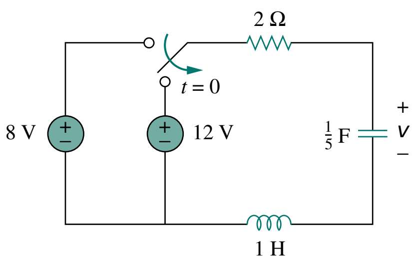

Figure 8.81 For Prob. 8.32.

8.33 Obtain $v(t)$ and $i(t)$ for $t > 0$ in the circuit in Fig. 8.82.

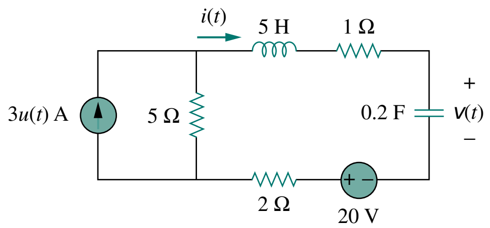

Figure 8.82 For Prob. 8.33.

*8.34 For the network in Fig. 8.83, solve for $i(t)$ for $t > 0$.

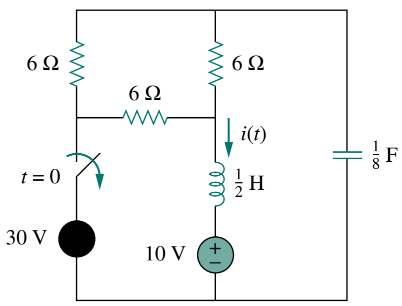

Figure 8.83 For Prob. 8.34.

8.35 Refer to the circuit in Fig. 8.84. Calculate $i(t)$ for $t > 0$.

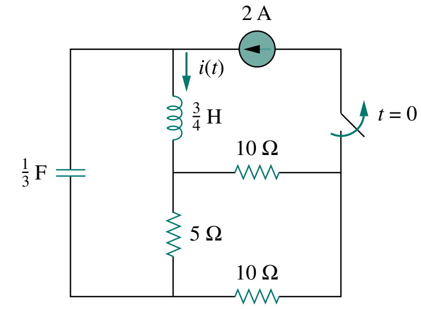

Figure 8.84 For Prob. 8.35.

8.36 Determine $v(t)$ for $t > 0$ in the circuit in Fig. 8.85.

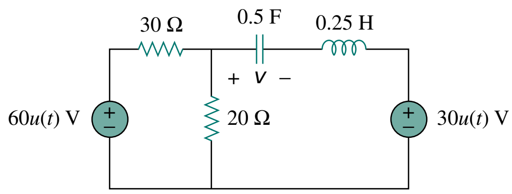

Figure 8.85 For Prob. 8.36.

8.37 The switch in the circuit of Fig. 8.86 is moved from position a to b at $t = 0$. Determine $i(t)$ for $t > 0$.

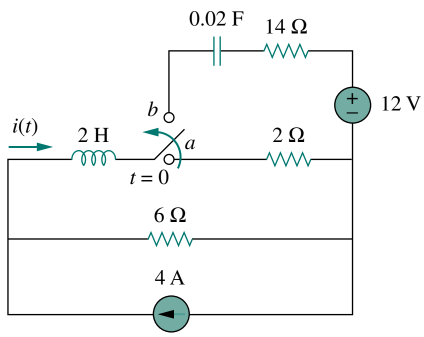

Figure 8.86 For Prob. 8.37.

*8.38 For the network in Fig. 8.87, find $i(t)$ for $t > 0$.

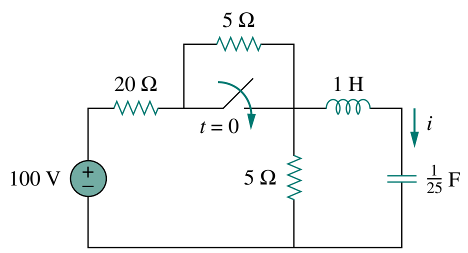

Figure 8.87 For Prob. 8.38.

