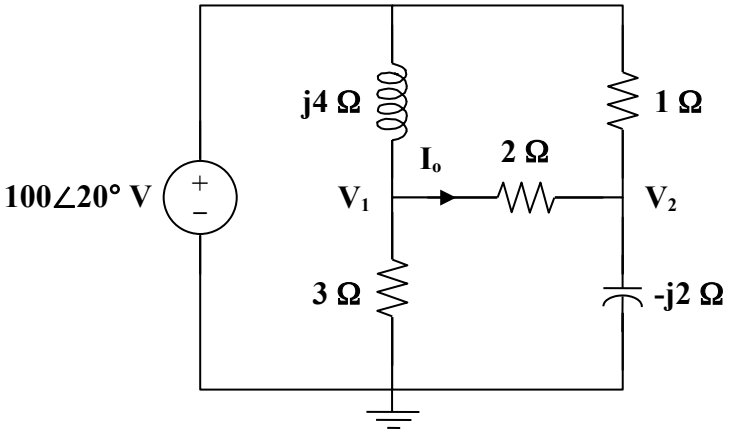
Chapter 10, Solution 17.

Consider the circuit below.



At node 1,

$$\frac{100\angle 20^\circ - \mathbf{V}_1}{\text{j4}} = \frac{\mathbf{V}_1}{3} + \frac{\mathbf{V}_1 - \mathbf{V}_2}{2}$$

$$100\angle 20^\circ = \frac{\mathbf{V}_1}{3}(3 + \text{j10}) - \text{j2}\,\mathbf{V}_2 \qquad (1)$$

At node 2,

$$\frac{100\angle 20^\circ - \mathbf{V}_2}{1} + \frac{\mathbf{V}_1 - \mathbf{V}_2}{2} = \frac{\mathbf{V}_2}{-\text{j2}}$$

$$100\angle 20^\circ = -0.5\,\mathbf{V}_1 + (1.5 + \text{j0.5})\,\mathbf{V}_2 \qquad (2)$$

From (1) and (2),

$$\begin{bmatrix} 100\angle 20^\circ \\ 100\angle 20^\circ \end{bmatrix} = \begin{bmatrix} -0.5 & 0.5(3+\text{j}) \\ 1 + \text{j10}/3 & -\text{j2} \end{bmatrix} \begin{bmatrix} \mathbf{V}_1 \\ \mathbf{V}_2 \end{bmatrix}$$

$$\Delta = \begin{vmatrix} -0.5 & 1.5 + \text{j0.5} \\ 1 + \text{j10}/3 & -\text{j2} \end{vmatrix} = 0.1667 - \text{j4.5}$$

$$\Delta_1 = \begin{vmatrix} 100\angle 20^\circ & 1.5 + \text{j0.5} \\ 100\angle 20^\circ & -\text{j2} \end{vmatrix} = -55.45 - \text{j286.2}$$

$$\Delta_2 = \begin{vmatrix} -0.5 & 100\angle 20^\circ \\ 1 + \text{j10}/3 & 100\angle 20^\circ \end{vmatrix} = -26.95 - \text{j364.5}$$

$$\mathbf{V}_1 = \frac{\Delta_1}{\Delta} = 64.74\angle -13.08^\circ$$

$$\mathbf{V}_2 = \frac{\Delta_2}{\Delta} = 81.17\angle -6.35°$$

$$\mathbf{I}_o = \frac{\mathbf{V}_1 - \mathbf{V}_2}{2} = \frac{\Delta_1 - \Delta_2}{2\Delta} = \frac{-28.5 + j78.31}{0.3333 - j9}$$

$$\mathbf{I}_o = \mathbf{9.25\angle -162.12°\ A}$$