C7 problems

Practice Problem 7.3

Find i and v_x in the circuit of Fig. 7.15. Let $i(0) = 12$ A.

Answer: $12e^{-2t}$ A, $-12e^{-2t}$ V, $t > 0$.

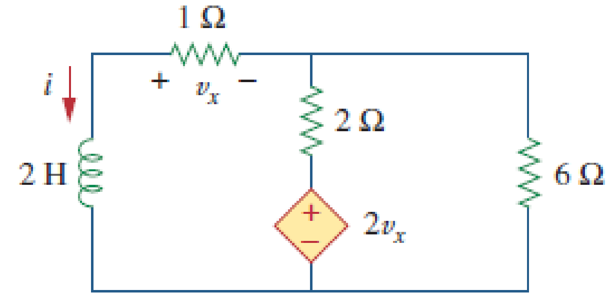

Figure 7.15
For Practice Prob. 7.3.

Practice Problem 7.5

Determine i, i_o, and v_o for all t in the circuit shown in Fig. 7.22. Assume that the switch was closed for a long time. It should be noted that opening a switch in series with an ideal current source creates an infinite voltage at the current source terminals. Clearly this is impossible. For the purposes of problem solving, we can place a shunt resistor in parallel with the source (which now makes it a voltage source in series with a resistor). In more practical circuits, devices that act like current sources are, for the most part, electronic circuits. These circuits will allow the source to act like an ideal current source over its operating range but voltage-limit it when the load resistor becomes too large (as in an open circuit).

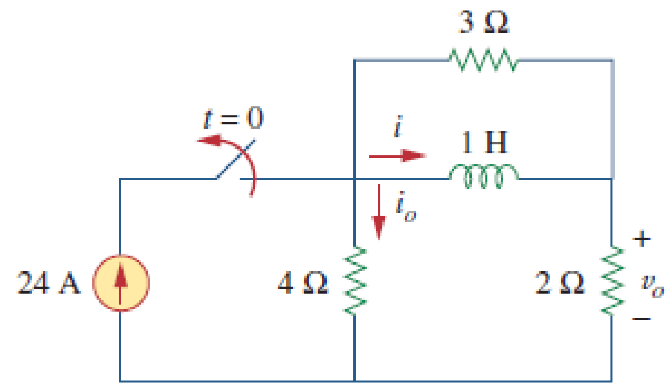

Figure 7.22
For Practice Prob. 7.5.

Answer:

$$i = \begin{cases} 16\text{ A}, & t < 0 \\ 16e^{-2t}\text{ A}, & t \geq 0 \end{cases}, \qquad i_o = \begin{cases} 8\text{ A}, & t < 0 \\ -5.333e^{-2t}\text{ A}, & t > 0 \end{cases}$$

$$v_o = \begin{cases} 32\text{ V}, & t < 0 \\ 10.667e^{-2t}\text{ V}, & t > 0 \end{cases}$$

Practice Problem 7.6

Express the current pulse in Fig. 7.33 in terms of the unit step. Find its integral and sketch it.

Answer: $10[u(t) - 2u(t-2) + u(t-4)]$, $10[r(t) - 2r(t-2) + r(t-4)]$. See Fig. 7.34.

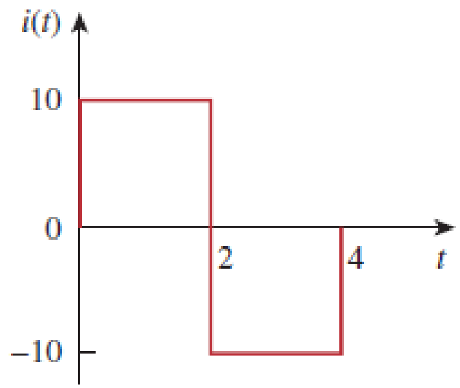

Figure 7.33
For Practice Prob. 7.6.

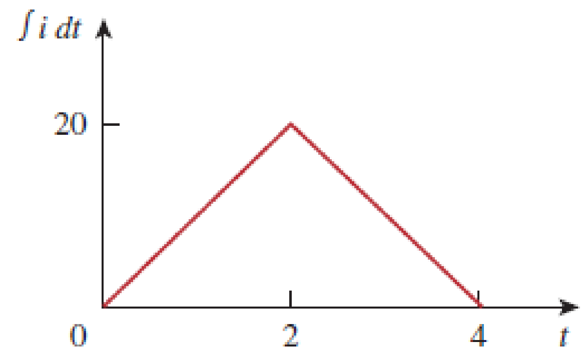

Figure 7.34
Integral of $i(t)$ in Fig. 7.33.

