Chapter 10, Solution 27.

Using mesh analysis, find $\mathbf{I}_1$ and $\mathbf{I}_2$ in the circuit of Fig. 10.75 as shown in the text.

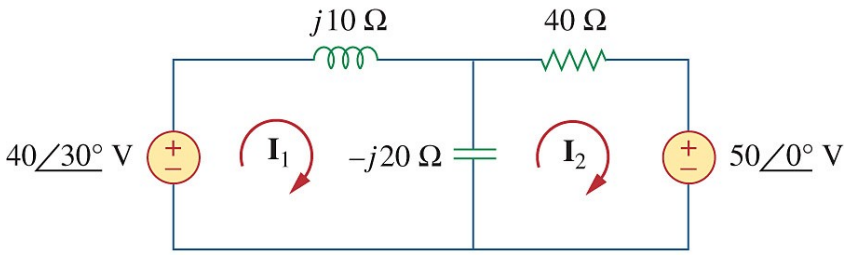

Figure 10.75
For Prob. 10.27.

Solution

For mesh 1,

$$-40\angle 30^\circ + (j10 - j20)\mathbf{I}_1 + j20\mathbf{I}_2 = 0$$
$$4\angle 30^\circ = -j\mathbf{I}_1 + j2\mathbf{I}_2 \qquad (1)$$

For mesh 2,

$$50\angle 0^\circ + (40 - j20)\mathbf{I}_2 + j20\mathbf{I}_1 = 0$$
$$5 = -j2\mathbf{I}_1 - (4 - j2)\mathbf{I}_2 \qquad (2)$$

From (1) and (2),

$$\begin{bmatrix} 4\angle 30^\circ \\ 5 \end{bmatrix} = \begin{bmatrix} -j & j2 \\ -j2 & -(4 - j2) \end{bmatrix} \begin{bmatrix} \mathbf{I}_1 \\ \mathbf{I}_2 \end{bmatrix}$$

$$\Delta = -2 + 4j = 4.472\angle 116.56^\circ$$

$$\Delta_1 = -(4\angle 30^\circ)(4 - j2) - j10 = 21.01\angle 211.8^\circ$$

$$\Delta_2 = -j5 + 8\angle 120^\circ = 4.44\angle 154.27^\circ$$

$$\mathbf{I}_1 = \frac{\Delta_1}{\Delta} = \mathbf{4.698Ð95.24° A}$$

$$\mathbf{I}_2 = \frac{\Delta_2}{\Delta} = \mathbf{992.8Ð37.71° mA}$$