Chapter 9, Solution 49.

Find $v_s(t)$ in the circuit of Fig. 9.56 if the current i_x through the 1-Ω resistor is 500 sin(200t) mA.

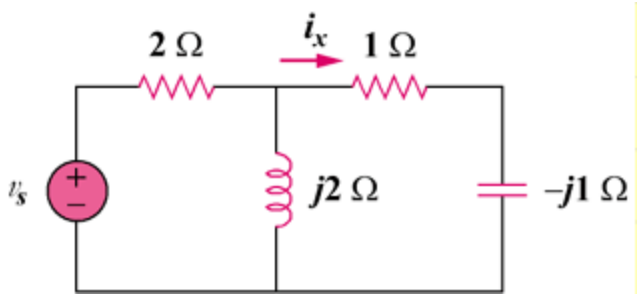
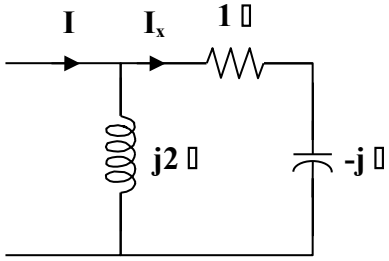


Figure 9.56
For Prob. 9.49.

Solution

$$\mathbf{Z}_T = 2 + j2 \,||\, (1 - j) = 2 + \frac{(j2)(1 - j)}{1 + j} = 4$$



$$\mathbf{I}_x = \frac{j2}{j2 + 1 - j}\mathbf{I} = \frac{j2}{1 + j}\mathbf{I}, \qquad \text{where } \mathbf{I}_x = 0.5\angle 0° = \frac{1}{2}$$

$$\mathbf{I} = \frac{1 + j}{j2}\mathbf{I}_x = \frac{1 + j}{j4}$$

$$\mathbf{V}_s = \mathbf{I}\,\mathbf{Z}_T = \frac{1 + j}{j4}(4) = \frac{1 + j}{j} = 1 - j = 1.414\angle -45°$$

$$v_s(t) = \mathbf{1.4142\ \sin(200t - 45°)\ V}$$