Chapter 11, Solution 69.

Refer to the circuit shown in Fig. 11.88.

(a) What is the power factor?
(b) What is the average power dissipated?
(c) What is the value of the capacitance that will give a unity power factor when connected to the load?

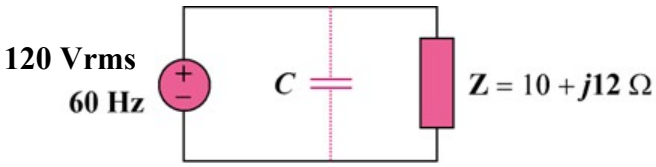

Figure 11.88
For Prob. 11.69.

Solution

(a) Given that $\mathbf{Z} = 10 + j12$

$$\tan\theta = \frac{12}{10} \longrightarrow \theta = 50.19^\circ$$

$$\text{pf} = \cos\theta = \mathbf{0.6402} = \mathbf{0.6402\ (lagging)}$$

(b)
$$\mathbf{S} = \frac{|\mathbf{V}|^2}{2\mathbf{Z}^*} = \frac{(120)^2}{(2)(10 - j12)} = 295.12 + j354.09$$

The average power absorbed $= P = \text{Re}(\mathbf{S}) = \mathbf{295.1\ W}$

(c) For unity power factor, $\theta_1 = 0^\circ$, which implies that the reactive power due to the capacitor is $Q_c = 354.09$

But
$$Q_c = \frac{V^2}{2X_c} = \frac{1}{2}\omega C V^2$$

$$C = \frac{2Q_c}{\omega V^2} = \frac{(2)(354.09)}{(2\pi)(60)(120)^2} = \mathbf{130.4\ \mu F}$$