Chapter 10, Solution 14.

At node 1,

$$\frac{0-\mathbf{V}_1}{-\text{j}2}+\frac{0-\mathbf{V}_1}{10}+\frac{\mathbf{V}_2-\mathbf{V}_1}{\text{j}4}=20\angle 30^\circ$$

$$-(1+\text{j}2.5)\mathbf{V}_1-\text{j}2.5\mathbf{V}_2=173.2+\text{j}100 \qquad (1)$$

At node 2,

$$\frac{\mathbf{V}_2}{\text{j}2}+\frac{\mathbf{V}_2}{-\text{j}5}+\frac{\mathbf{V}_2-\mathbf{V}_1}{\text{j}4}=20\angle 30^\circ$$

$$-\text{j}5.5\mathbf{V}_2+\text{j}2.5\mathbf{V}_1=173.2+\text{j}100 \qquad (2)$$

Equations (1) and (2) can be cast into matrix form as

$$\begin{bmatrix}1+\text{j}2.5 & \text{j}2.5\\ \text{j}2.5 & -\text{j}5.5\end{bmatrix}\begin{bmatrix}\mathbf{V}_1\\ \mathbf{V}_2\end{bmatrix}=\begin{bmatrix}-200\angle 30^\circ\\ 200\angle 30^\circ\end{bmatrix}$$

$$\Delta=\begin{vmatrix}1+\text{j}2.5 & \text{j}2.5\\ \text{j}2.5 & -\text{j}5.5\end{vmatrix}=20-\text{j}5.5=20.74\angle -15.38^\circ$$

$$\Delta_1=\begin{vmatrix}-200\angle 30^\circ & \text{j}2.5\\ 200\angle 30^\circ & -\text{j}5.5\end{vmatrix}=\text{j}3(200\angle 30^\circ)=600\angle 120^\circ$$

$$\Delta_2=\begin{vmatrix}1+\text{j}2.5 & -200\angle 30^\circ\\ \text{j}2.5 & 200\angle 30^\circ\end{vmatrix}=(200\angle 30^\circ)(1+\text{j}5)=1020\angle 108.7^\circ$$

$$\mathbf{V}_1=\frac{\Delta_1}{\Delta}=28.93\angle 135.38^\circ\,\text{V}$$

$$\mathbf{V}_2=\frac{\Delta_2}{\Delta}=49.18\angle 124.08^\circ\,\text{V}$$