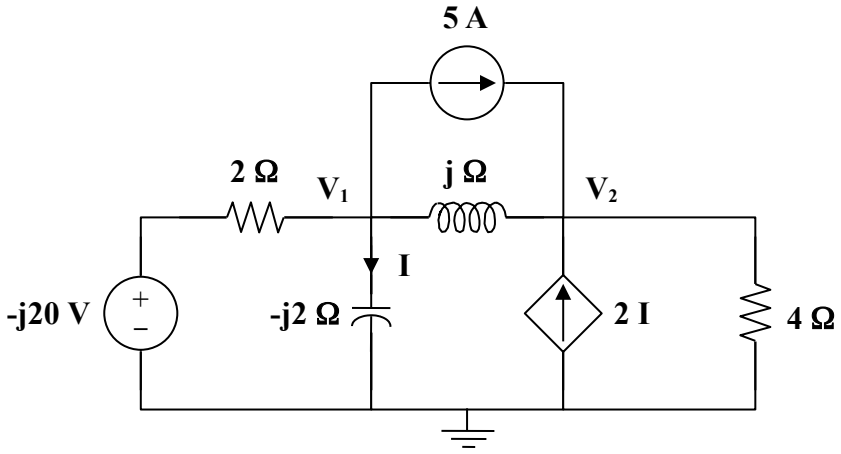
Chapter 10, Solution 15.

We apply nodal analysis to the circuit shown below.



At node 1,

$$\frac{-j20 - \mathbf{V}_1}{2} = 5 + \frac{\mathbf{V}_1}{-j2} + \frac{\mathbf{V}_1 - \mathbf{V}_2}{j}$$

$$-5 - j10 = (0.5 - j0.5)\mathbf{V}_1 + j\mathbf{V}_2 \qquad (1)$$

At node 2,

$$5 + 2\mathbf{I} + \frac{\mathbf{V}_1 - \mathbf{V}_2}{j} = \frac{\mathbf{V}_2}{4},$$

where $\mathbf{I} = \dfrac{\mathbf{V}_1}{-j2}$

$$\mathbf{V}_2 = \frac{5}{0.25 - j}\mathbf{V}_1 \qquad (2)$$

Substituting (2) into (1),

$$-5 - j10 - \frac{j5}{0.25 - j} = 0.5(1 - j)\mathbf{V}_1$$

$$(1 - j)\mathbf{V}_1 = -10 - j20 - \frac{j40}{1 - j4}$$

$$(\sqrt{2}\angle -45°)\mathbf{V}_1 = -10 - j20 + \frac{160}{17} - \frac{j40}{17}$$

$$\mathbf{V}_1 = 15.81\angle 313.5°$$

$$\mathbf{I} = \frac{\mathbf{V}_1}{-j2} = (0.5\angle 90°)(15.81\angle 313.5°)$$

$$\mathbf{I} = \mathbf{7.906\angle 43.49°\ A}$$