*8.39 Given the network in Fig. 8.88, find $v(t)$ for $t > 0$.

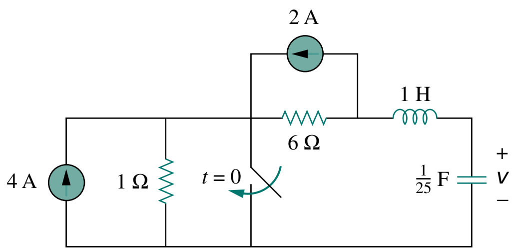

Figure 8.88 For Prob. 8.39.

Section 8.6 Step Response of a Parallel *RLC* Circuit

8.40 In the circuit of Fig. 8.89, find $v(t)$ and $i(t)$ for $t > 0$. Assume $v(0) = 0$ V and $i(0) = 1$ A.

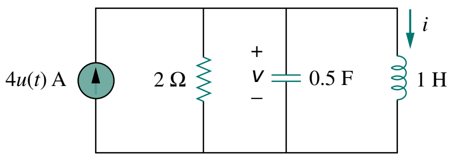

Figure 8.89 For Prob. 8.40.

8.41 Find $i(t)$ for $t > 0$ in the circuit in Fig. 8.90.

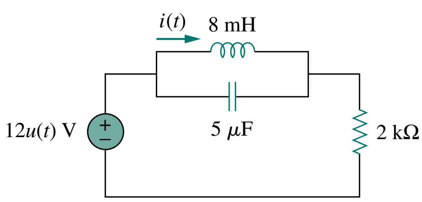

Figure 8.90 For Prob. 8.41.

8.42 Find the output voltage $v_o(t)$ in the circuit of Fig. 8.91.

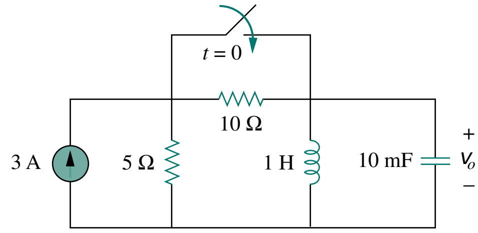

Figure 8.91 For Prob. 8.42.

8.43 Given the circuit in Fig. 8.92, find $i(t)$ and $v(t)$ for $t > 0$.

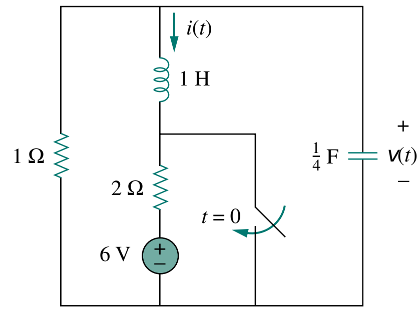

Figure 8.92 For Prob. 8.43.

8.44 Determine $i(t)$ for $t > 0$ in the circuit of Fig. 8.93.

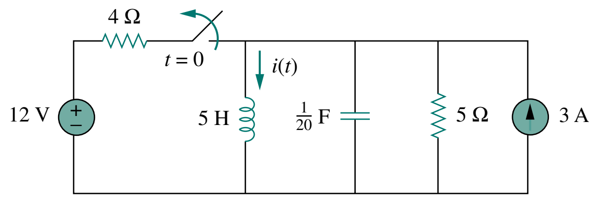

Figure 8.93 For Prob. 8.44.

8.45 For the circuit in Fig. 8.94, find $i(t)$ for $t > 0$.

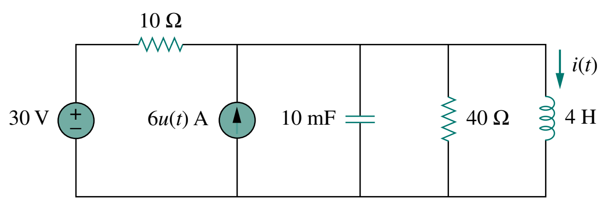

Figure 8.94 For Prob. 8.45.