Practice Problem 7.9

Evaluate the following integrals:

$$\int_{-\infty}^{\infty} (t^3 + 5t^2 + 10)\delta(t + 3)\,dt, \qquad \int_{0}^{10} \delta(t - \pi) \cos 3t\, dt$$

Answer: 28, -1.

Practice Problem 7.10

Find $v(t)$ for $t > 0$ in the circuit of Fig. 7.44. Assume the switch has been open for a long time and is closed at $t = 0$. Calculate $v(t)$ at $t = 0.5$.

Answer: $(9.375 + 5.625e^{-2t})$ V for all $t > 0$, 7.63 V.

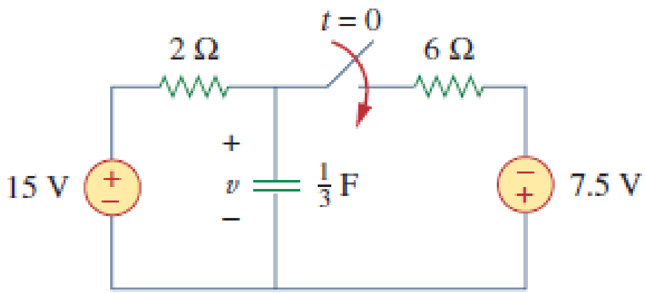

Figure 7.44
For Practice Prob. 7.10.

Practice Problem 7.12

The switch in Fig. 7.52 has been closed for a long time. It opens at $t = 0$. Find $i(t)$ for $t > 0$.

Answer: $(4 + 2e^{-10t})$ A for all $t > 0$.

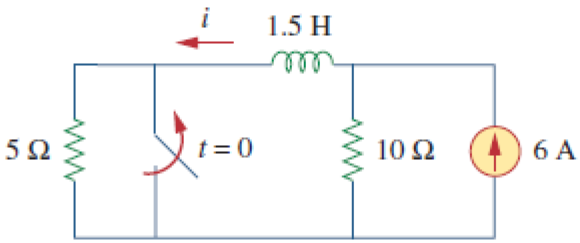

Figure 7.52
For Practice Prob. 7.12.

Practice Problem 7.13

Switch S_1 in Fig. 7.54 is closed at $t = 0$, and switch S_2 is closed at $t = 2$ s. Calculate $i(t)$ for all t. Find $i(1)$ and $i(3)$.

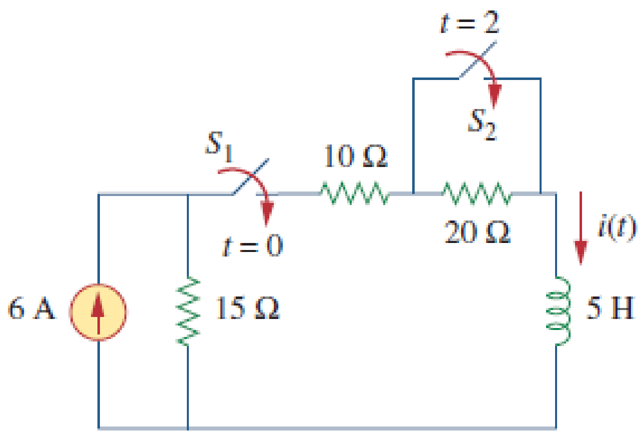

Figure 7.54
For Practice Prob. 7.13.

Answer:

$$i(t) = \begin{cases} 0, & t < 0 \\ 2(1 - e^{-9t}), & 0 < t < 2 \\ 3.6 - 1.6e^{-5(t-2)}, & t > 2 \end{cases}$$

$i(1) = 1.9997$ A, $i(3) = 3.589$ A.

Practice Problem 7.14

For the op amp circuit in Fig. 7.56, find v_o for $t > 0$ if $v(0) = 4$ V. Assume that $R_f = 50\ \text{k}\Omega$, $R_1 = 10\ \text{k}\Omega$, and $C = 10\ \mu\text{F}$.

