57. For the circuit given in **Fig. 14.55**, (*a*) draw the s-domain equivalent; (*b*) write the three s-domain mesh equations; (*c*) determine i_1, i_2, and i_3.

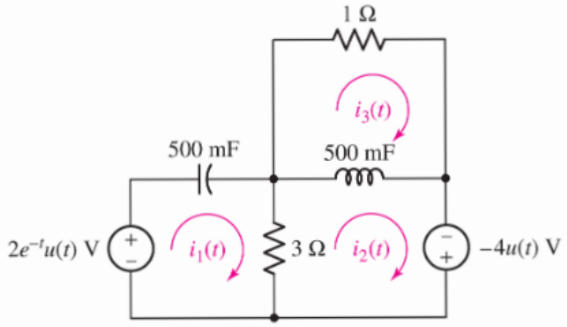
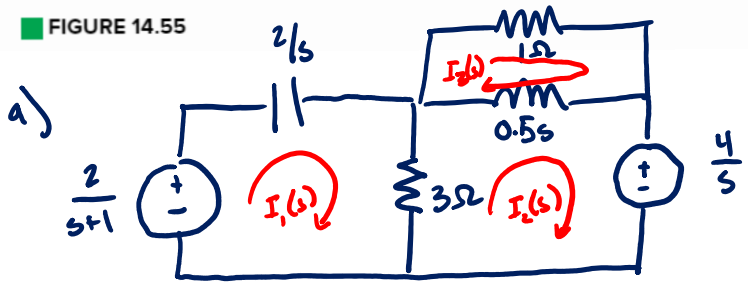


FIGURE 14.55

a)



b) $$\frac{2}{s+1} = I_1\frac{2}{s} + (I_1 - I_2)3$$

$$-\frac{4}{s} = (I_2 - I_1)3 + (I_2 - I_3)0.5s$$

$$\emptyset = I_3(1) + (I_3 - I_2)0.5s$$

c) $$\begin{bmatrix} \frac{2}{s+1} \\ -4/s \\ \emptyset \end{bmatrix} = \begin{bmatrix} \frac{2}{s}+3 & -3 & \emptyset \\ -3 & 3+0.5s & -0.5s \\ \emptyset & -0.5s & 1+0.5s \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix}$$

$$I_1 = \frac{-4s^2 - 24s - 24}{(s+1)(3s^2 + 8s + 12)}$$

$$I_2 = \frac{(s+2)(-6s^2 - 20s - 8)}{s(s+1)(3s^2 + 8s + 12)}$$

$$I_3 = \frac{-6s^2 - 20s - 8}{(s+1)(3s^2 + 8s + 12)}$$

Using residue in Matlab

$$I_1 = \frac{-0.571}{s+1} + \frac{-0.38+1.57j}{s+\frac{4}{3}-1.5j} + \frac{-0.38-1.57j}{s+\frac{4}{3}+1.5j}$$

$$I_2 = \frac{-4/3}{s} + \frac{-0.86}{s+1} + \frac{0.095+1.32j}{s+\frac{4}{3}-1.5j} + \frac{0.095-1.32j}{s+\frac{4}{3}+1.5j}$$

$$I_3 = \frac{0.86}{s+1} + \frac{-1.43+0.77j}{s+\frac{4}{3}-1.5j} + \frac{-1.43-0.77j}{s+\frac{4}{3}+1.5j}$$

so

$$i_1(t) = \left[-0.571e^{-t} + 2(1.62)e^{-\frac{4}{3}t}\cos(1.5t+103^\circ)\right]u(t)$$

$$i_2(t) = \left[-\frac{4}{3} - 0.86e^{-t} + 2(1.32)e^{-\frac{4}{3}t}\cos(1.5t+86^\circ)\right]u(t)$$

$$i_3(t) = \left[0.86e^{-t} + 2(1.62)e^{-\frac{4}{3}t}\cos(1.5t+152^\circ)\right]u(t)$$