8.46 Find $v(t)$ for $t > 0$ in the circuit in Fig. 8.95.

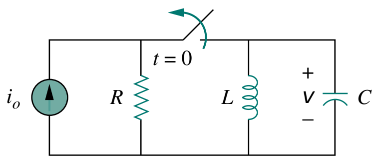

Figure 8.95 For Prob. 8.46.

Section 8.7 General Second-Order Circuits

8.47 Derive the second-order differential equation for v_o in the circuit of Fig. 8.96.

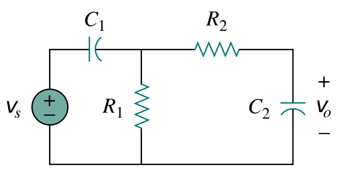

Figure 8.96 For Prob. 8.47.

8.48 Obtain the differential equation for v_o in the circuit in Fig. 8.97.

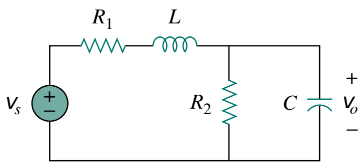

Figure 8.97 For Prob. 8.48.

8.49 For the circuit in Fig. 8.98, find $v(t)$ for $t > 0$. Assume that $v(0^+) = 4$ V and $i(0^+) = 2$ A.

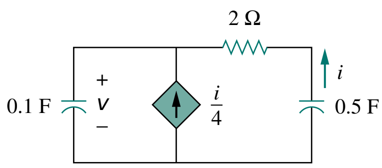

Figure 8.98 For Prob. 8.49.

8.50 In the circuit of Fig. 8.99, find $i(t)$ for $t > 0$.

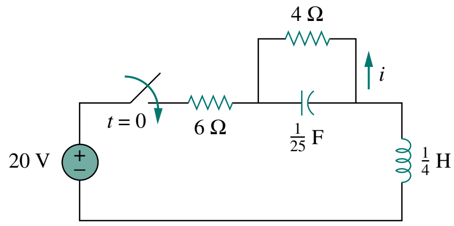

Figure 8.99 For Prob. 8.50.

8.51 If the switch in Fig. 8.100 has been closed for a long time before $t = 0$ but is opened at $t = 0$, determine:

(a) the characteristic equation of the circuit,

(b) i_x and v_R for $t > 0$.

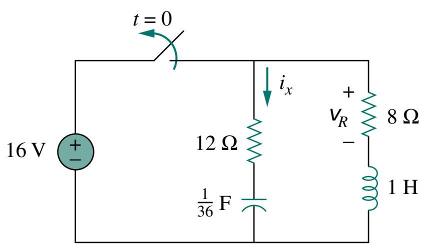

Figure 8.100 For Prob. 8.51.

8.52 Obtain i_1 and i_2 for $t > 0$ in the circuit of Fig. 8.101.

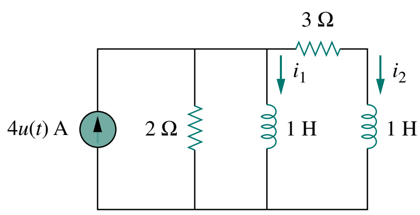

Figure 8.101 For Prob. 8.52.

8.53 For the circuit in Prob. 8.5, find i and v for $t > 0$.

8.54 Find the response $v_R(t)$ for $t > 0$ in the circuit in Fig. 8.102. Let $R = 3\ \Omega$, $L = 2$ H, and $C = 1/18$ F.

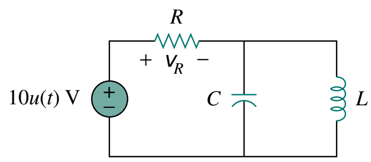

Figure 8.102 For Prob. 8.54.