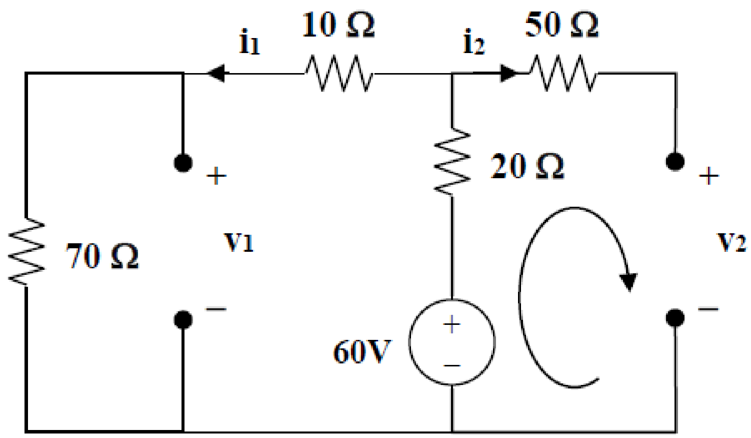
Solution 6.13

Under dc conditions, the circuit becomes that shown below:



$i_2 = 0$, $i_1 = 60/(70+10+20) = 0.6$ A

$v_1 = 70i_1 = 42$ V, $v_2 = 60–20i_1 = 48$ V

Thus, $v_1 =$ **42 V**, $v_2 =$ **48 V**.

Solution 6.32

In the circuit in Fig. 6.64, let $i_s = 4.5e^{-2t}$ mA and the voltage across each capacitor is equal to zero at t = 0. Determine v_1 and v_2 and the energy stored in each capacitor for all t > 0.

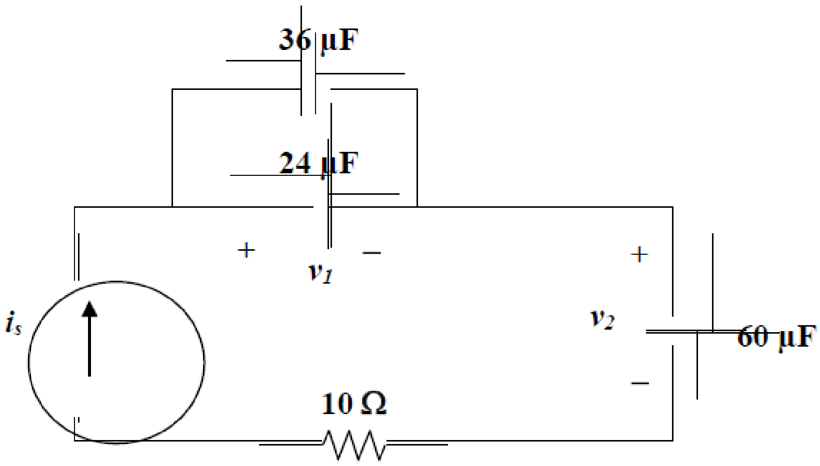


Figure 6.64
For Prob. 6.32.

Solution

Combining the 36 µF with the 24 µF we get 60 µF which leads to $v_1 = \frac{1}{60\mu}\int_0^t 4.5e^{-2\tau}m\,d\tau$

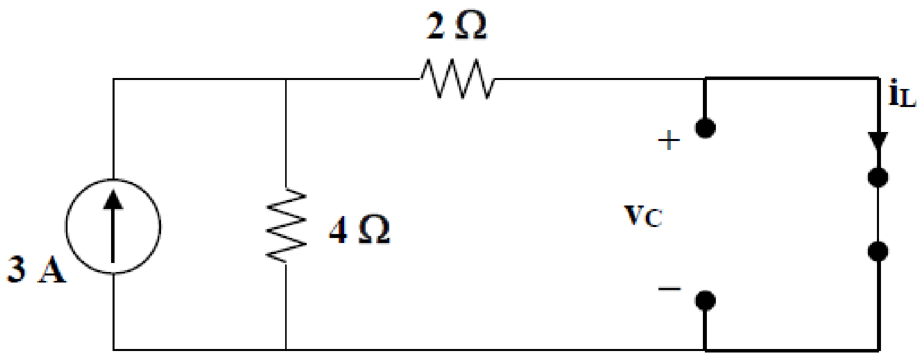
= $\mathbf{[37.5 – 37.5e^{-2t}]\ V}$ = v_2.

$(v_1)^2 = [(37.5)^2 – 2(37.5)^2e^{-2t} + (37.5)^2e^{-4t}] = 1406.25[1 – 2e^{-2t} + e^{-4t}] = (v_2)^2$

$w_{24} = 0.5x24x10^{-6}(v_1)^2 = \mathbf{16.875[1 – 2e^{-2t} + e^{-4t}]\ mJ}$
$w_{36} = 0.5x36x10^{-6}(v_1)^2 = \mathbf{25.31[1 – 2e^{-2t} + e^{-4t}]\ mJ}$
$w_{60} = 0.5x60x10^{-6}(v_2)^2 = \mathbf{42.19[1 – 2e^{-2t} + e^{-4t}]\ mJ}$

Solution 6.46

Under dc conditions, the circuit is as shown below:



By current division,

$$i_L = \frac{4}{4+2}(3) = \mathbf{2A}, \quad v_c = \mathbf{0V}$$

$$w_L = \frac{1}{2}L\, i_L^2 = \frac{1}{2}\left(\frac{1}{2}\right)(2)^2 = \mathbf{1J}$$

$$w_c = \frac{1}{2}C\, v_c^2 = \frac{1}{2}(2)(v) = \mathbf{0J}$$

Solution 6.62

Consider the circuit in Fig. 6.84. Given that $v(t) = 12e^{-3t}$ mV for $t > 0$ and $i_1(0) = -30$ mA, find: (a) $i_2(0)$, (b) $i_1(t)$ and $i_2(t)$.

