**Chapter 10, Solution 53.**

Use the concept of source transformation to find $\mathbf{V}_o$ in the circuit of Fig. 10.97.

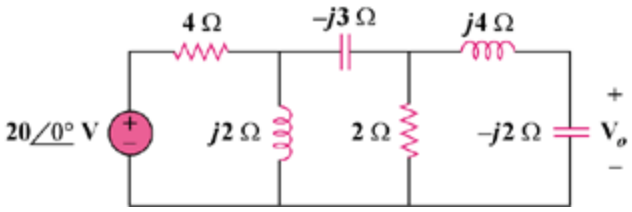
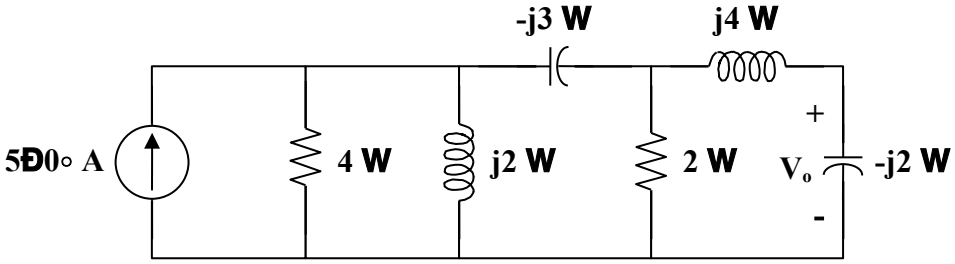



Figure 10.97
For Prob. 10.53.

**Solution**

We transform the voltage source to a current source to obtain the circuit in Fig. (a).



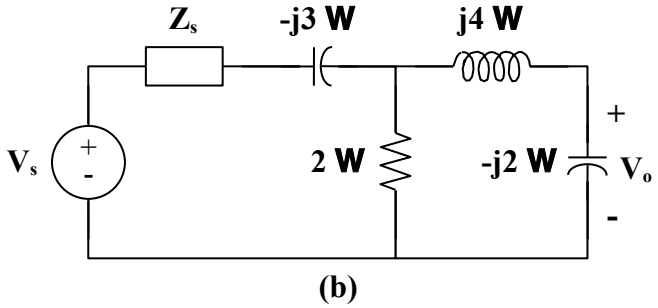

**(a)**

Let

$$\mathbf{Z}_s = 4 \,||\, j2 = \frac{j8}{4 + j2} = 0.8 + j1.6$$

$$\mathbf{V}_s = (5\angle 0°)\,\mathbf{Z}_s = (5)(0.8 + j1.6) = 4 + j8$$

With these, the current source is transformed so that the circuit becomes that shown in Fig. (b).



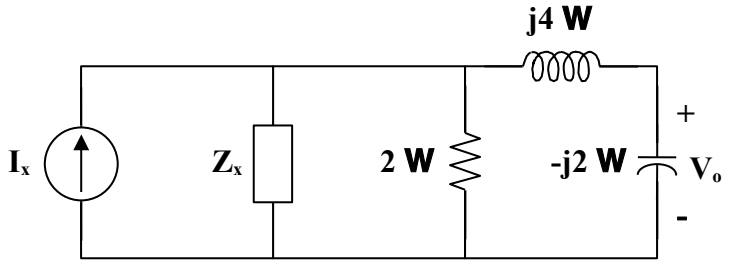

**(b)**

Let

$$\mathbf{Z}_x = \mathbf{Z}_s - j3 = 0.8 - j1.4$$

$$\mathbf{I}_x = \frac{\mathbf{V}_s}{\mathbf{Z}_s} = \frac{4 + j8}{0.8 - j1.4} = -3.0769 + j4.6154$$

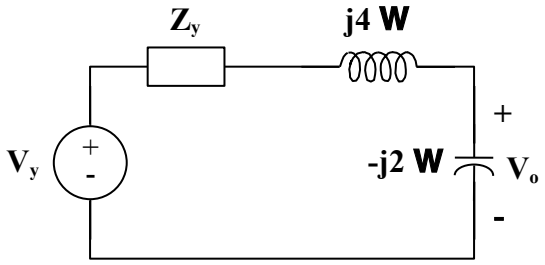
With these, we transform the voltage source in Fig. (b) to obtain the circuit in Fig. (c).




**(c)**

Let
$$\mathbf{Z}_y = 2 \,||\, \mathbf{Z}_x = \frac{1.6 - j2.8}{2.8 - j1.4} = 0.8571 - j0.5714$$
$$\mathbf{V}_y = \mathbf{I}_x \, \mathbf{Z}_y = (-3.0769 + j4.6154) \cdot (0.8571 - j0.5714) = j5.7143$$

With these, we transform the current source to obtain the circuit in Fig. (d).




**(d)**

Using current division,

$$\mathbf{V}_o = \frac{-j2}{\mathbf{Z}_y + j4 - j2} \mathbf{V}_y = \frac{-j2(j5.7143)}{0.8571 - j0.5714 + j4 - j2} = \mathbf{(3.529 - j5.883)\ V}$$

$$= \mathbf{6.86 \angle -59.04°\ V}$$