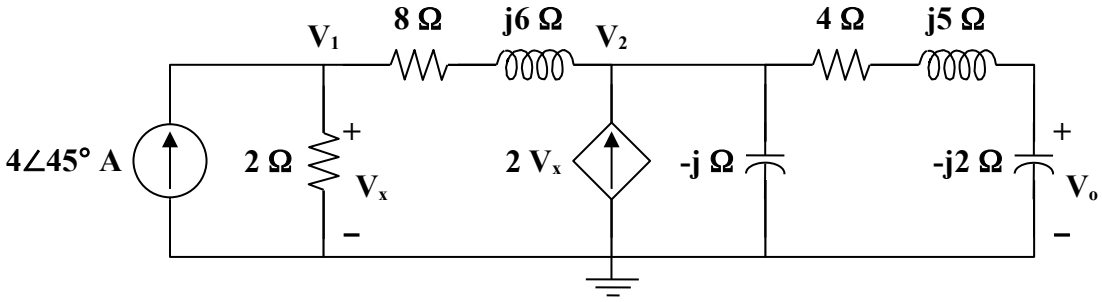
Chapter 10, Solution 18.

Consider the circuit shown below.



At node 1,

$$4\angle 45^\circ = \frac{\mathbf{V}_1}{2} + \frac{\mathbf{V}_1 - \mathbf{V}_2}{8 + j6}$$

$$200\angle 45^\circ = (29 - j3)\mathbf{V}_1 - (4 - j3)\mathbf{V}_2 \qquad (1)$$

At node 2,

$$\frac{\mathbf{V}_1 - \mathbf{V}_2}{8 + j6} + 2\mathbf{V}_x = \frac{\mathbf{V}_2}{-j} + \frac{\mathbf{V}_2}{4 + j5 - j2}, \qquad \text{where } \mathbf{V}_x = \mathbf{V}_1$$

$$(104 - j3)\mathbf{V}_1 = (12 + j41)\mathbf{V}_2$$

$$\mathbf{V}_1 = \frac{12 + j41}{104 - j3}\mathbf{V}_2 \qquad (2)$$

Substituting (2) into (1),

$$200\angle 45^\circ = (29 - j3)\frac{(12 + j41)}{104 - j3}\mathbf{V}_2 - (4 - j3)\mathbf{V}_2$$

$$200\angle 45^\circ = (14.21\angle 89.17^\circ)\mathbf{V}_2$$

$$\mathbf{V}_2 = \frac{200\angle 45^\circ}{14.21\angle 89.17^\circ}$$

$$\mathbf{V}_o = \frac{-j2}{4 + j5 - j2}\mathbf{V}_2 = \frac{-j2}{4 + j3}\mathbf{V}_2 = \frac{-6 - j8}{25}\mathbf{V}_2$$

$$\mathbf{V}_o = \frac{10\angle 233.13^\circ}{25} \cdot \frac{200\angle 45^\circ}{14.21\angle 89.17^\circ}$$

$$\mathbf{V}_o = \mathbf{5.63\angle 189^\circ\ V}$$