Answer: $-4e^{-2t}$ V, $t > 0$.

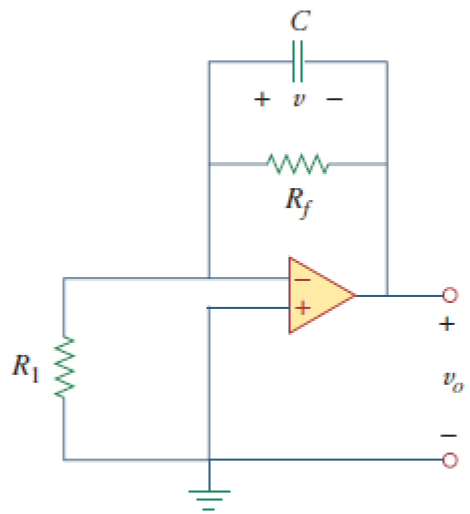

Figure 7.56
For Practice Prob. 7.14.

Practice Problem 7.15

Find $v(t)$ and $v_o(t)$ in the op amp circuit of Fig. 7.58.

Answer: (Note, the voltage across the capacitor and the output voltage must be both equal to zero, for $t < 0$, since the input was zero for all $t < 0$.) $40(1 - e^{-10t})\,u(t)$ mV, $40(e^{-10t} - 1)\,u(t)$ mV.

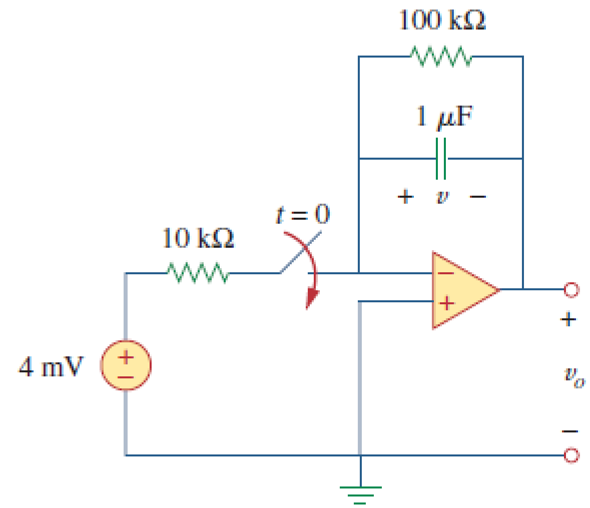

Figure 7.58
For Practice Prob. 7.15.

Practice Problem 7.16

Obtain the step response $v_o(t)$ for the circuit in Fig. 7.62. Let $v_i = 4.5u(t)$ V, $R_1 = 20$ kΩ, $R_f = 40$ kΩ, $R_2 = R_3 = 10$ kΩ, $C = 2\ \mu$F.

Answer: $13.5(1 - e^{-50t})u(t)$ V.

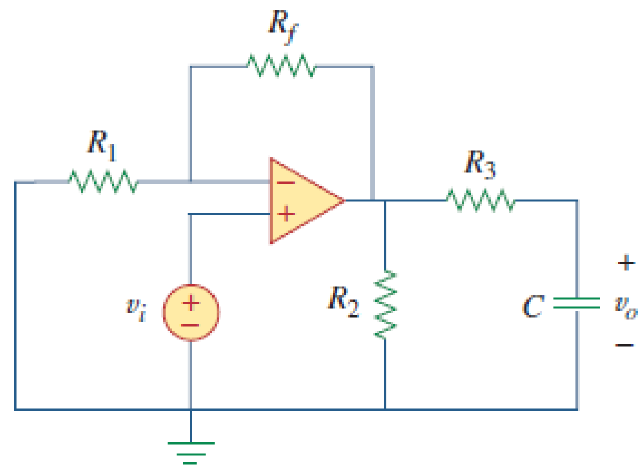

Figure 7.62
For Practice Prob. 7.16.

- 7.3 (s7.3)
- 7.5 (s7.3)
- 7.6 (s7.4)
- 7.9 (s7.4)
- 7.10 (s7.5)
- 7.12 (s7.6)
- 7.13 (s7.6)
- 7.14 (s7.7)
- 7.15 (s7.7)
- 7.16 (s7.7)