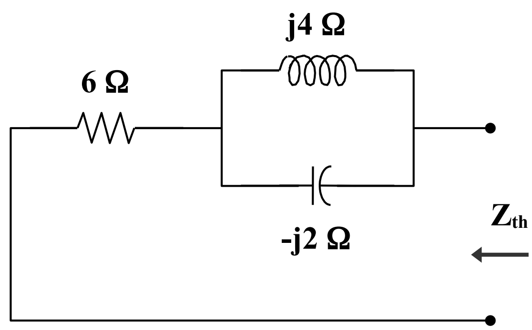
Chapter 10, Solution 56.

(a) To find $\mathbf{Z}_{th}$, consider the circuit in Fig. (a).



(a)

$$\mathbf{Z}_N = \mathbf{Z}_{th} = 6 + j4 \,||\, (-j2) = 6 + \frac{(j4)(-j2)}{j4 - j2} = 6 - j4$$

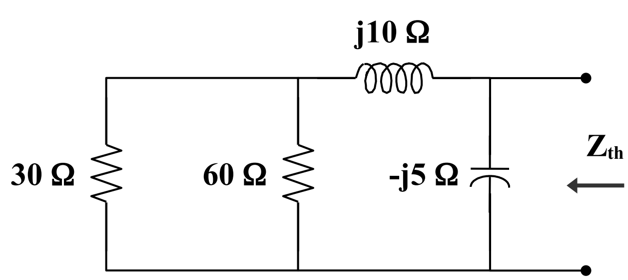
$$= \mathbf{7.211\angle\text{-}33.69° \; \Omega}$$

By placing short circuit at terminals a-b, we obtain,

$\mathbf{I}_N = \mathbf{2\angle 0° \; A}$

$$\mathbf{V}_{th} = \mathbf{Z}_{th}\,\mathbf{I}_{th} = (7.211\angle -33.69°)(2\angle 0°) = \mathbf{14.422\angle\text{-}33.69° \; V}$$

(b) To find $\mathbf{Z}_{th}$, consider the circuit in Fig. (b).



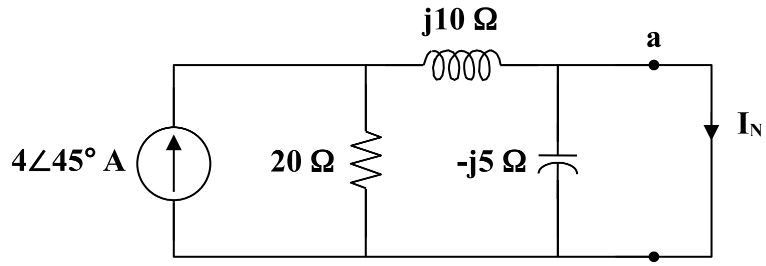
(b)

$30 \,||\, 60 = 20$

$$\mathbf{Z}_N = \mathbf{Z}_{th} = -j5 \,||\, (20 + j10) = \frac{(-j5)(20 + j10)}{20 + j5}$$

$$= \mathbf{5.423\angle\text{-}77.47° \; \Omega}$$

To find $\mathbf{V}_{th}$ and $\mathbf{I}_N$, we transform the voltage source and combine the 30 Ω and 60 Ω resistors. The result is shown in Fig. (c).



(c)

$$\mathbf{I}_N = \frac{20}{20 + j10}(4\angle 45°) = \frac{2}{5}(2 - j)(4\angle 45°)$$
$$= \mathbf{3.578\angle 18.43°\ A}$$

$$\mathbf{V}_{th} = \mathbf{Z}_{th}\,\mathbf{I}_N = (5.423\angle -77.47°)(3.578\angle 18.43°)$$
$$= \mathbf{19.4\angle -59°\ V}$$