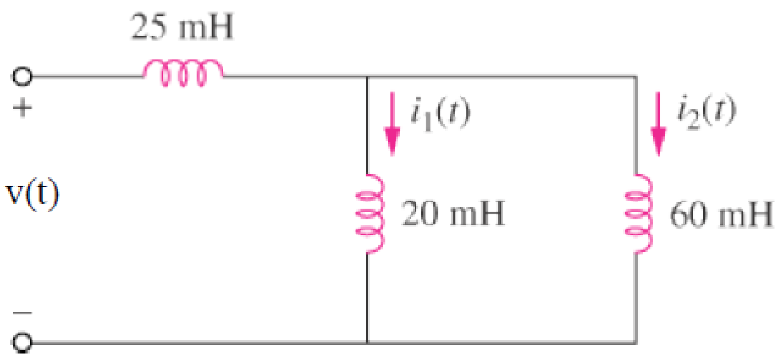


Figure 6.84
For Prob. 6.62.

Solution

(a) $L_{eq} = 25 + 20 \,||\, 60 = 25 + \frac{20x60}{80} = 40 \text{ mH}$

$$v = L_{eq}\frac{di}{dt} \longrightarrow i = \frac{1}{L_{eq}}\int v(t)dt + i(0) = \frac{10^{-3}}{40x10^{-3}}\int_0^t 12e^{-3t}dt + i(0) = -0.1(e^{-3t} - 1) + i(0)$$

Using current division and the fact that all the currents were zero when the circuit was put together, we get,

$$i_1 = \frac{60}{80}i = \frac{3}{4}i, \qquad i_2 = \frac{1}{4}i$$

$$i_1(0) = \frac{3}{4}i(0) \longrightarrow 0.75i(0) = -0.03 \longrightarrow i(0) = -0.04$$

$$i_2 = \frac{1}{4}(-0.1e^{-3t} + 0.06) \text{ A} = (-25e^{-3t} + 15) \text{ mA}$$

$i_2(0) = -25+15 =$ **-10 mA**.

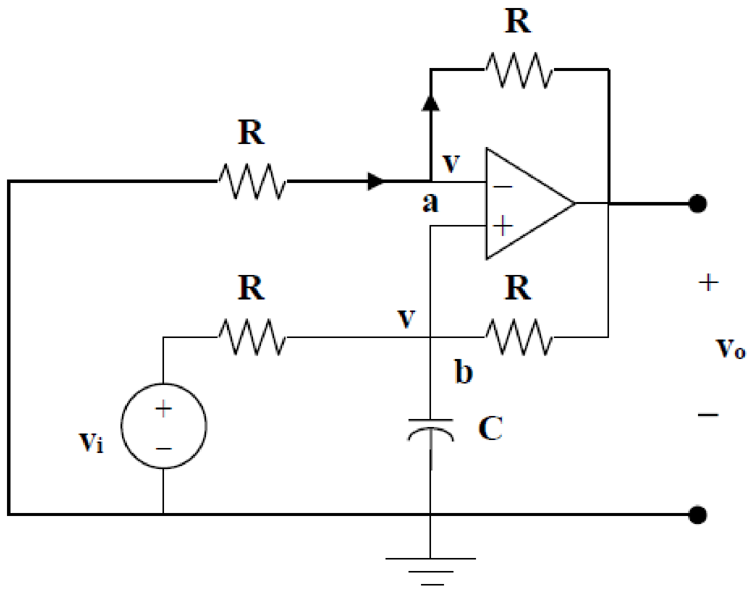
(b) $i_1(t) = 0.75(-0.1e^{-3t} + 0.06) =$ **$(-75e^{-3t} + 45)$ mA** and $i_2(t) =$ **$(-25e^{-3t} + 15)$ mA**.

Solution 6.73

Consider the op amp as shown below:

Let $v_a = v_b = v$

At node a, $\frac{0-v}{R} = \frac{v-v_o}{R} \longrightarrow \mathbf{2v - v_o = 0}$ (1)



At node b, $\frac{v_i - v}{R} = \frac{v - v_o}{R} + C\frac{dv}{dt}$

$$v_i = 2v - v_o + RC\frac{dv}{dt} \quad (2)$$

Combining (1) and (2),

$$v_i = v_o - v_o + \frac{RC}{2}\frac{dv_o}{dt}$$

or

$$v_o = \frac{2}{RC}\int v_i \, dt$$

showing that the circuit is a noninverting integrator.