Chapter 11, Solution 7.

Given the circuit of Fig. 11.40, find the average power absorbed by the 10-Ω resistor.

Figure 11.40
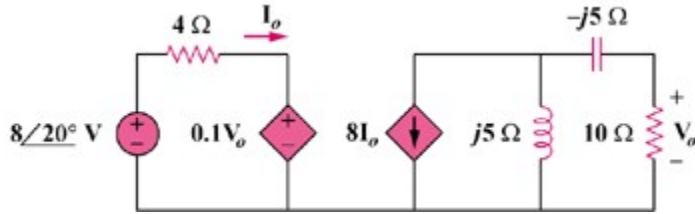For Prob. 11.7.

Solution

Applying KVL to the left-hand side of the circuit,
$$8\angle 20° = 4I_o + 0.1V_o \tag{1}$$

Applying KCL to the right side of the circuit,
$$8I_o + \frac{V_1}{j5} + \frac{V_1}{10 - j5} = 0$$

But,
$$V_o = \frac{10}{10 - j5}V_1 \qquad \longrightarrow \qquad V_1 = \frac{10 - j5}{10}V_o$$

Hence,
$$8I_o + \frac{10 - j5}{j50}V_o + \frac{V_o}{10} = 0$$

$$I_o = j0.025\,V_o \tag{2}$$

Substituting (2) into (1),
$$8\angle 20° = 0.1V_o\,(1 + j)$$

$$V_o = \frac{80\angle 20°}{1 + j}$$

$$I_1 = \frac{V_o}{10} = \frac{8}{\sqrt{2}}\angle -25°$$

$$P = \frac{1}{2}|I_1|^2 R = \left(\frac{1}{2}\right)\left(\frac{64}{2}\right)(10) = \mathbf{160W}$$